The Socio-Economic Impacts of the Puerto Rico Electric Power Authority (PREPA) Restructuring Support Agreement (RSA) on the Population of Puerto Rico

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Executive Summary

This report examines the demographic and socio-economic composition Puerto Rico's population; levels of electric consumption and payments by income category; the socio-economic impact of the proposed PREPA 2019 Restructuring Support Agreement (RSA) on the population of Puerto Rico; and the expected macro-social impacts including increased outmigration and reduced electricity consumption on the island. The report also finds that:

1) **A significant proportion of Puerto Rico's population is poor and vulnerable.** If we combine the proportion of the population in Puerto Rico that is below poverty, or that is younger than 15 years of age, or that is older than 65 years of age, or that has any disability, as seen in Table 4, that adds up to about 68.9% of the population.
2) **The poor and low-income populations in Puerto Rico consume significantly less electricity.** Households in the bottom 40% of the income distribution in Puerto Rico consume about 28% of the total kilowatt hours. In contrast, households in the top 20% of the income distribution consume about 33%, or one third, of the total energy consumed by households in Puerto Rico.
3) **The contemplated price increases are significant especially for populations with low incomes or with fixed income from pensions or other retirement income.** About 13% of the rate increase is expected to be collected from households in the bottom 20% of the income distribution (the poorest households) but they only make 1.4% of the total income in Puerto Rico. Households in the second quintile are expected to cover about 14.8% of the electricity rate increase but they make only about 7.5% of the total household income. At the other top extreme of the income distribution, households in the top 5% of the household income distribution in Puerto Rico are expected to cover about 10.5% of the electricity rate increase while making 26.4% of the total income.
4) **The electric rate increase hits the poor and vulnerable more as a proportion of their incomes and makes the settlement agreement unfair and inequitable.** For the base year, it is estimated that the bottom 20% spent about 33% of their income in electric costs and, assuming constant incomes, that percentage goes up to 42% of household income by the last increase required under the RSA. The proportion of income spent on electricity for households in the second quintile in the base year is about 9% and that percentage could go up to about 11%. For the third, fourth and top quintiles the proportion of income spent on electricity hovers between one and 5% in the base year and that percentage could go up to between two and 7% by the time of the fourth increase. The data suggest that the average household in the bottom 20% of the income distribution will pay, after the fourth increase, an average of $991.25 per year in electrical charges. The second quintile will pay an average of $1065.77 per year. It is unreasonable to expect that families with very low incomes would be able to afford any additional price increases. The RSA is not fair and equitable as it is unreasonable to expect low income families in Puerto Rico to bear such a disproportionate burden of increased costs mandated in the PREPA RSA.
5) **Electricity consumption seems to be declining with time.** In 2009, the average family consumed about 222 kWh per month and that number appears to have gone down to about 202 kWh per month in 2017 and 179 kWh per month if we use 2019 prices.
6) **Increased electric costs add to migration pressures and further exacerbate the demographic and socioeconomic death spiral that Puerto Rico has been trapped in for the last 15 years.** Examining Puerto Rico data between 2000 and 2017 shows that there is a correlation between increases in electricity costs and out-migration from Puerto Rico. Increases in the price of electricity lead to higher levels of out-migration. At the same time, increases in levels of outmigration and in the number of persons and families leaving Puerto Rico reduces the demand for electricity further eroding the income potential of the Puerto Rico Electric Power Authority (PREPA).
7) **The approval of the RSA will automatically cause an increase in the cost of living of the people of Puerto Rico, which, in turn, will cause additional social and economic precariousness to the most vulnerable segments of the population, particularly those at the bottom 40% of the income distribution.** Increases in the costs of electric and related services (as other costs would also increase with more expensive energy); the changing demographic profile of the population, high levels of poverty and disability, and continued population declines due to persistent outmigration and precariousness cause a further slowdown in economic activity which further exacerbates outmigration trends and lowers the demand for electricity. With lower demand for electricity, the prospects of PREPA complying with operational requirements and obligations to workers and retirees will be severely impaired. The RSA has a disproportionate impact on poor and low-income populations, threatens PREPA's ability to consistently provide its essential services to the population, and leads to a vicious cycle that affects revenue collection and the overall mission and finances of the Puerto Rico Electric Power Authority (PREPA).

Report in Brief

1) A significant proportion of Puerto Rico's population is poor and vulnerable.

a. In 2009 there were about 1 million persons under 18 years of age in Puerto Rico and by 2017 that number was close to 700,000 for a decrease of about 300,000 persons under 18 years of age. The young population constituted about 26% of Puerto Rico's population in 2009 and that declined to about 21% of the population by 2017.
b. In 2009 there were about 2.1 million persons between 19 and 59 years of age in Puerto Rico and that number decreased to about 1,760,000 by 2017 or a decrease of almost 400,000 persons. In contrast there were about 786,000 persons over 60 in Puerto Rico in 2009 and that number increased by about 85,000 persons to 872,000 by 2017. Persons over 60 were about 20% of the population of Puerto Rico in 2009 and that number increased about 26% of the total by 2017. This is a remarkable increase in the population over 60 and a decrease in the population under 18 in a short period of eight years in Puerto Rico.
c. On the island, less than 10% of the population is nine years of age or younger and only about 36% of the population is below the age of 29.
d. A significant proportion of the population on the island, about 21.8%, report one or more type of disability and this means that there is a segment of the population that relies disproportionately on the continuity of electric service for their safety, the stability of their health, and well-being and the continuity of their daily lives.
e. About 24.6% of the population in Puerto Rico, or 812,258 persons, report incomes below half of the poverty line--or less than about $6,000 per person per year. Another 19.9%, or 658,795 persons, have incomes between half and the poverty line (between $6,000 and $12,000 per person per year) which means that the proportion of the population below poverty in Puerto Rico is 44.5%.
f. If we combine the proportion of the population in Puerto Rico that is below poverty, or that is younger than 15 years of age, or that is older than 65 years of age, or that has any disability, as seen in Table 4, that adds up to about 68.9% of the population. This means that close to 2.3 million, out of the 3.3 million persons reported residing on the island in 2017, is either below poverty, or is younger than 15 years of age, or is older than 65 years of age, or has reported a disability.
g. About 35.5% of the population reported being employed, 7% reported looking for work (the definition of unemployment status), and about 56.5% of the population reported being out of the labor force. This does not include the slightly over half a million persons that are 16 years of age and younger that are not considered part of the labor force.

2) The poor and low-income populations in Puerto Rico consume significantly less electricity.

a. Households in the bottom 20% of the population together consume about 13% of the total kilowatt hours and together with households in the next 20%, which consume about 15% of the total kilowatt hours, households at the bottom 40% of the income distribution in Puerto Rico consume about 28% of the total kilowatt hours.
b. In contrast, households in the top 20% of the income distribution consume about 33%, or one third, of the total energy consumed by households in Puerto Rico. Households with incomes in the top 5% of the population consume about 11% of the total energy consumed by households in Puerto Rico.

3) **The contemplated price increases are significant especially for populations with low incomes or with fixed income from pensions or other retirement income.**

a. The average monthly electrical bill for the total population is estimated at $95.81 per month. Estimates by income level indicate that households at the bottom 20% were estimated to pay about $65.88, households in the next 20% (second quintile) pay on average $70.83. Households in the third quintile pay about $84.59 per month while those in the fourth quintile pay about $103.93. Households in the top 15% pay about $135.47 per month while households in the top 5% of the population were estimated to pay about $195.25 per household per month in electrical bill.
b. The total amount paid by households in the bottom 20% was about $14.3 million per month while all households in the second quintile paid about $16.2 million in their total aggregate electric bill per month.
c. Households in the bottom 20% of the income distribution are estimated to pay about $65.88 per month in the base year and that will go up to $77.21 per month with the first increase required if the RSA is approved, $77.78 in the second increase, $78.66 in the third increase, and up to a total of $82.60 with the fourth increase. That means that total fee collections from households at the bottom 20% of the income distribution would increase from $14.3 million per month in the base year to potentially about $17.9 million per month after the fourth increase or $3.6 million more in payments per month.
d. The total amount of electrical charges paid by households in each of the income segments of the distribution suggests that in the base month total collections are estimated at about $110 million and they would increase $128.9 million per month with the first increase to a total of $129.8 million with the second increase, $131.3 million for the third increase and up to $137.9 million per month with the fourth increase.
e. Of the first electricity rate increase of $18.9 million, about $2.5 million will be charged to households in the bottom 20% of the income distribution (the poorest households), $2.8 million to households in the second quintile (also below poverty), $3.4 million to households in the third quintile, $4.2 million to households in the fourth quintile, $4.1 million from households in the top 15%, and about $2 million from households in the top 5% of the household income distribution in Puerto Rico.
f. About 13% of the rate increase is expected to be collected from households in the bottom 20% of the income distribution (the poorest households) but they only earn 1.4% of the total income in Puerto Rico. Households in the second quintile are expected to cover about 14.8% of the electricity rate increase but they earn only about 7.5% of the total household income. Households in the third quintile are expected to cover about 17.7% of the rate increase while they make 13.9% of the total household income. At the other top extreme of the income distribution, households in the top 15% of incomes are expected to cover about 21.7% of the electricity rate increase while making 28.8% of the income while households in the top 5% of the household income distribution in Puerto Rico are expected to cover about 10.5% of the electricity rate increase while taking 26.4% of the total income.
g. The average bill per person is expected to increase from $46.66 per person per month to about $58.50 per month per person with the full electricity rate increase. Individuals in households at the bottom 20% of the income distribution are estimated to currently pay about $39.61 per person per month and that would increase to $46.43 per person per month with the first increase and up to $49.67 with the fourth electricity rate increase.

h. The data suggest that the average household in the bottom 20% of the income distribution pays on average $790.54 per year in their electrical bill. The second quintile pays an average of $849.97 per year, the third quintile pays about $1,015, the fourth quintile pays about $1,247, those in the top 15% of income earners pay about $1,625 per year while those in the top 5% pay close to $2,343 per year electrical bill.

4) The electric rate increase affects the poor and vulnerable more as a proportion of their incomes and makes the settlement agreement unfair and inequitable.

a. Those at the bottom 20% of the household income distribution, for example would see an electricity bill increase of about $136 per year after the first increase mandated by the RSA, while those in the second quintile will shoulder an increase of about $146 per household per year. The third quintile we see an electricity bill increase of $175 per household per year for that first increase while those in the fourth quintile would see an electricity bill increase of $215 per year. The top 15% will pay about $280 more per year while those in the top 5% will pay about $403 more per year. On average the fee increases total about $198 per household or a total of $227 million dollars more than the amount collected in the base year.
b. For the base year, it is estimated that the bottom 20% spent about 33% of their income in electricity costs and, assuming constant incomes, that percentage goes up to 42% of household income by the last increase. The proportion of income spent on electricity for households in the second quintile in the base year is about 9% and that percentage could go up to about 11%. For the third, fourth and top quintiles the proportion of income spent on electricity hovers between one and 5% in the base year and that percentage could go up to between two and 7% by the time of the fourth increase.
c. It is clear that as a proportion of income, the regressive electricity fee increase impacts those at the bottom two quintiles of the income distribution (the poorest segments of the population) significantly more than those in the third, fourth and top quintiles of the income distribution with the very poor faring significantly worse.
d. The data suggest that the average household in the bottom 20% of the income distribution will pay, after the fourth increase, an average of $991.25 per year in their electrical bill. The second quintile will pay an average of $1,065.77 per year. It is unreasonable to expect that families with very low incomes (averaging $2,365 for the bottom 20% and $9,788 for the second quintile) would be able to afford any additional price increases. The third quintile pays about $1272.81, the fourth quintile pays about $1563.86, those in the top 15% of income earners pay about $2,038.30 per year while those in the top 5% pay close to $2,938.04 per year in electrical bill.

5) Electricity consumption in Puerto Rico is declining over time for all socio-economic sectors.

a. In 2009, the average family consumed about 222 kWh per month and that number appears to have gone down to about 202 kWh per month in 2017 (using 2017 prices) and 179 kWh per month if we base the calculation on 2019 prices.

6) **Higher electric rates (already among the highest of any US jurisdiction) add to migration pressures and further exacerbate the demographic and socioeconomic death spiral that Puerto Rico has been trapped in for the last 15 years.**

   a. Labor market collapse has led to unprecedented numbers of Puerto Ricans migrating out of the island with an estimate of about 89,000 leaving in 2015, and about 25,000 returning to the Island, for a net outmnigration of 64,238 in just one year, 2015. If we examine the net migration patterns over the last decade, we see an increase in net out-migration from an average around 25 thousand per year between 2005 and 2010 to an average over 50 thousand per year between 2011 and 2014 with all signs suggesting that the net migration number continues to be in the 80 thousand to 90 thousand range or higher since 2014.
   b. Analyzing Puerto Rico data between 2000 and 2017 shows that there is a correlation between increases in electricity costs and out-migration from Puerto Rico. Increases in the price of electricity lead to higher levels of out-migration. At the same time, increases in levels of outmigration and in the number of persons and families leaving Puerto Rico reduces the demand for electricity further eroding the income potential of the Puerto Rico Electric Power Authority (PREPA).
   c. The shape of Puerto Rico's population pyramid shows fewer young persons and a significant aging of the population between 1950 and 2017. By the year 2050 we see an inversion of the age pyramid with the largest cohorts being those between ages 50 and 80 and much smaller younger age cohorts. By 2100 we see how Puerto Rico's population is expected to be significantly smaller especially when compared to 1950 where we see age cohorts that have close to 400,000 persons turning into age cohorts that are about one fourth of the size with about 100,000 persons remaining in that age group.

7) **The approval of the RSA will automatically cause an increase in the cost of living of the people of Puerto Rico, which, in turn, will cause additional social and economic precariousness to the most vulnerable segments of the population, particularly those at the bottom 40% of the income distribution.** Increases in the costs of electric and related services (as other costs would also increase with more expensive energy); the changing demographic profile of the population; high levels of poverty and disability; and continued population declines due to persistent outmigration and precariousness cause a further slowdown in economy activity which further exacerbates outmigration trends and lowers the demand for electricity. With lower demand for electricity, the prospects of PREPA complying with operational requirements and obligations to workers and retirees will be severely impaired. The RSA has a disproportionate impact on poor and low-income populations, threatens PREPA's ability to consistently provide its essential services to the population, and leads to a vicious cycle that affects revenue collection and the overall mission and finances of the Puerto Rico Electric Power Authority (PREPA).

I. Puerto Rico's Crises and the PREPA RSA

By now it is broadly acknowledged across a range of sectors, in Puerto Rico and beyond, that the island is in a deep crisis and that it will take a sustained effort and significant resources for Puerto Rico to recover from a long-term recession, financial bankruptcy, and the multiple effects of calamitous natural disasters on the Island's infrastructure and population. The current crisis in Puerto Rico has various dimensions and manifestations: there is a *social dimension* reflected in increased population loss and outmigration, growing pessimism, and a sense of despair; an *economic dimension* reflected in reductions in employment and flattening of incomes and a high poverty rate particularly for young persons and children; a *fiscal dimension* manifested in high levels of government debt, the bankruptcy of the Puerto Rico government and various instrumentalities and public corporations, and the fiscal reorganization process; and a *recovery and reconstruction dimension* that involves repairing the damage from the recent storms, taking stock of the infrastructure on the Island, particularly the Puerto Rico Electric Power Authority (PREPA), planning for continuing climate related changes, and developing the capacity to address the various needs of the changing population.

To deal with the fiscal crisis and bankruptcy process, Congress passed the PROMESA law (Puerto Rico Oversight Management and Economic Stability Act) in 2016 granting broad powers to a Financial Oversight and Management Board of Puerto Rico (FOMBPR), named by the US Congress and the President, to approve Puerto Rico's local government expenditure and income budget parameters; make any changes to local government pensions; and to represent Puerto Rico in court proceedings seeking to address Puerto Rico's bonded debt and other liabilities. The PROMESA law requires that the Financial Oversight Board (FOMBPR) approve a fiscal plan (PRFP) setting broad budgetary parameters and goals for the government and its various instrumentalities and public corporations including the Puerto Rico Electric Power Authority (PREPA). The various versions of the PRFP approved by FOMBPR have included significant cuts to the University of Puerto Rico (UPR); cuts to central government support to Puerto Rico municipalities, and various other cuts and changes to the central government payroll and expenses. It was during the early stages of implementation of the first FOMBPR approved fiscal plan (PRFP)[1] that hurricanes Irma and Maria hit the Island of Puerto Rico around September 20, 2017. The devastation caused by the hurricanes forced the FOMBPR and the Commonwealth government to re-do the PRFP and seek support from Congress and the administration in Washington, DC for disaster relief, reconstruction, and to mitigate the economic, health, housing, physical infrastructure and related impacts of a storm that landed on top of a ten-year recession.

The storms exposed the significant impacts of climate change on Puerto Rico and exposed the substantial level of poverty and the many vulnerabilities of the local population. The high level of direct (and indirect) deaths attributed to the storm[2] and the loss of electric power in the weeks and months after have highlighted the need for the Island to have a resilient infrastructure and dependable electric service. The Puerto Rico Electric Power Authority (PREPA) received substantial media and other attention from the public as efforts to restore electricity to portions of the island took many months. The

[1] https://www.elnuevodia.com/english/english/nota/ayearofpromesa-2341707/

[2] For a detailed report on deaths after the hurricanes and some of the direct and indirect causes see https://publichealth.gwu.edu/sites/default/files/downloads/projects/PRstudy/Acertainment%20of%20the%20Estimated%20Excess%20Mortality%20from%20Hurricane%20Maria%20in%20Puerto%20Rico.pdf

Puerto Rico Electric Power Authority (PREPA) has seen a significant reduction in its workforce and the infrastructure has suffered from a lack of maintenance as is well documented in the fiscal plans submitted to the Federal Oversight and Management Board of Puerto Rico [FOMBPR] [***PREPA 2018 Amended and Restated Fiscal Plan (April 5, 2018)***[3]*]*. The Puerto Rico Electric Power Authority (PREPA) must continue to manage costs, expenses, and income in order to provide steady, reliable, and affordable electricity to the population of Puerto Rico. In addition to the effects of climate change and storms, management of fiscal matters and priorities appear to threaten the viability and ability of the Puerto Rico Electric Power Authority (PREPA) to fulfill its mission.

As the FOMBPR and PREPA completed negotiations of the latest Restructuring Support Agreement (RSA) [***PREPA RSA (May 3, 2019)***[4]***]*** there have been growing concerns over the contents of the agreement and, in particular, the impacts on the significant proportion of Puerto Rico's population that is poor, elderly, and/or disabled. Since electricity is such an essential service for families in Puerto Rico there is a need to examine the potential impacts of the PREPA RSA on the population of Puerto Rico and the poorest and most disadvantaged segments in particular.

This study seeks to fill that gap by providing a social scientific analysis of:

a) The socio-economic and demographic characteristics of the population highlighting the most disadvantaged sectors and assessing the impact of AEE [Puerto Rico Electric Power Authority (PREPA)] RSA [agreement] on those segments of the population.
b) The vulnerability of the population in Puerto Rico with respect to poverty and disability and the impact of AEE/PREPA RSA on populations with low-incomes and disabilities.
c) The aging of the population in Puerto Rico; the vulnerabilities of the population under 18 years of age and of populations over 65 years of age; and the impact of AEE/PREPA RSA on populations and households with minors and elderly.
d) The differential impact of the AEE/PREPA RSA on households by income level and the effects of price increases on disposable incomes and in the quality of life of the most vulnerable and disadvantaged segments of the population in Puerto Rico.
e) Examine the effects of increases in the price of energy on increases in emigration, changes in the composition of the population, and population decline.
f) Study the likelihood of substantial impairment of EEA\PREPA's income due to the impact of price increases on further emigration from the island and the effects of population decline, and changes in composition, on reductions in electricity consumption.

[3] http://www.aafaf.pr.gov/assets/prepa-fiscal-plan-(v_april)-4.5.18.pdf and http://www.aafaf.pr.gov/assets/fiscal-plan---pr-electric-power-authority.pdf
[4] https://oversightboard.pr.gov/documents/

II. Data Sources and Research Methods

Several primary and secondary data sources were consulted in the preparation of this report. I analyzed the monthly reports [***PREPA Monthly Reports***[5]***]*** for the Corporation for the month of March to get basic data on the pricing structure to residential customers. I also examined the corporations RSA and the fiscal plans submitted to the Federal Oversight and Management Board of Puerto Rico [FOMBPR] [***PREPA RSA (May 3, 2019)***[6] and ***PREPA 2018 Amended and Restated Fiscal Plan (April 5, 2018)***[7]*]*. Some of the key data from the Puerto Rico Electric Power Authority (PREPA) that was collected from the various reports is summarized in the table below and it was used in the production of the estimates and projections of the socioeconomic impact of the RSA on the population in Puerto Rico.

Key Study Assumptions and PREPA Data				
Fee Structure	**March-09**	**March-17**	**March-19**	**Fee After Increase**
Basic	$ 0.0505	$ 0.0566	$ 0.0574	
Provisional		$ 0.0122	$ 0.0119	
Fuel Charge	$ 0.0838	$ 0.0734	$ 0.0955	
Purchased Power	$ 0.0423	$ 0.0518	$ 0.0538	
Total Cents per KwHr	**$ 0.1766**	**$ 0.1940**	**$ 0.2186**	
KWHr per client	355	366.0	328.0	
Total Residential Clients	1,327,244	1,335,398	1,348,854.00	
Increase #1			$ 0.02768	$ 0.24628
Increase #2			$ 0.02957	$ 0.24817
Increase #3			$ 0.03242	$ 0.25102
Increase #4			$ 0.04522	$ 0.26382

In addition, I examined the report prepared by the Center for the New Economy [***GRUPO CNE Analysis of the RSA (May 2019)***[8]], a think tank in Puerto Rico, on the PREPA RSA. In order to study the potential impacts of the PREPA RSA on the population I looked at a report on migration from Puerto Rico prepared by the Puerto Rico Institute of Statistics [***Perfil del Migrante***[9]**,** Instituto de Estadisticas de Puerto Rico] and a series of materials from the United Nations Population Division [***World Population Prospects***[10]] that estimate population change in Puerto Rico both in terms of changing population levels and in terms of the age composition of the population.

The bulk of the demographic and socioeconomic analysis of energy\electricity consumption and the effects of the RSA on electricity cost to consumers in Puerto Rico by income group was done with data from the Puerto Rico Community Survey (PRCS)[11] produced by the US Bureau of the Census. For the analysis, I use the data file for 2017 that was recently released (on October 2, 2018) and includes data from a one-year (2017) sample of the population in Puerto Rico. The household level file includes information on households in Puerto Rico and the families that make up these households. The data

[5] https://aeepr.com/es-pr/investors/Paginas/Financial-Information.aspx
[6] https://oversightboard.pr.gov/documents/
[7] http://www.aafaf.pr.gov/assets/prepa-fiscal-plan-(v_april)-4.5.18.pdf and http://www.aafaf.pr.gov/assets/fiscal-plan---pr-electric-power-authority.pdf
[8] http://grupocne.org/wp-content/uploads/2019/05/PREPA-Debt-Restructuing-3.0-FINAL.pdf
[9] https://estadisticas.pr/files/Publicaciones/PM_2016_1.pdf
[10] https://population.un.org/wpp/
[11] https://www.census.gov/programs-surveys/acs/about/puerto-rico-community-survey.html

contains information on key socioeconomic characteristics of the households including household structure and income and it also includes a variable that asked the respondents about their monthly electric bill. The data on the monthly electric bill was combined with the price data from the various PREPA reports in order to estimate consumption levels for households in Puerto Rico by income category. The total monthly bill divided by the price of a kilowatt per hour will give us an estimate of the number of kilowatts consumed by households in Puerto Rico of various income levels. To produce the estimates, I used 2017 consumption levels at 2019 prices and then added the subsequent increases to estimate the impact on households per month and per year. The household expenditures divided by the number of persons per household gives us an estimate of per capita consumption and the prices paid monthly for electricity per person. Those estimates are used to then estimate the impact of the RSA on monthly and annual electric bills for households of different income levels in Puerto Rico. Finally, I use data on the estimated annual electric bill to compute the proportion of annual household income spent on electricity for households in Puerto Rico different income levels. This analysis shows the differential impact of an increase in electric costs on the poorest and most disadvantaged households in Puerto Rico.

It is important to point out that while all the PREPA documents I examined, including the Puerto Rico Electric Power Authority (PREPA) RSA and the fiscal plans submitted to the Federal Oversight and Management Board of Puerto Rico [FOMBPR] [***PREPA RSA (May 3, 2019)***[12] and ***PREPA 2018 Amended and Restated Fiscal Plan (April 5, 2018)***[13]*],* provide substantial information on the workings of the Puerto Rico Electric Power Authority (PREPA), and its plans moving forward, there is little or no mention of the socioeconomic characteristics of the Puerto Rico Electric Power Authority (PREPA) customer base, and the potential impacts of changes in the price structure on customers of different income levels in Puerto Rico. The purpose of this study is to fill some of that knowledge gap by focusing on socio-economic differences in electric consumption, what different segments spent on electricity, and on the impact of changes in electric prices on households of different income levels in Puerto Rico.

III. Population Composition in Puerto Rico and Socio-Economic Characteristics

Having a clear data-based understanding of the socio-economic and changing demographic characteristics, and the rapid aging, of the population that lives in Puerto Rico is essential in order to understand the effects of the Puerto Rico Electric Power Authority (PREPA) RSA on the population of Puerto Rico. On the island, less than 10% of the population is nine years of age or younger and only about 36% of the population is below the age of 29 as seen in Table 1 showing the age distribution. Puerto Rico's rapidly aging population is exemplified by the fact that one of the two largest age cohorts on the island are persons between 50 and 59 years of age which comprise about 13.1% of the population. The age cohorts between 30 and 39 years of age and 40 and 49 years of age are unusually and comparatively small reflecting significant outmigration from Puerto Rico and its effects on the population's age structure.

[12] https://oversightboard.pr.gov/documents/
[13] http://www.aafaf.pr.gov/assets/prepa-fiscal-plan-(v_april)-4.5.18.pdf and http://www.aafaf.pr.gov/assets/fiscal-plan---pr-electric-power-authority.pdf

Table 1 Age Categories (grouped) in Puerto Rico (PRCS 2017, 1yr file)			
	Frequency	Percent	Cumulative Percent
lo to 9	322,447	9.7	9.7
10 to 19	431,338	12.9	22.6
20 to 29	449,244	13.5	36.0
30 to 39	405,162	12.1	48.2
40 to 49	420,031	12.6	60.8
50 to 59	437,239	13.1	73.9
60 to 69	406,651	12.2	86.1
70 to 79	305,567	9.2	95.2
80 to 89	132,542	4.0	99.2
90 and Older	26,956	0.8	100.0
Total	**3,337,177**	**100.0**	

A significant proportion of the population on the island, about 21.8%, report one or more type of disability. This means that there is a large segment of the population that relies disproportionately on the continuity of electric service for their safe and stable functioning. Many disabled persons in Puerto Rico are low income and poor which compounds their vulnerability particularly before, during, and after storms and related events.

Table 2 Disability in Puerto Rico (PRCS 2017, 1yr file)			
	Frequency	Percent	Cumulative Percent
No Disability	2,609,952	78.2	78.2
With Disability	727,225	21.8	100.0
Total	**3,337,177**	**100.0**	

About 24.6% of the population in Puerto Rico reports income below half of the poverty line, or less than about $6,000 per person per year. This is about 812,258 persons. Another 19.9%, or 658,795 persons, have incomes between half and the poverty line (between $6,000 and $12,000 per person per year) which means that the overall proportion of the population living below the federal poverty guidelines is 44.5%. The poverty rate for children in Puerto Rico is about 56%. Puerto Rico's poverty rate is more than double the poorest states in the nation and has been persistently so for the last two decades or more[14].

Table 3 Poverty Level in Puerto Rico (PRCS 2017, 1yr file)				
Family Income Level	Frequency	Percent	Valid Percent	Cumulative Percent
Extreme Poverty (below 49%)	812,258	24.3	24.6	24.6
Below Poverty (50-99%)	658,795	19.7	19.9	44.5
Near Poverty (100-149%)	525,859	15.8	15.9	60.4
Low Income (150-199%)	373,766	11.2	11.3	71.7
Middle Income + (over 200%)	936,466	28.1	28.3	100.0
Total	**3,307,144**	**99.1**	**100.0**	
Missing	**30,033**	**0.9**		
Total	**3,337,177**	**100.0**		

[14]For a detailed analysis of poverty in Puerto Rico see Cordero-Guzman, Hector, Raul Figueroa and Alberto Velazquez (2016) Poverty in Puerto Rico: A Socio-Economic and Demographic Analysis. San Juan, PR: Inter-American University Press and Human Services Research Partnerships Puerto Rico. Available at https://www.dropbox.com/s/rj26lxcywcbwodq/Tomo%20IV-Cordero-Figueroa-Velazquez-PR-Poverty-8-16.pdf?dl=0

In a recent article published in the journal Caribbean Studies[15] the authors propose a definition of vulnerability that includes elements of age, poverty status, and disability. If we combine the proportion of the population in Puerto Rico that is below poverty, that is younger than 15 years of age, or that is older than 65 years of age, or that has a disability, as seen in Table 4, that adds up to about 68.9% of the population. This is close to 2.3 million out of the 3.3 million persons reported residing on the island in 2017. This suggest that a significant proportion of the population, more than two in three residents in Puerto Rico, is vulnerable in terms of their age, their income, or their disability status (or a combination of the three). With significant proportions of the population below poverty, with some disability, and either under 16 or over 65 years of age, Puerto Rico appears uniquely susceptible to the consequences of economic, social and environmentally related challenges and to discontinuities and increases in the costs of electric service.

Table 4 Poverty + Age + Disability in Puerto Rico (PRCS 2017, 1yr file)			
	Frequency	Percent	Cumulative Percent
Poor, >15, 65+, or Disabled	2,297,974	68.9	68.9
Able bodied person 16-64 not poor	1,039,203	31.1	100.0
Total	**3,337,177**	**100.0**	

A significant proportion of the population in Puerto Rico, about 26.5% many of them young persons or elderly, did not report any income. Another 28.9% of the population reported incomes of between one dollar and $9,999 dollars. Another 22.5% of the population reported incomes between $10,000 and $19,999. About 87.5% of the population in Puerto Rico reported incomes of $29,999 or less. The income distribution for persons in Puerto Rico can be seen in Table 5 and shows significant concentrations in the low-income segments and also significant levels of socio-economic inequality that have to be understood in order to evaluate the socio-economic effects of the PREPA RSA on the overall population.

Table 5 Persons Total Income in Puerto Rico (PRCS 2017, 1yr file)				
Personal Income	Frequency	Percent	Valid Percent	Cumulative Percent
Lowest thru 0	746,554	22.4	26.5	26.5
1 to 9999	812,662	24.4	28.9	55.4
10k to 19,999	631,490	18.9	22.5	77.9
20k to 29,999	270,688	8.1	9.6	87.5
30k to 39999	145,954	4.4	5.2	92.7
40k to 49999	66,753	2.0	2.4	95.1
50k to 59999	45,251	1.4	1.6	96.7
60k to 79999	40,322	1.2	1.4	98.1
80k to 99999	17,199	0.5	0.6	98.7
100k to 124999	7,089	0.2	0.3	99.0
Over 150,000	28,254	0.8	1.0	100.0
Total	**2,812,216**	**84.3**	**100.0**	
LT 15 years of age	**524,961**	**15.7**		
Total	**3,337,177**	**100.0**		

[15] Padilla-Elias, Nilsa, et. al. "Una Mirada a las Poblaciones Vulnerables en Puerto Rico Ante Desastres." Caribbean Studies 44(1-2):141-163.

Table 6 divides the population of Puerto Rico into five more or less equally sized segments each including about 20% of the population or close to 660,000 of the 3.3 million persons reported residing on the island in 2017. The groups are ranked by income quintile from the bottom 20%, the second quintile, the third quintile, the fourth quintile and then the fifth quintile is divided into the top 15% of incomes and the very top 5% of incomes in Puerto Rico. In the subsequent tables and analysis, I will use these six income groupings to explore patterns of energy consumption and the impact of the RSA on different income groups in the population of Puerto Rico.

Table 6 Income Quintiles in 2017 in Puerto Rico (PRCS 2017, 1yr file)

Personal Income Quartile	Frequency	Percent	Valid Percent	Cumulative Percent
Bottom 20%	655,970	19.7	19.8	19.8
Second 20%	664,035	19.9	20.1	39.9
Third 20%	659,449	19.8	19.9	59.9
Fourth 20%	658,524	19.7	19.9	79.8
Top 15%	503,771	15.1	15.2	95.0
Top 5%	165,395	5.0	5.0	100.0
Total	**3,307,144**	**99.1**	**100.0**	
Missing	**30,033**	**0.9**		
Total	**3,337,177**	**100.0**		

In order to understand the capacity of residents of the island of Puerto Rico to pay for electric service at different levels it is critical to understand the employment status of the population presented in Table 7. After the substantial collapse in the labor market since 2006, the number of jobs and persons employed has declined significantly. About 35.5% of the population reported being employed, 7% reports looking for work (the definition of unemployed), and about 56.5% of the population reported being out of the labor force. This does not include the slightly over half a million persons that are 16 years of age and younger and not considered part of the labor force. It does include a significant proportion of the population that is over age 65. Puerto Rico's labor force includes 983,444 persons employed and 194,546 persons that reported looking for work or are unemployed. Another 1.6 million persons in Puerto Rico are not in the labor force.

Table 7 Employment Status in Puerto Rico (PRCS 2017, 1yr file)

	Frequency	Percent	Valid Percent	Cumulative Percent
Civilian employed, at work	983,444	29.5	35.5	35.5
Civilian employed, with a job but not at work	26,055	0.8	0.9	36.4
Unemployed	194,546	5.8	7.0	43.4
Armed forces, at work	2,405	0.1	0.1	43.5
Not in labor force	1,565,924	46.9	56.5	100.0
Total	**2,772,374**	**83.1**	**100.0**	
LT 16 yrs of age	**564,803**	**16.9**		
Total	**3,337,177**	**100.0**		

There are significant demographic differences by income in the population of Puerto Rico as shown in the averages and percentages presented in Table 8 by socio-economic background. Lower income persons in Puerto Rico tend to be significantly younger, more likely to be students and in school, less likely to have graduated from high school, more likely to have changed residences in the previous year, less likely to be married, and significantly more likely to be unemployed or out of the labor force. The proportion of the population with a high school degree, that is married, that is employed and in the labor force, increases significantly by income group. It is important to keep these socio-economic differences in mind when trying to understand the differential impact of increases in electric rates on various segments of the population in Puerto Rico.

Table 8 Demographic Characteristics in Puerto Rico by Income Level (PRCS 2017, 1yr file)

Personal Income Quartile	Age	In School	High School Graduate	Recent Movers	Married	Employed	Unemployed	Not in Labor Force
Bottom 20%	32	35%	49%	10%	13%	10%	17%	73%
Second 20%	42	24%	54%	7%	25%	26%	8%	67%
Third 20%	45	21%	64%	4%	33%	35%	5%	59%
Fourth 20%	42	25%	73%	5%	36%	49%	4%	47%
Top 15%	45	18%	83%	4%	43%	56%	3%	40%
Top 5%	44	23%	83%	5%	45%	64%	2%	34%
Total	**41**	**25%**	**65%**	**6%**	**30%**	**37%**	**7%**	**56%**

Sources and levels of income also vary significantly by income group in Puerto Rico. Low-income persons are more likely to receive public assistance, Social Security income, and a smaller proportion of their total income comes from wages and earnings. As we go up the income distribution, income from interests, dividends and rents; retirement income; self-employment income; and wages and salaries increase significantly. Income from public assistance decreases with income levels while income from Social Security is concentrated more heavily in the middle-income categories. Puerto Rico's income shows significant concentration with the bottom 20% making 1% of the income, the next 20% making about 8% of the income. This means that the bottom 40% of the population makes about 9% of the total income. The third quintile makes about 14% of the total income, the fourth quintile makes 22%, and the top 20% take about 55% of all the income. The top 5% in Puerto Rico make about 25% of all income generated on the Island.

Table 9 Income Sources and Levels in Puerto Rico by Income Level (PRCS 2017, 1yr file)

Income Quintile in 2017		Interest, dividends, and net rental income past 12 months	Public assistance income past 12 months	Retirement income past 12 months	Self-employment income past 12 months	Supplementary Security Income past 12 months	Social Security income past 12 months	Wages or salary income past 12 months	Total person's earnings	Total person's income	Usual hours worked per week past 12 months
Bottom 20%	Mean	$ 2.77	$ 208.08	$ 28.48	$ 93.19	$ 7.22	$ 352.74	$ 310.65	$ 415.28	$ 1,208.73	$ 22.39
	Sum	$ 1,322,100	$ 99,403,250	$ 13,603,120	$ 44,519,780	$ 3,449,800	$ 168,508,220	$ 148,398,610	$ 192,918,390	$ 577,423,130	$ 1,321,074
Second 20%	Mean	$ 21.86	$ 144.74	$ 171.68	$ 350.93	$ 13.45	$ 2,430.40	$ 2,112.04	$ 2,502.68	$ 5,485.30	$ 29.10
	Sum	$ 12,075,090	$ 79,945,650	$ 94,828,300	$ 193,832,780	$ 7,428,100	$ 1,342,420,930	$ 1,166,574,140	$ 1,360,406,920	$ 3,029,776,400	$ 4,585,337
Third 20%	Mean	$ 64.67	$ 89.33	$ 643.09	$ 314.85	$ 19.70	$ 3,541.40	$ 4,869.80	$ 5,235.05	$ 9,860.57	$ 34.64
	Sum	$ 37,060,830	$ 51,194,560	$ 368,553,080	$ 180,440,280	$ 11,292,800	$ 2,029,569,220	$ 2,790,871,610	$ 2,971,311,890	$ 5,651,071,490	$ 7,433,528
Fourth 20%	Mean	$ 95.14	$ 17.87	$ 1,444.95	$ 521.89	$ 20.99	$ 2,994.53	$ 10,018.34	$ 10,671.14	$ 15,567.00	$ 36.92
	Sum	$ 54,498,350	$ 10,236,740	$ 827,707,110	$ 298,954,560	$ 12,023,500	$ 1,715,353,020	$ 5,738,796,530	$ 6,037,751,090	$ 8,917,228,380	$ 10,811,582
Top 15%	Mean	$ 391.90	$ 25.69	$ 2,636.40	$ 1,247.83	$ 36.41	$ 2,984.18	$ 16,830.50	$ 18,200.85	$ 25,264.60	$ 38.08
	Sum	$ 181,045,700	$ 11,869,930	$ 1,217,940,840	$ 576,461,260	$ 16,822,000	$ 1,378,606,690	$ 7,775,200,920	$ 8,351,662,180	$ 11,671,512,090	$ 10,486,133
Top 5%	Mean	$ 6,041.43	$ 14.02	$ 7,086.43	$ 6,688.36	$ 77.44	$ 3,516.59	$ 48,946.48	$ 56,509.24	$ 73,472.07	$ 40.19
	Sum	$ 882,380,470	$ 2,047,250	$ 1,035,009,250	$ 976,867,860	$ 11,310,500	$ 513,615,920	$ 7,148,877,644	$ 8,125,745,504	$ 10,730,962,674	$ 3,911,759
Total	**Mean**	**$ 419.68**	**$ 91.49**	**$ 1,277.88**	**$ 815.76**	**$ 22.39**	**$ 2,567.55**	**$ 8,896.78**	**$ 9,853.55**	**$ 14,575.37**	**$ 35.15**
	Sum	**$ 1,168,382,540**	**$ 254,697,380**	**$ 3,557,641,700**	**$ 2,271,076,520**	**$ 62,326,700**	**$ 7,148,074,000**	**$ 24,768,719,454**	**$ 27,039,795,974**	**$ 40,577,974,164**	**$ 38,549,413**

IV. Consumption of Electricity by Household Income Level

The Puerto Rico Community Survey (PRCS) asks respondents to provide the amount of the previous months electric bill. With that information, and information on the prices per kilowatt hour, we can estimate the electric consumption of households. Table 10 estimates the average consumption of kilowatt hours for households in different parts of the income distribution in Puerto Rico from low to high incomes. Whether we compute consumption using prices for 2017 or prices for 2019, the pattern is essentially the same. Low-income households consume significantly less energy, as measured in kilowatt hours, than higher income households in Puerto Rico. Households in the bottom 20% of the population consume about 340 kWh per month compared to 1007 KWh per month for households at the top 5% of the income distribution. Households in the bottom 20% of the population together consume about 13% of the total kilowatt hours and together with households in the next 20%, which consume about 15% of the total kilowatt hours, households at the bottom 40% of the income distribution in Puerto Rico consume about 28% of the total kilowatt hours. In contrast, households in the top 20% of the income distribution consume about 33%, or one third, of the total energy consumed by households in Puerto Rico. Households with incomes in the top 5% of the population consume about 11% of the total energy consumed by households in Puerto Rico.

Table 10 Monthly KWhr Consumption in Puerto Rico by Income in 2017 Prices (PRCS 2017, 1yr file)

HH Income Quintile in 2017	at $19.40 KwH	KWhr Consumption 2017	PP KWhr Consumption 2017	Percentage of Consumption
Bottom 20%	Mean	340	204	
[from $0 to $6,499]	Sum	73,621,990		13%
Second 20%	Mean	365	225	
[from $6,500 to $14,399]	Sum	83,740,144		15%
Third 20%	Mean	436	225	
[from $14,400 to $24,499]	Sum	100,433,670		18%
Fourth 20%	Mean	536	240	
[from $25,000 to $45,099]	Sum	126,131,691		22%
Top 15%	Mean	698	280	
[from $45,100 to $90,799]	Sum	123,223,052		22%
Top 5%	Mean	1,007	376	
[higher than $90,800]	Sum	59,673,649		11%
Total	**Mean**	**494**	**241**	
	Sum	**566,824,196**		**100%**

If we use 2019 prices of 21.86 cents per kilowatt hour the consumption level decreases for households but the pattern by income level remains essentially the same. Households and individuals in the top 5% consume about three times more energy, as measured in kilowatt hours per household or person, than households in the bottom 20% of the population.

Table 11 Monthly KWhr Consumption in Puerto Rico by Income 2019 Prices (PRCS 2017, 1yr file)				
HH Income Quintile in 2017	at $21.86 KwH	KWhr Consumption 2019	PP KWhr Consumption 2019	Percentage of Consumption
Bottom 20%	Mean	301	181	
[from $0 to $6,499]	Sum	65,336,990		13%
Second 20%	Mean	324	199	
[from $6,500 to $14,399]	Sum	74,316,505		15%
Third 20%	Mean	387	200	
[from $14,400 to $24,499]	Sum	89,131,436		18%
Fourth 20%	Mean	475	213	
[from $25,000 to $45,099]	Sum	111,937,548		22%
Top 15%	Mean	620	249	
[from $45,100 to $90,799]	Sum	109,356,231		22%
Top 5%	Mean	893	334	
[higher than $90,800]	Sum	52,958,317		11%
Total	**Mean**	**438**	**213**	
	Sum	**503,037,027**		**100%**

V. Electricity Costs and the Effects of RSA Increases by Household Income Level

Using 2019 prices, we can estimate the average monthly electrical bill for households in Puerto Rico by income level and then project increase in rates forward to calculate the impact of the rate increases on households of different income levels. Table 12 shows the average monthly electrical bill for the total population estimated at $95.81 per month and then by income level. Households in the bottom 20% are estimated to pay about $65.88, households in the next 20% (second quintile) pay on average $70.83. Households in the third quintile pay about $84.59 per month while those in the fourth quintile pay about $103.93. Households in the top 15% pay about $135.47 per month while households in the top 5% of the population pay about $195.25 per household per month in electrical bill.

Table 12 also includes the sum of the payments expected to be made by households in each of the income categories. We can see households in the bottom 20% paid about $14.3 million per month while all households in the second quintile paid about $16.2 million in electric bill in total per month. The table provides information on the average monthly electrical bill and the total paid by households in each income segment in the base year in the first column and then projects the impact of the rate increases forward. Households in the bottom 20% of the income distribution that are estimated to pay about $65.88 in the base year will go up to pay $77.21 with the first increase required by the RSA, $77.78 in the second increase, $78.66 in the third increase, and up to a total of $82.60 with the fourth increase required by the RSA. That means that collections from households at the bottom 20% of the income distribution would increase from $14.3 million per month in the base year to potentially about $17.9 million per month after the fourth increase required by the RSA.

Table 12 Monthly Electricity Costs and Effects of RSA Increases in Puerto Rico by Income Level at 2019 prices (PRCS 2017, 1yr file)							
HH Income Quintile in 2017		Monhly Electricity Cost ($.2186)	Increase #1 ($.2462)	Increase #2 ($.2481)	Increase #3 ($.2510)	Increase #4 ($.2641)	
Bottom 20%	Mean	$ 65.88	$ 77.21	$ 77.78	$ 78.66	$ 82.60	
[from $0 to $6,499]	Sum	$ 14,282,666	$ 16,739,337	$ 16,863,477	$ 17,052,954	$ 17,908,869	
Second 20%	Mean	$ 70.83	$ 83.01	$ 83.63	$ 84.57	$ 88.81	
[from $6,500 to $14,399]	Sum	$ 16,245,588	$ 19,039,889	$ 19,181,090	$ 19,396,608	$ 20,370,154	
Third 20%	Mean	$ 84.59	$ 99.14	$ 99.88	$ 101.00	$ 106.07	
[from $14,400 to $24,499]	Sum	$ 19,484,132	$ 22,835,474	$ 23,004,824	$ 23,263,305	$ 24,430,927	
Fourth 20%	Mean	$ 103.93	$ 121.81	$ 122.71	$ 124.09	$ 130.32	
[from $25,000 to $45,099]	Sum	$ 24,469,548	$ 28,678,400	$ 28,891,081	$ 29,215,700	$ 30,682,082	
Top 15%	Mean	$ 135.47	$ 158.77	$ 159.94	$ 161.74	$ 169.86	
[from $45,100 to $90,799]	Sum	$ 23,905,272	$ 28,017,066	$ 28,224,843	$ 28,541,976	$ 29,974,543	
Top 5%	Mean	$ 195.26	$ 228.85	$ 230.54	$ 233.14	$ 244.84	
[higher than $90,800]	Sum	$ 11,576,688	$ 13,567,921	$ 13,668,542	$ 13,822,121	$ 14,515,875	
Total	**Mean**	**$ 95.81**	**$ 112.29**	**$ 113.13**	**$ 114.40**	**$ 120.14**	
	Sum	**$ 109,963,894**	**$ 128,878,086**	**$ 129,833,857**	**$ 131,292,664**	**$ 137,882,449**	

Table 13 details the total amount of electrical charges paid by households in each of the income segments of the distribution. In the base month total collections are estimated at about $110 million and they would increase $128.9 million per month with the first increase to a total of $129.8 million with the second increase, $131.3 million for the third increase and up to $137.9 million per month with the fourth increase. The table details the amounts that could potentially be due and collected from households in each of the segments of the income distribution in Puerto Rico including the bottom 40% of households.

Table 13 Monthly Electricity Costs and Effects of RSA Increases in Puerto Rico by Income Level at 2019 prices (PRCS 2017, 1yr file)						
HH Income Quintile in 2017	Monhly Electricity Cost ($.2186)	Increase #1 ($.2462)	Increase #2 ($.2481)	Increase #3 ($.2510)	Increase #4 ($.2641)	
Bottom 20%	$ 14,282,666	$ 16,739,337	$ 16,863,477	$ 17,052,954	$ 17,908,869	
Second 20%	$ 16,245,588	$ 19,039,889	$ 19,181,090	$ 19,396,608	$ 20,370,154	
Third 20%	$ 19,484,132	$ 22,835,474	$ 23,004,824	$ 23,263,305	$ 24,430,927	
Fourth 20%	$ 24,469,548	$ 28,678,400	$ 28,891,081	$ 29,215,700	$ 30,682,082	
Top 15%	$ 23,905,272	$ 28,017,066	$ 28,224,843	$ 28,541,976	$ 29,974,543	
Top 5%	$ 11,576,688	$ 13,567,921	$ 13,668,542	$ 13,822,121	$ 14,515,875	
Total	**$ 109,963,894**	**$ 128,878,086**	**$ 129,833,857**	**$ 131,292,664**	**$ 137,882,449**	

Table 14 includes the base year in the first column and then it includes the total additional amount to be collected from households in each of the income categories with each of the proposed and projected electricity rate increases included in the PREPA RSA. The second column (increase #1) shows that of the total collected after the first increase of $18.9 million about $2.5 million will be due to households in the bottom 20% of the income distribution (the poorest households), $2.8 million to households in the second quintile, $3.4 million to households in the third quintile, $4.2 million to households in the fourth quintile, $4.1 million from households in the top 15%, and about $2 million from households in the top 5% of the household income distribution in Puerto Rico.

The amounts of subsequent increases and the quantities expected to be collected from each segment of the household income distribution are included in the rest of Table 14. Column six of the table includes the percent of the total increase that is expected to be collected from households in each of the segments of the income distribution while the last column includes the percent of total income that is received by households in

each segment of the household income distribution. As we can see in Table 14, about 13% of the rate increase is expected to be collected from households in the bottom 20% of the income distribution (the poorest households) but they only make 1.4% of the total income in Puerto Rico. Households in the second quintile are expected to cover about 14.8% of the electricity rate increase but they make only about 7.5% of the total household income. Households in the third quintile are expected to cover about 17.7% of the rate increase while they make 13.9% of the total household income. At the other top extreme of the income distribution, households in the top 15% of incomes are expected to cover about 21.7% of the electricity rate increase while making 28.8% of the income while households in the top 5% of the household income distribution in Puerto Rico are expected to cover about 10.5% of the electricity rate increase while making 26.4% of the total income.

This means that a disproportionate burden of the increase falls on the bottom 40% of the population and, in particular, on the poorest bottom 20% of the population that has the fewest resources, the highest levels of vulnerability, and the lowest incomes.

Table 14 Monthly Electricity Costs and Effects of RSA Increases in Puerto Rico by Income Level at 2019 prices (PRCS 2017, 1yr file)

HH Income Quintile in 2017	Monhly Electricity Cost ($.2186)	Increase #1 ($.2462)	Increase #2 ($.2481)	Increase #3 ($.2510)	Increase #4 ($.2641)	Percentage of Rate Increase Paid by each Quintile	Percentage of Total Income in each Quintile
Bottom 20%	$ 14,282,666	$ 2,456,671	$ 124,140	$ 189,477	$ 855,915	13.0%	1.4%
Second 20%	$ 16,245,588	$ 2,794,301	$ 141,201	$ 215,518	$ 973,546	14.8%	7.5%
Third 20%	$ 19,484,132	$ 3,351,342	$ 169,350	$ 258,481	$ 1,167,622	17.7%	13.9%
Fourth 20%	$ 24,469,548	$ 4,208,852	$ 212,681	$ 324,619	$ 1,466,382	22.3%	22.0%
Top 15%	$ 23,905,272	$ 4,111,794	$ 207,777	$ 317,133	$ 1,432,567	21.7%	28.8%
Top 5%	$ 11,576,688	$ 1,991,233	$ 100,621	$ 153,579	$ 693,754	10.5%	26.4%
Total	**$ 109,963,894**	**$ 18,914,192**	**$ 955,770**	**$ 1,458,807**	**$ 6,589,785**	**100%**	**100%**

Table 15 provides estimates of the monthly electrical bill per person by dividing the household electrical bill by the number of persons per household. The table also includes information on the per person impact of the rate increase for households in different segments of the income distribution in Puerto Rico. The average bill per person is expected to increase from $46.66 per person per month to about $58.50 per month per person with the full increases imposed under the PREPA RSA. Individuals in households in the bottom 20% of the income distribution estimated to currently pay about $39.61 per person per month and that would increase to $46.43 per person per month with the first increase and up to $49.67 after the fourth increase. Table 15 provides the details of the impact of increases in rates per person for individuals in households that are in different segments of the income distribution in Puerto Rico.

Table 15 Monthly Electricity Costs Per Person & Effects of RSA Increases in Puerto Rico by Income Level at 2019 prices (PRCS 2017, 1yr file)

HH Income Quintile in 2017	Electric Bill Per Person	PP Increase #1	PP Increase #2	PP Increase #3	PP Increase #4
Bottom 20%	$ 39.61	$ 46.43	$ 46.77	$ 47.30	$ 49.67
Second 20%	$ 43.60	$ 51.09	$ 51.47	$ 52.05	$ 54.66
Third 20%	$ 43.70	$ 51.21	$ 51.59	$ 52.17	$ 54.79
Fourth 20%	$ 46.62	$ 54.64	$ 55.05	$ 55.67	$ 58.46
Top 15%	$ 54.37	$ 63.72	$ 64.19	$ 64.91	$ 68.17
Top 5%	$ 72.97	$ 85.52	$ 86.16	$ 87.12	$ 91.50
Total	**$ 46.66**	**$ 54.68**	**$ 55.09**	**$ 55.71**	**$ 58.50**

The annual electrical cost for households in Puerto Rico is included in table 16 for the overall population and also for households in different segments of the income distribution. The average annual electrical bill in Puerto Rico is estimated at $1,149.76 per household and that is estimated to generate about $1.3 billion a year in residential collections. The table includes information on the average annual electrical bill for households in different segments of the income distribution and it also includes the total annual payments made by households in each of the segments of the income distribution. I then estimate the annual impact of the rate increases on the overall population and for households in different segments of the income distribution. The table also includes information on both the average household income for households in different segments of the income distribution as well as the total estimated income generated by households in that segment of the income distribution. That information allows us to calculate the proportion of household income that is devoted to paying electrical bills and the impact of the electricity rate increases on household incomes and budgets for different segments of the population.

The data suggest that the average household in the bottom 20% of the income distribution pays on average $790.54 per year in electrical bills. The second quintile pays an average of $849.97 per year, the third quintile pays about $1,015, the fourth quintile pays about $1,247, those in the top 15% of income earners pay about $1,625 per year while those in the top 5% pay close to $2,343 for electric service per year. If we examine the effect of increases in the price of electricity, the data suggest that the average household in the bottom 20% of the income distribution will pay, after the fourth increase, an average of $991.25 per year in electrical bill. The second quintile will pay an average of $1,065.77 per year after the fourth increase. It is unreasonable to expect that families with very low incomes would be able to afford any additional price increases. The third quintile pays about $1,272.81, the fourth quintile pays about $1,563.86, those in the top 15% of income earners pay about $2,038.30 per year while those in the top 5% pay close to $2,938.04 per year in electrical bill after the fourth increase.

Table 16 Annual Electricity Costs and Effects of RSA Increases in Puerto Rico by Income Level at 2019 prices (PRCS 2017, 1yr file)

HH Income Quintile in 2017		Annual Electricity Cost ($.2186)	Increase #1 ($.2462)	Increase #2 ($.2481)	Increase #3 ($.2510)	Increase #4 ($.2641)	Household income
Bottom 20%	Mean	$ 790.54	$ 926.51	$ 933.39	$ 943.87	$ 991.25	$ 2,365.36
[from $0 to $6,499]	Sum	$ 171,391,992	$ 200,872,042	$ 202,361,725	$ 204,635,452	$ 214,906,427	$ 557,170,180
Second 20%	Mean	$ 849.97	$ 996.17	$ 1,003.56	$ 1,014.83	$ 1,065.77	$ 9,788.58
[from $6,500 to $14,399]	Sum	$ 194,947,056	$ 228,478,663	$ 230,173,079	$ 232,759,294	$ 244,441,848	$ 2,137,600,900
Third 20%	Mean	$ 1,015.09	$ 1,189.69	$ 1,198.51	$ 1,211.98	$ 1,272.81	$ 19,210.01
[from $14,400 to $24,499]	Sum	$ 233,809,584	$ 274,025,688	$ 276,057,885	$ 279,159,659	$ 293,171,121	$ 4,599,317,830
Fourth 20%	Mean	$ 1,247.21	$ 1,461.74	$ 1,472.58	$ 1,489.12	$ 1,563.86	$ 33,812.51
[from $25,000 to $45,099]	Sum	$ 293,634,576	$ 344,140,798	$ 346,692,974	$ 350,588,400	$ 368,184,983	$ 8,088,797,660
Top 15%	Mean	$ 1,625.58	$ 1,905.19	$ 1,919.32	$ 1,940.88	$ 2,038.30	$ 60,974.09
[from $45,100 to $90,799]	Sum	$ 286,863,264	$ 336,204,795	$ 338,698,117	$ 342,503,714	$ 359,694,514	$ 10,920,642,760
Top 5%	Mean	$ 2,343.14	$ 2,746.17	$ 2,766.54	$ 2,797.62	$ 2,938.04	$ 173,131.50
[higher than $90,800]	Sum	$ 138,920,256	$ 162,815,048	$ 164,022,498	$ 165,865,447	$ 174,190,495	$ 10,321,061,364
Total	**Mean**	**$ 1,149.76**	**$ 1,347.53**	**$ 1,357.52**	**$ 1,372.78**	**$ 1,441.68**	**$ 31,268.43**
	Sum	**$ 1,319,566,728**	**$ 1,546,537,034**	**$ 1,558,006,279**	**$ 1,575,511,967**	**$ 1,654,589,388**	**$ 36,624,590,694**

The effects of the annual increases are calculated in table 17 and show the regressive nature of the fee increase and how it impacts those at the bottom of the income distribution disproportionately and more significantly. Those at the bottom 20% of the household income distribution, for example, would see increases of about $136 per year while those in the second quintile see an increase of about $146 per household per

year. The third quintile will see an increase of $175 per household per year for that first increase while those in the fourth quintile would see an increase of $215 per year. The top 15% will pay about $280 more per year while those in the top 5% will pay about $403 more per year. On average, the fee increases are about $198 per household or a total of $227 million dollars more per year than the amount collected in the base year.

Table 17 details the dollar increases from the base year for each proposed electric rate increase. For the second, third, and then the fourth increase, the electric fee goes up by $201 per household per year for those in the bottom 20% and $216 per household per year for those in the second lowest quintile. The last column in the table details the amount of household income left over after paying for the last fee increase, of course assuming constant incomes. We see how the fee increase impacts those with lower income significantly more than those with the higher income households.

Table 17 Annual Electricity Costs and Income Effects of RSA Increases in Puerto Rico by Income Level at 2019 prices (PRCS 2017, 1yr file)

HH Income Quintile in 2017	Increase #1 ($.2462)	Increase #2 ($.2481)	Increase #3 ($.2510)	Increase #4 ($.2641)	Income left over
Bottom 20%	$ 136	$ 143	$ 153	$ 201	$ 1,438.85
[from $0 to $6,499]	$ 29,480,050	$ 30,969,733	$ 33,243,460	$ 43,514,435	$ 356,298,138.14
Second 20%	$ 146	$ 154	$ 165	$ 216	$ 8,792.41
[from $6,500 to $14,399]	$ 33,531,607	$ 35,226,023	$ 37,812,238	$ 49,494,792	$ 1,909,122,236.93
Third 20%	$ 175	$ 183	$ 197	$ 258	$ 18,020.32
[from $14,400 to $24,499]	$ 40,216,104	$ 42,248,301	$ 45,350,075	$ 59,361,537	$ 4,325,292,141.89
Fourth 20%	$ 215	$ 225	$ 242	$ 317	$ 32,350.77
[from $25,000 to $45,099]	$ 50,506,222	$ 53,058,398	$ 56,953,824	$ 74,550,407	$ 7,744,656,862.33
Top 15%	$ 280	$ 294	$ 315	$ 413	$ 59,068.90
[from $45,100 to $90,799]	$ 49,341,531	$ 51,834,853	$ 55,640,450	$ 72,831,250	$ 10,584,437,964.77
Top 5%	$ 403	$ 423	$ 454	$ 595	$ 170,385.33
[higher than $90,800]	$ 23,894,792	$ 25,102,242	$ 26,945,191	$ 35,270,239	$ 10,158,246,315.57
Total	**$ 198**	**$ 208**	**$ 223**	**$ 292**	**$ 29,920.90**
	$ 226,970,306	**$ 238,439,551**	**$ 255,945,239**	**$ 335,022,660**	**$ 35,078,053,659.63**

The impact of the electric rate increases as a proportion of household income can be seen more clearly in table 18. For the base year, it is estimated that the bottom 20% spent about 33% of their income on electric bills and, assuming constant incomes, that percentage goes up to 42% of household income by the last increase. The proportion of income spent on electricity for households in the second quintile in the base year is about 9% and that percentage could go up to about 11%. For the third, fourth and top quintiles the proportion of income spent on electricity hovers between one and 5% in the base year and that percentage could go up to between two and 7% after the fourth increase mandated by the RSA. It is clear that as a proportion of income the regressive fee increases impact those at the bottom two quintiles of the income distribution significantly more than those in the third, fourth, and top quintiles of the income distribution with the very poor faring significantly worse.

Table 18 Annual Electricity Costs as a Percent of Income and Effects of RSA Increases in Puerto Rico by Income Level at 2019 prices (PRCS 2017, 1yr file)

HH Income Quintile in 2017		Annual Electricity Cost ($.2186)	Increase #1 ($.2462)	Increase #2 ($.2481)	Increase #3 ($.2510)	Increase #4 ($.2641)
Bottom 20%	Mean	33%	39%	39%	40%	42%
[from $0 to $6,499]	Sum	31%	36%	36%	37%	39%
Second 20%	Mean	9%	10%	10%	10%	11%
[from $6,500 to $14,399]	Sum	9%	11%	11%	11%	11%
Third 20%	Mean	5%	6%	6%	6%	7%
[from $14,400 to $24,499]	Sum	5%	6%	6%	6%	6%
Fourth 20%	Mean	4%	4%	4%	4%	5%
[from $25,000 to $45,099]	Sum	4%	4%	4%	4%	5%
Top 15%	Mean	3%	3%	3%	3%	3%
[from $45,100 to $90,799]	Sum	3%	3%	3%	3%	3%
Top 5%	Mean	1%	2%	2%	2%	2%
[higher than $90,800]	Sum	1%	2%	2%	2%	2%
Total	**Mean**	**4%**	**4%**	**4%**	**4%**	**5%**
	Sum	**4%**	**4%**	**4%**	**4%**	**5%**

VI. Effects of Population Changes and the Potential Effects on Additional Exodus from Puerto Rico

Puerto Rico's population has been decreasing at an unprecedented rate and the Island is caught up in a demographic and economic death spiral. Puerto Rico's demographic death spiral was set in motion by the collapse of Puerto Rico's labor market and it is having, and will continue to have, consequences for the population of the island whose full magnitude do not appear to be seen or appreciated[16]. In the year 2000, there were about 3.6 million Puerto Ricans living in Puerto Rico and about 3.4 million living in the continental United States but by 2013 there were 5.1 million living in the mainland and 3.5 million on the island. Of the 7 million Puerto Ricans in 2000, about half lived on the island and half on the mainland. By 2013, there were 8.6 million Puerto Ricans with 59.3% living on the mainland and 40.6% on the island. That ratio is going to continue to grow with recent migration trends and is unlikely to be reversed in the foreseeable future as millions of citizens from Puerto Rico leave the island with their children to join the over 55 million Hispanics\Latinos living in the continental US.

Table 19 shows how there have been significant changes in the age composition of the population between 2009 and 2017. In 2009, there were about 1 million persons under 18 years of age in Puerto Rico and by 2017 that number was close to 700,000 for a decrease of about 300,000 persons under 18 years of age. The young population was about 26% of Puerto Rico's population in 2009 and that declined to about 21% of the population by 2017. In 2009, there were about 2.1 million persons between 19 and 59 years of age in Puerto Rico and that number decreased to about 1,760,000 by 2017 or a decrease of almost 400,000 persons. In contrast, there were about 786,000 persons over 60 in Puerto Rico in 2009 and that number increased by about 85,000 persons to 872,000 by 2017. Persons over 60 were about 20% of the population of Puerto Rico in 2009 and that number increased about 26% of the total by 2017. This is a remarkable increase in the population over 60 and a decrease in the population under 18 in a short period of eight years in Puerto Rico.

Table 19 Change in Population Levels and Composition in Puerto Rico (PRCS, 1yr File)

	2009	2017	Difference	2009	2017
under 18	1,025,102	705,757	(319,345)	26%	21%
19-59	2,155,871	1,759,704	(396,167)	54%	53%
over 60	786,315	871,716	85,401	20%	26%
total	**3,967,288**	**3,337,177**	**(630,111)**		

[16] Puerto Rico's Oversight Board's "Plan Fiscal" assumes a -0.2 population decline per year in the next decade. See page 15 https://juntasupervision.pr.gov/index.php/en/documents/ "Commonwealth Fiscal Plan [CFP]" of March 13, 2017. In recent years, population decline has been orders of magnitude higher than the -.2% assumed in the CFP. See https://tradingeconomics.com/puerto-rico/population-growth-annual-percent-wb-data.html. For a more recent report on population change in Puerto Rico see Alexis Santos Lozada "Revisiting the Demography of Disaster: Population Estimates After Hurricane Maria" at https://osf.io/preprints/socarxiv/n8vpe/

The combined effects of high outmigration of younger populations, lower fertility rates for women in Puerto Rico, and an aging of the population will increasingly leave Puerto Rico with a population that is significantly smaller and significantly older over the next few decades. A smaller and older population has substantial consequences for estimates of the size of the labor force, employment, income, and economic activity; government collections and revenues; estimates of population needs; the provision and costs of infrastructure, electric, and related social services; the income and costs of pensions and related programs; and estimates of the potential for future economic activity and growth.

We can see the effects of population decline in reductions in electrical consumption at both the family and household level between 2009 and 2017. In 2009, the average family consumed about 222 kWh per month and that number appears to have gone down to about 202 kWh per month in 2017 and 179 kWh per month if we use 2019 prices.

Table 20 Changes in Per Capita KwHr Consumption Between 2009 and 2017 by Family Income Level

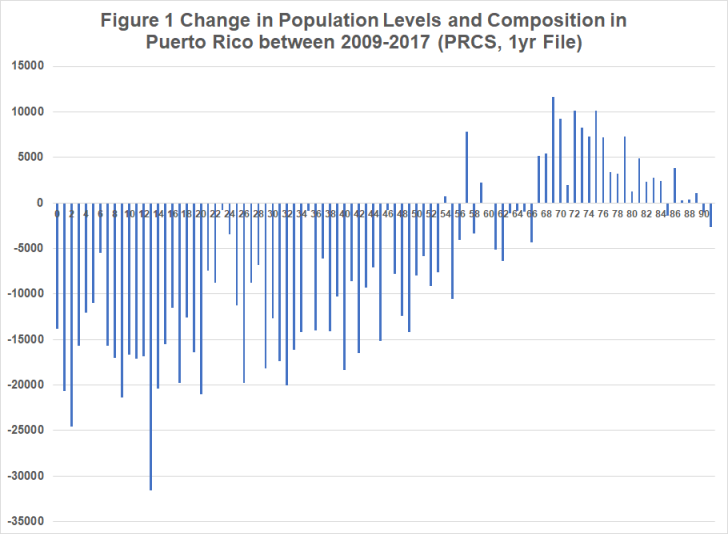
	PP KWhr Consumption 2009 at $.1766			PP KWhr Consumption 2017 prices at $.1940		PP KWhr Consumption 2019 prices at $.2186		
Family Income (CATEGORIZED)	Mean	Households 2009	Sum	Mean	Sum	Mean	Sum	Households 2017
Lowest thru 0	155	46,091	7,157,180	146	6,241,858	130	5,539,435	42,707
1 to 9999	165	167,837	27,670,746	148	20,718,616	131	18,387,061	140,189
10k to 19,999	195	199,371	38,807,316	178	28,997,289	158	25,734,099	163,145
20k to 29,999	219	137,485	30,160,085	189	23,396,494	168	20,763,585	123,779
30k to 39999	235	100,214	23,585,236	212	19,119,256	188	16,967,684	90,392
40k to 49999	247	71,451	17,656,289	219	15,320,893	195	13,596,766	69,809
50k to 59999	272	43,516	11,833,123	244	11,490,612	217	10,197,524	47,037
60k to 79999	294	47,518	13,951,704	257	12,694,828	228	11,266,225	49,381
80k to 99999	318	25,528	8,130,577	272	6,078,417	241	5,394,386	22,352
100k to 124999	348	12,335	4,291,522	306	3,656,750	272	3,245,240	11,939
Over 150,000	468	23,906	11,195,301	393	11,570,021	349	10,267,997	29,418
Total	**222**	**875,252**	**194,439,079**	**202**	**159,285,034**	**179**	**141,360,002**	**790,148**

Similarly, in terms of households, the data show a slight decline in the average consumption per household from 257 kWh per month in 2009 to about 241 kWh per month on average in 2017 (or 219 kWh per month using the 2019 prices). The table shows the persistent pattern of significant differences in electric consumption by income level with households in the lower income levels consuming much less electricity than households in the higher income brackets.

Table 21 Changes in Per Capita KwHr Consumption Between 2009 and 2017 by Household Income Level

	PP KWhr Consumption 2009 at $.1766			PP KWhr Consumption 2017 prices at $.1940		PP KWhr Consumption 2019 prices at $.2186		
Household Income (CATEGORIZED)	Mean	Households 2009	Sum	Mean	Sum	Mean	Sum	Households 2017
Lowest thru 0	215	68,407	14,711,096	222	15,562,649	197	13,811,317	70,078
1 to 9999	230	285,120	65,437,959	208	53,376,756	184	47,370,040	257,117
10k to 19,999	239	271,371	64,969,328	226	56,892,416	200	50,490,068	251,828
20k to 29,999	247	171,596	42,458,967	223	37,335,925	198	33,134,352	167,272
30k to 39999	256	120,936	30,903,951	253	29,965,118	224	26,593,014	118,605
40k to 49999	274	84,171	23,075,738	239	19,630,197	212	17,421,126	82,129
50k to 59999	293	52,362	15,361,170	273	16,016,797	243	14,214,358	58,594
60k to 79999	328	57,497	18,860,150	285	18,003,245	253	15,977,262	63,066
80k to 99999	340	28,946	9,852,258	340	9,472,349	302	8,406,385	27,849
100k to 124999	349	14,009	4,888,578	314	4,619,432	279	4,099,588	14,720
Over 150,000	507	26,696	13,547,730	416	15,150,307	369	13,445,378	36,426
Total	**257**	**1,181,111**	**304,066,923**	**241**	**276,025,192**	**213**	**244,962,888**	**1,147,684**

To illustrate the sharp declines in population and changes in the age composition, Figure 1estimates which specific ages lost population and which ones gained population between 2009 and 2017. The data confirm and illustrate the large and significant population declines for the younger ages particularly for those between 30 and 50 years of age and their children younger than 18. The data also show increases for the population older than 60 years of age and the attendant aging of the population of Puerto Rico.



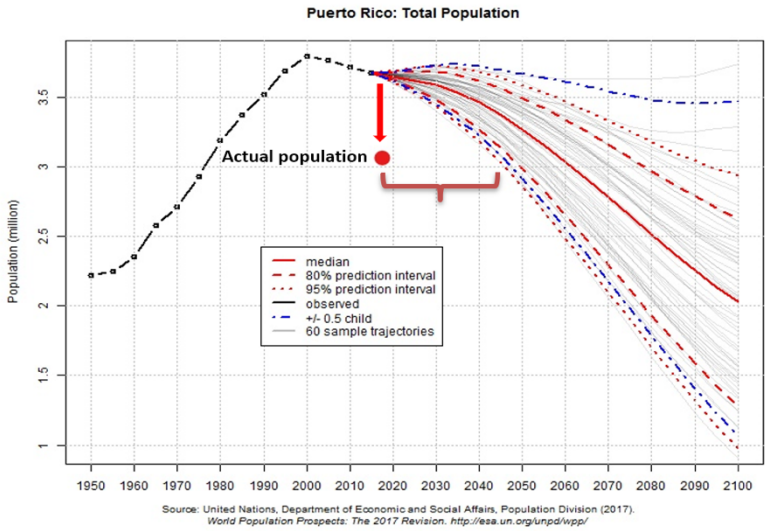
As a result of the combined effects of significant outmigration, decreases in fertility, and slight increases in mortality (due to increased aging), the population in Puerto Rico is projected to continue to decline from around 3.4 million in 2017 to about 3 million by the year 2050 according to estimates by the Pew Center[17]. Keep in mind, however, that the population losses have been more accelerated than the estimates suggest and that most estimates do not take into account population loses after the recent hurricanes.[18] Given recent population numbers, it appears that Puerto Rico's population decline is at a pace a decade faster than expected and projected in estimates produced using 2010 US census data for Puerto Rico.

More recent projections and estimates of the total population for Puerto Rico produced by the United Nations Population Division in 2017 consider various possible scenarios but the vast majority suggest significant population decline. It also looks like Puerto Rico's actual population numbers (3.1 million persons), as shown by the red dot and the blue arrow, are 20-30 years ahead (as shown by the bracket) of even the most conservative population estimates for Puerto Rico in the United Nations models. The expected population decline will have lasting effects and it is likely to be even larger and more precipitous than Figure 2 suggests.

[17] For a more detailed analysis of population change and migration in Puerto Rico see Cohn, D'Vera, Eileen Patten and Mark Hugo Lopez. 2014. "Puerto Rican Population Declines on Island, Grows on U.S. Mainland." Washington, D.C.: Pew Research Center's Hispanic Trends Project, July.

[18] See Edwin Melendez and Jennifer Hinojosa Estimates of Post-Hurricane Maria Exodus from Puerto Rico. Center for Puerto Rican Stuties Research Brief (October 2017) available at https://centropr.hunter.cuny.edu/sites/default/files/RB2017-01-POST-MARIA%20EXODUS_V3.pdf

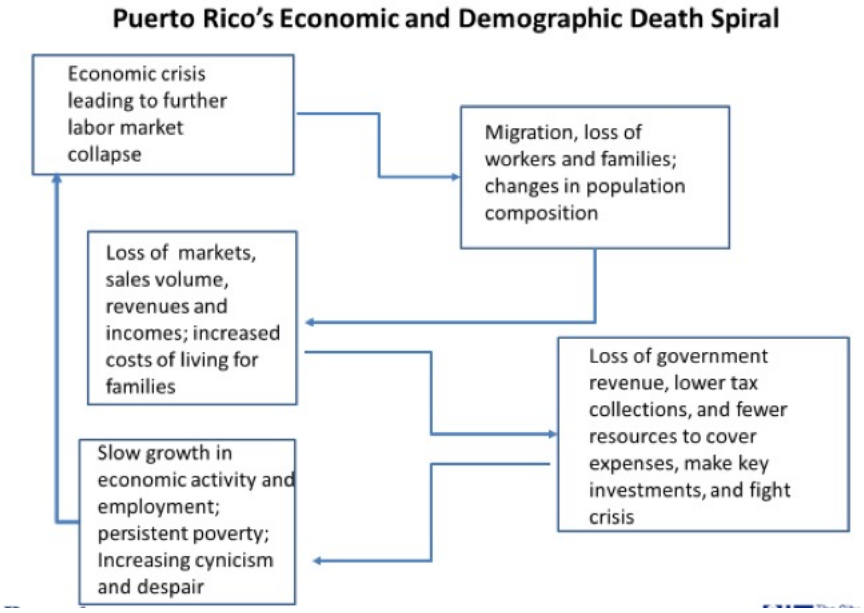
Figure 2



Explanation: These charts show estimates and probabilistic projections of the total population for countries or areas, geographical aggregates and World Bank income groups as defined in Definition of Regions. The population projections are based on the probabilistic projections of total fertility and life expectancy at birth, based on estimates of the 2017 Revision of the World Population Prospects. These probabilistic projections of total fertility and life expectancy at birth were carried out with a Bayesian Hierarchical Model. The figures display the probabilistic median, and the 80 and 95 per cent prediction intervals of the probabilistic population projections, as well as the (deterministic) high and low variant (+/- 0.5 child) of the 2017 Revision of the World Population Prospects.

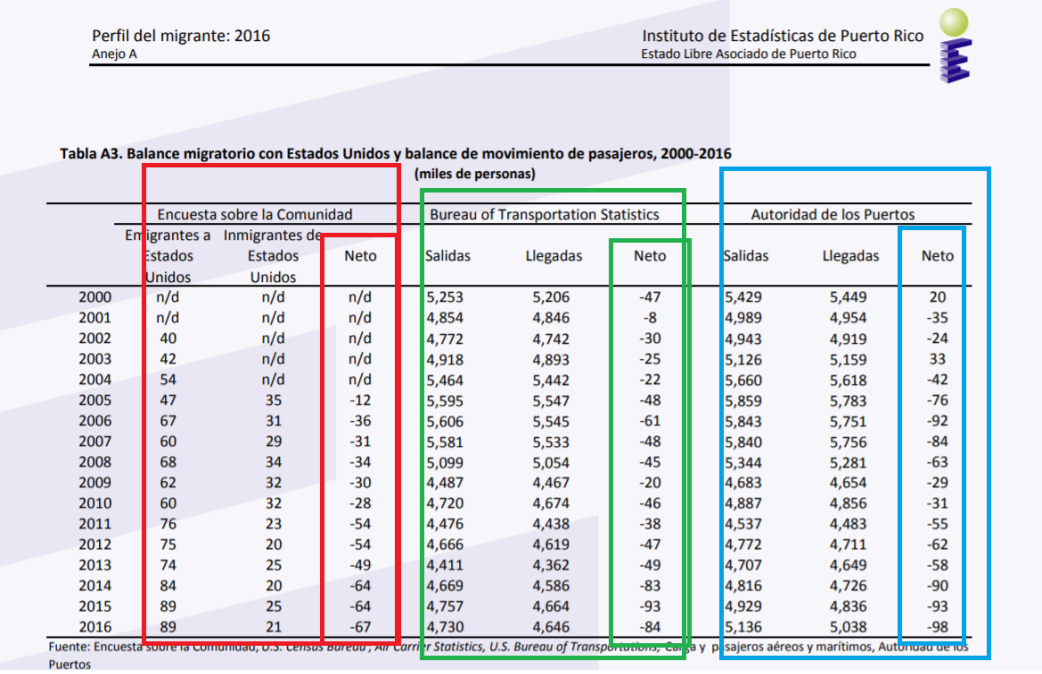
As we have seen, even before Hurricanes Irma and Maria, a close to 20% reduction in the size of the labor force has led to a 10 to 15% reduction in the size of Puerto Rico's population and a noticeable change in its age structure and composition with implications for the present and for the future. The effects of the 2017 hurricanes Irma and Maria have accelerated Puerto Rico's demographic "death spiral." The short, medium, and long-term consequences of large outmigration from Puerto Rico are significant and involve both *population decline* and *changes in the composition of the population*.

Figure 3



Labor market collapse has led to unprecedented numbers of Puerto Ricans migrating out of the island with an estimate of about 89,000 leaving in 2015, and about 25 thousand returning to the Island, for a net outmnigration of 64,238 in just one year, 2015[19]. If we examine the net migration patterns over the last decade, we see an increase in net out-migration from an average around 25 thousand per year between 2005 and 2010 to an average over 50 thousand per year between 2011 and 2014 with all signs suggesting that the net migration number continues to be in the 80 thousand to 90 thousand range or higher since 2014 as seen in Figure 4 taken from various estimates from a number of sources and included in the most recent report on migration from Puerto Rico prepared by the Puerto Rico Institute of Statistics [***Perfil del Migrante***[20]**,** Instituto de Estadisticas de Puerto Rico].

Figure 4



Perfil del migrante: 2016
Anejo A

Instituto de Estadísticas de Puerto Rico
Estado Libre Asociado de Puerto Rico

Tabla A3. Balance migratorio con Estados Unidos y balance de movimiento de pasajeros, 2000-2016
(miles de personas)

	Encuesta sobre la Comunidad			Bureau of Transportation Statistics			Autoridad de los Puertos		
	Emigrantes a Estados Unidos	Inmigrantes de Estados Unidos	Neto	Salidas	Llegadas	Neto	Salidas	Llegadas	Neto
2000	n/d	n/d	n/d	5,253	5,206	-47	5,429	5,449	20
2001	n/d	n/d	n/d	4,854	4,846	-8	4,989	4,954	-35
2002	40	n/d	n/d	4,772	4,742	-30	4,943	4,919	-24
2003	42	n/d	n/d	4,918	4,893	-25	5,126	5,159	33
2004	54	n/d	n/d	5,464	5,442	-22	5,660	5,618	-42
2005	47	35	-12	5,595	5,547	-48	5,859	5,783	-76
2006	67	31	-36	5,606	5,545	-61	5,843	5,751	-92
2007	60	29	-31	5,581	5,533	-48	5,840	5,756	-84
2008	68	34	-34	5,099	5,054	-45	5,344	5,281	-63
2009	62	32	-30	4,487	4,467	-20	4,683	4,654	-29
2010	60	32	-28	4,720	4,674	-46	4,887	4,856	-31
2011	76	23	-54	4,476	4,438	-38	4,537	4,483	-55
2012	75	20	-54	4,666	4,619	-47	4,772	4,711	-62
2013	74	25	-49	4,411	4,362	-49	4,707	4,649	-58
2014	84	20	-64	4,669	4,586	-83	4,816	4,726	-90
2015	89	25	-64	4,757	4,664	-93	4,929	4,836	-93
2016	89	21	-67	4,730	4,646	-84	5,136	5,038	-98

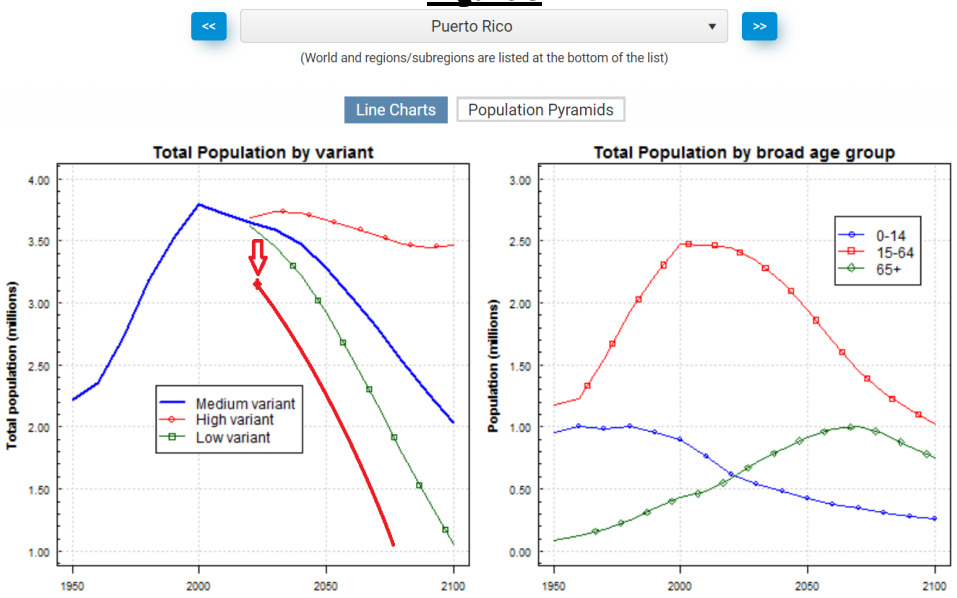
Fuente: Encuesta sobre la Comunidad, *U.S. Census Bureau; Air Carrier Statistics, U.S. Bureau of Transportation*; Carga y pasajeros aéreos y marítimos, Autoridad de los Puertos

Figure 5 illustrates the expected population decline in Puerto Rico compared to the red line which appears to be closer to the actual pattern observed especially after Hurricanes Irma and Maria in 2017. The second panel of figure 5, taken from the United Nations population division, shows the expected change in the age composition of the population suggesting a precipitous and significant decrease in the populations 15 to 64 years of age and steady decline in the population younger than 14 years of age, and an increase in the population older than 65 years of age through 2060.

[19] For a more detailed analysis of the causes and consequences of population change in Puerto Rico see https://www.newyorkfed.org/research/current_issues/ci20-4.html

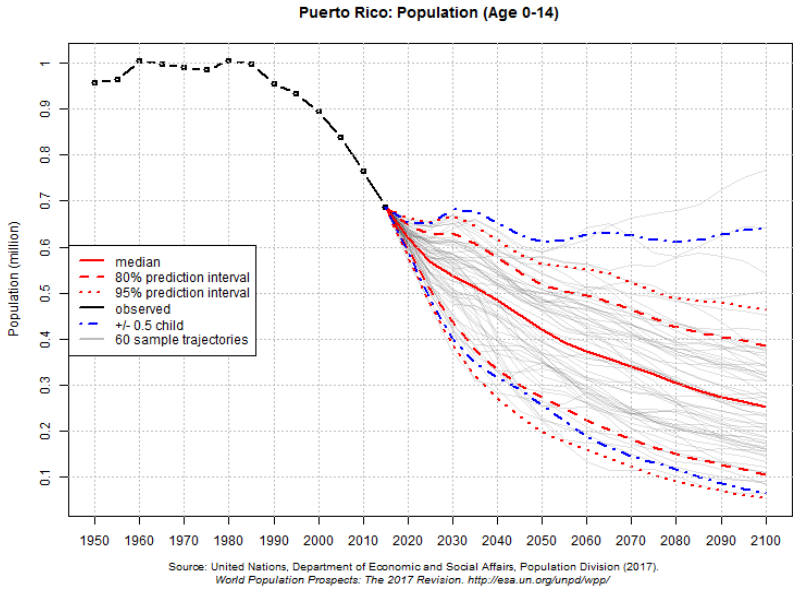
[20] https://estadisticas.pr/files/Publicaciones/PM_2016_1.pdf

Figure 5



The decline in the population younger than 14 can be seen clearly in figure 6 were the observed pattern of decline is closer to the more pessimistic estimates produced by the United Nations.

Figure 6

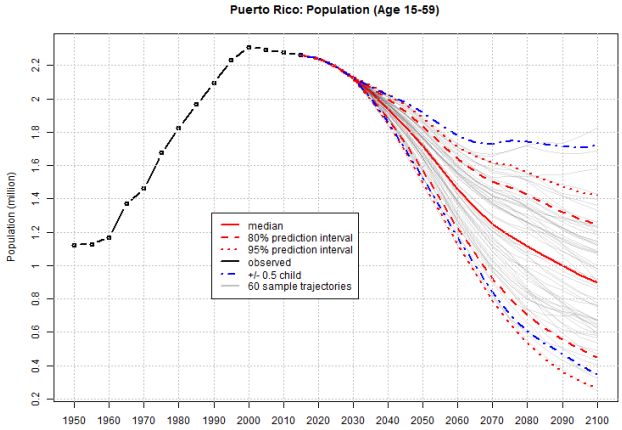


Source: United Nations, Department of Economic and Social Affairs, Population Division (2017).
World Population Prospects: The 2017 Revision. http://esa.un.org/unpd/wpp/

Explanation: These charts show estimates and probabilistic projections of the specified population age range for countries or areas with a population of 90,000 or more in 2017, along with geographical aggregates and World Bank income groups as defined in Definition of Regions. The population projections are based on the probabilistic projections of total fertility and life expectancy at birth, based on estimates of the 2017 Revision of the World Population Prospects. These probabilistic projections of total fertility and life expectancy at birth were carried out with a Bayesian Hierarchical Model. The figures display the probabilistic median, and the 80 and 95 per cent prediction intervals of the probabilistic population projections, as well as the (deterministic) high and low variant (+/- 0.5 child) of the 2017 Revision of the World Population Prospects.

Similarly, the adult population has started to decline significantly and is expected to continue in that pattern for the next decades due to continued outmigration and reductions in the size of the younger age cohorts.

Figure 7



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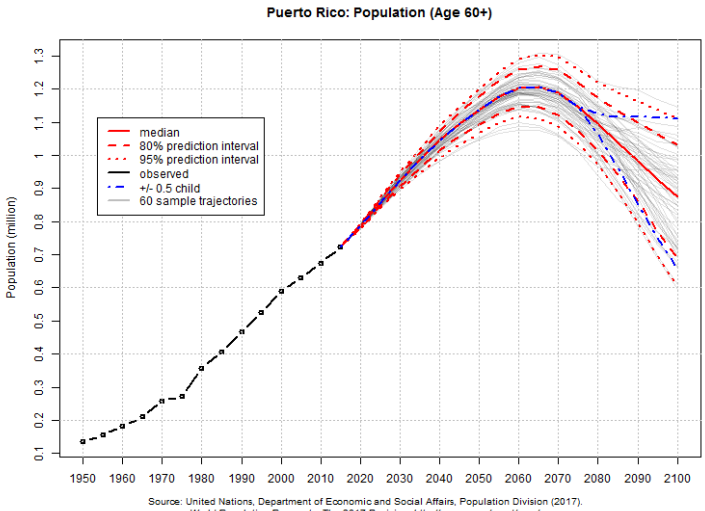
The rapid increase in the population over 60 years of age can be seen in figure 7 that shows the older population steadily increasing up until the younger cohorts of today, that are much smaller, begin to age and Puerto Rico's population would have shrunk significantly. The aging of the population in Puerto Rico has significant impacts for economic activity, infrastructure and electric needs, and for the vulnerability of the population to interruptions in electric service.

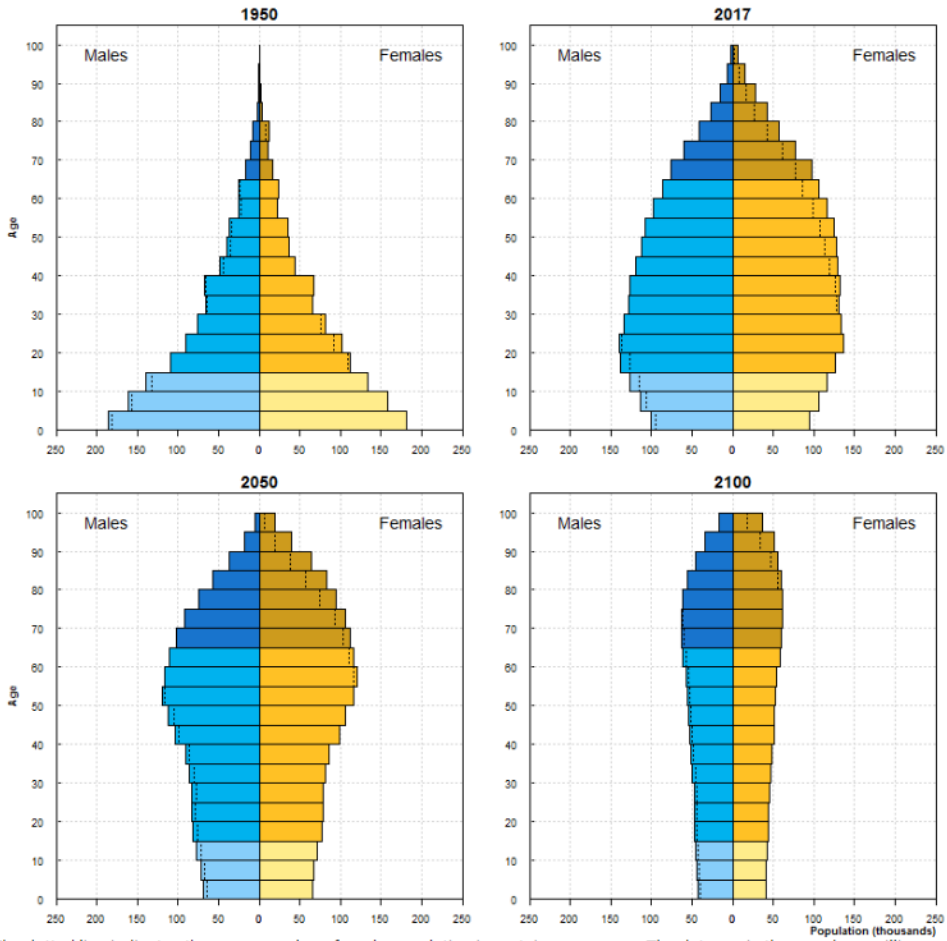
Figure 8



Explanation: These charts show estimates and probabilistic projections of the specified population age range for countries or areas with a population of 90,000 or more in 2017, along with geographical aggregates and World Bank income groups as defined in Definition of Regions. The population projections are based on the probabilistic projections of total fertility and life expectancy at birth, based on estimates of the 2017 Revision of the World Population Prospects. These probabilistic projections of total fertility and life expectancy at birth were carried out with a Bayesian Hierarchical Model. The figures display the probabilistic median, and the 80 and 95 per cent prediction intervals of the probabilistic population projections, as well as the (deterministic) high and low variant (+/- 0.5 child) of the 2017 Revision of the World Population Prospects.

In addition to lower population levels for Puerto Rico, outmigration is significantly changing the age structure and composition of the population[21]. This is reflected in the shape of Puerto Rico's population pyramid in Figure 9 showing fewer young persons and a significant aging of the population between 1950 and 2017. By the year 2050 we begin to see almost an inversion of the age pyramid with the largest cohorts being those between ages 50 and 80 and much smaller younger cohorts in the population. By 2100 we see how Puerto Rico's population is expected to be significantly smaller especially when compared to 1950 where we observe age cohorts that have close to 400,000 persons turning into age cohorts that are about one fourth of the size with about 100,000 persons in them.

Figure 9



The dotted line indicates the excess male or female population in certain age groups. The data are in thousands or millions and represent the population in each age group.

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

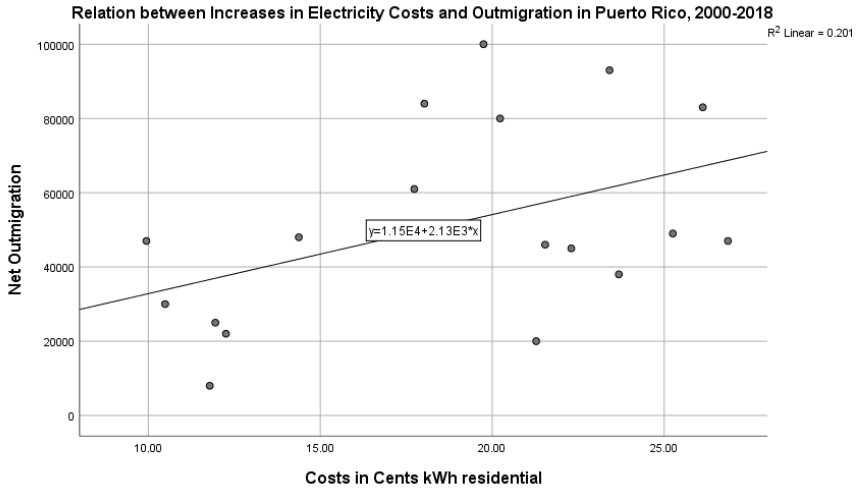
Suggested citation: *Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Online Demographic Profiles. Available from https://population.un.org/wpp/Graphs/DemographicProfiles/, Accessed on [date].*

[21] For an in depth discussion of population change and aging in Puerto Rico see the excellent book by Raul Figueroa Rodriguez Elders Colony available at https://www.amazon.com/Elders-Colony-Ra%C3%BAl-Figueroa-Rodr%C3%ADguez-ebook/dp/B00H9DOOR6

The push forces of a collapsing Puerto Rico economy, the cuts in services, and increases in taxes and fees imposed by the PROMESA austerity regime combined with the pull of better wages, better living conditions, and more access to economic opportunity are significantly changing and shrinking Puerto Rico's population. Hurricane Maria brought significant devastation to the local infrastructure including hundreds of thousands of homes, roads, water systems, electricity, communications infrastructure and it has caused significant disruption to businesses, markets, education, healthcare and other key aspects of life in Puerto Rico. The immediate phase after the storm hit was to provide emergency food and water and other forms of assistance and support. There was significant mobilization and out-migration with estimates suggesting that between 114,000 to 213,000 persons may have left Puerto Rico in the aftermath of hurricanes Irma and Maria[22].

In order to study the effects of price increases on changes in outmigration from Puerto Rico we used the 2000-2016 data series on outmigration from the Bureau of Transportation Statistics (BTS) in Figure 4 from 2016 and added an estimate of 100,000 for 2017 and an 80,000 estimate for 2018 and plotted it against the PREPA prices by year between 2000 and 2018. Figure 10 and Figure 11 show that there is a correlation between increases in prices and higher outmigration levels and one can see the causal mechanism that links increased costs for a basic service adding to the pressures of local families and households, particularly those with lower incomes, for whom outmigration becomes the only option to be able to make ends meet. It is estimated that for every one cent increase in the price of electricity close to 2,100 persons leave Puerto Rico.

Figure 10



[22] See Edwin Melendez and Jennifer Hinojosa Estimates of Post-Hurricane Maria Exodus from Puerto Rico. Center for Puerto Rican Stuties Research Brief (October 2017) available at https://centropr.hunter.cuny.edu/sites/default/files/RB2017-01-POST-MARIA%20EXODUS_V3.pdf

Figure 11

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.448[a]	.201	.154	24016.55054

a. Predictors: (Constant), Costo Cents kWh residencial

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2464174313	1	2464174313	4.272	.054[b]
	Residual	9805509897	17	576794699.8		
	Total	1.227E+10	18			

a. Dependent Variable: Perdida Migracion

b. Predictors: (Constant), Costo Cents kWh residencial

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	11513.322	20005.081		.576	.572
	Costo Cents kWh residencial	2130.369	1030.694	.448	2.067	.054

a. Dependent Variable: Perdida Migracion

We can also see in Figures 12 and 13 how an increase in outmigration from Puerto Rico is also associated with decreases in consumption of electricity by persons, families and households in Puerto Rico which further impairs the capacity of the Puerto Rico Electric Power Authority (PREPA) to generate income. The high, and projected higher if the PREPA RSA is approved, costs of electricity in Puerto Rico lead to a reduction in population and reductions in population lead to a further loss of consumption and, likely, income for PREPA. The data analysis suggests that the costs of electricity in Puerto Rico play a part in population loss and that population loss further reduces the demand for and consumption of electricity for families across income levels in Puerto Rico.

Figure 12

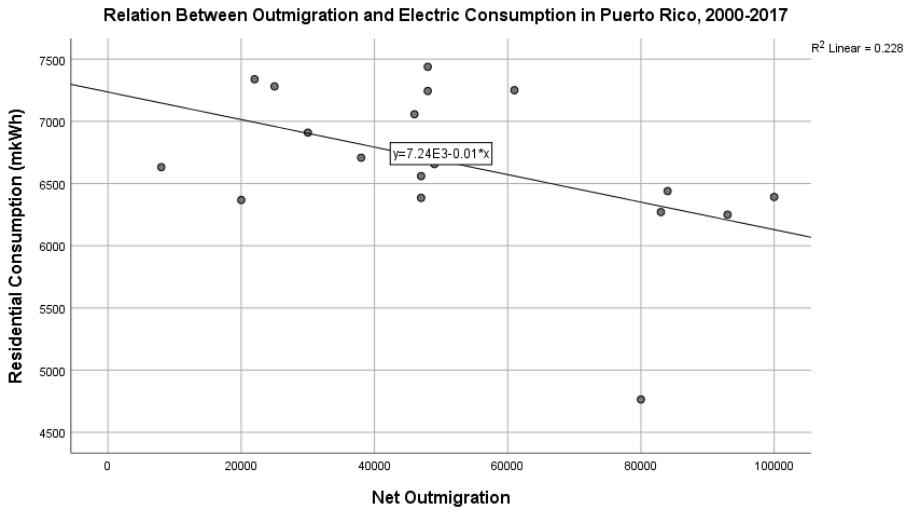


Figure 13

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.478[a]	.228	.183	546.2784445

a. Predictors: (Constant), Perdida Migracion

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1501393.625	1	1501393.625	5.031	.039[b]
	Residual	5073142.361	17	298420.139		
	Total	6574535.986	18			

a. Dependent Variable: Consumo residencial (mkWh)

b. Predictors: (Constant), Perdida Migracion

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	7235.327	282.173		25.641	.000
	Perdida Migracion	-.011	.005	-.478	-2.243	.039

a. Dependent Variable: Consumo residencial (mkWh)

VII. On the Socio-Economic Impacts of the Puerto Rico Electric Power Authority (PREPA) Restructuring Support Agreement (RSA) on the Population of Puerto Rico

A significant proportion of Puerto Rico's population is poor and vulnerable. This was clearly seen during and after hurricanes Irma and Maria. And it is quite visible still. The combination of poverty, disability, and vulnerabilities due to age create significant inequalities in the population. Inequality involves different sets of risks and has differential impacts for particular segments of the population including in access to and the use of electricity. The most marginalized segments are affected by disasters in concrete ways. Before and as the storm hits, the poor and marginalized are: a) more likely to live in vulnerable structures and places; and b) have less supplies to prepare to protect life and property. During rescue and aid distribution phase these populations: a) have fewer cash and other reserves; b) often more isolated from aid distribution channels; c) are more prone to adverse impacts on affected personal networks and have less access to network resources; d) are more dependent on charity and the "kindness of strangers;" and e) are more vulnerable and insecure in life and property. During recovery and reconstruction, low income and marginalized populations are further disadvantaged because: a) their needs and voices are not considered central; b) often not incorporated in damage assessment and planning; c) are often seen as a cost and a nuisance that can be disposable; and d) have difficulties in having voices, positions and interests heard. This may also be the case with the PREPA RSA because of the disproportionate burden that vulnerable populations will be forced to bear if the agreement is approved.

This study finds that in 2009 there were about 1 million persons under 18 years of age in Puerto Rico and by 2017 that number was close to 700,000 for a decrease of about 300,000 persons under 18 years of age. The young population constituted about 26% of Puerto Rico's population in 2009 and that declined to about 21% of the population by 2017. In contrast there were about 786,000 persons over 60 in Puerto Rico in 2009 and that number increased by about 85,000 persons to 872,000 by 2017. Persons over 60 were about 20% of the population of Puerto Rico in 2009 and that number increased about 26% of the total by 2017. This is a remarkable increase in the population over 60 and a decrease in the population under 18 in a short period of eight years in Puerto Rico. A significant proportion of the population on the island, about 21.8%, report one or more type of disability and this means that there is a significant segment of the population that relies disproportionately on the continuity of electric service for their safe and stable functioning.

In addition, about 24.6% of the population in Puerto Rico, about 812,258 persons, report incomes below half of the poverty line, or less than about $6,000 per person per year. Another 19.9%, or 658,795 persons, have incomes between half and the poverty line (between $6,000 and $12,000 per person per year) which means that the overall proportion of the population below poverty in Puerto Rico is 44.5%. If we combine the proportion of the population in Puerto Rico that is below poverty, or that is younger than 15 years of age, or that is older than 65 years of age, or that has any disability that adds up to about 68.9% of the population. This means that close to 2.3 million out of the 3.3 million persons reported residing on the island in 2017 is below poverty, or is younger than 15 years of age, or is older than 65 years of age, or that has any disability. **Puerto Rico's population is vulnerable and relies on accessible, steady and affordable electric power.**

The contemplated price increases in electricity mandated by the PREPA RSA are significant particularly for populations with low incomes or with fixed income from pensions or other retirement income. The average monthly electrical bill for the total population was estimated at $95.81 per month for the total population and then by income level. Households at the bottom 20% were estimated to pay about $65.88 per month while households in the next 20% (second quintile) paid an average of $70.83. Households in the third quintile paid about $84.59 per month while those in the fourth quintile paid about $103.93. Households in the top 15% paid about $135.47 per month on average while households in the top 5% of the population paid about $195.25 per household per month in electrical bill. The total amount paid by households in the bottom 20% was about $14.3 million per month while all households in the second quintile paid about $16.2 million in electric bill in total per month. With the increase mandated by the PREPA RSA, households in the bottom 20% of the income distribution (who are estimated to pay about $65.88 per month in the base year) would have to pay $77.21 per month with the first increase, $77.78 in the second increase, $78.66 in the third increase, and up to a total of $82.60 per month with the fourth increase. That means that total fee collections from households at the bottom 20% of the income distribution would increase from $14.3 million per month in the base year to potentially about $17.9 million per month after the fourth increase or $3.6 million more in payments per month.

In aggregate terms, of the first electricity rate increase of $18.9 million, about $2.5 million will be due to households in the bottom 20% of the income distribution (the poorest households), $2.8 million to households in the second quintile (also below poverty), $3.4 million to households in the third quintile, $4.2 million two households in the fourth quintile, $4.1 million from households in the top 15%, and about $2 million from households in the top 5% of the household income distribution in Puerto Rico. About 13% of the rate increase is expected to be collected from households in the bottom 20% of the income distribution (the poorest households) but they only make 1.4% of the total income in Puerto Rico. Households in the second quintile are expected to cover about 14.8% of the electricity rate increase but they make only about 7.5% of the total household income. Households in the third quintile are expected to cover about 17.7% of the rate increase while they make 13.9% of the total household income. At the other top extreme of the income distribution, households in the top 15% of the income distribution are expected to cover about 21.7% of the electricity rate increase while making 28.8% of the income. Households in the top 5% of the household income distribution in Puerto Rico are expected to cover about 10.5% of the electricity rate increase while making 26.4% the total income.

The electric rate increase affects the poor and vulnerable much more as a proportion of their incomes and makes the settlement agreement unfair and inequitable. Those at the bottom 20% of the household income distribution, for example, would see an electricity bill increase of about $136 per year while those in the second quintile we see an increase of about $146 per household per year. The third quintile we see an electricity bill increase of $175 per household per year for that first increase while those in the fourth quintile would see an electricity bill increase of $215 per year. The top 15% will pay about $280 more per year while those in the top 5% will pay about $403 more per year. On average the fee increases about $198 per household or $227 million dollars more than the amount collected in the base year. **For the base year, it is estimated that the bottom 20% spent about 33% of their income electric costs and, assuming constant incomes, that percentage goes up to 42% of household income by the last increase. The proportion of income spent on electricity for households in the second quintile in the base year is about 9% and that percentage could go up to about 11%.** For the third and fourth and top quintiles the proportion of income spent on electricity hovers between one and 5% in the base year and that percentage could go up to between two and 7% by the time of the fourth increase.

It is clear that as a proportion of income the regressive electricity fee increase impacts those at the bottom two quintiles of the income distribution (the poorest segments of the population) significantly more than those in the third fourth and top quintiles of the income distribution with the very poor faring significantly worse. The data suggest that the average household in the bottom 20% of the income distribution will pay, after the fourth increase, an average of $991.25 per year in electrical bill. The second quintile will pay an average of $1,065.77 per year. It is unreasonable to expect that families with very low incomes would be able to afford any additional price increases. The third quintile pays about $1,272.81, the fourth quintile pays about $1,563.86, those in the top 15% of income earners pay about thousand $2,038.30 per year while those in the top 5% pay close to $2,938.04 per year electrical bill.

Electricity consumption in Puerto Rico is declining over time for all socio-economic sectors. In 2009, the average family consumed about 222 kWh per month and that number appears to have gone down to about 202 kWh per month in 2017 and 179 kWh per month if we use 2019 prices. **Increase electric cost add to migration pressures and further exacerbate the demographic and socioeconomic death spiral that Puerto Rico has been trapped in for the last 15 years.** Labor market collapse has led to unprecedented numbers of Puerto Ricans migrating out of the island with an estimate of about 89,000 leaving in 2015, and about 25 thousand returning to the Island, for a net outmnigration of 64,238 in just one year, 2015. If we examine the net migration patterns over the last decade, we see an increase in net out-migration from an average around 25 thousand per year between 2005 and 2010 to an average over 50 thousand per year between 2011 and 2014 with all signs suggesting that the net migration number continues to be in the 80 thousand to 90 thousand range or higher since 2014.

An analysis of Puerto Rico data between 2000 and 2017 shows that there is a correlation between increases in electricity costs and out-migration from Puerto Rico. **Increases in the price of electricity lead to higher levels of out-migration. At the same time, increases in levels of outmigration and in the number of persons and families leaving Puerto Rico reduces the demand for electricity further eroding the income potential of the Puerto Rico Electric Power Authority (PREPA).** The shape of Puerto Rico's population pyramid shows fewer young persons and a significant aging of the population between 1950 and 2017. By the year 2050 we see in Figure 9 an inversion of the age pyramid with the largest cohorts being those between ages 50 and 80 and much smaller younger cohorts. By 2100 we see how Puerto Rico's population is expected to be significantly smaller especially when compared to 1950 where we see age cohorts that have close to 400,000 persons turning into age cohorts that are about one fourth of the size with about 100,000 persons in them.

The approval of the RSA will automatically cause an increase in the cost of living of the people of Puerto Rico, which, in turn, will cause additional social and economic precariousness to the most vulnerable segments of the population, particularly those at the bottom 40% of the income distribution. Increases costs of electric and related services (as other costs would also increase with more expensive energy); the changing demographic profile of the population, high levels of poverty and disability, and continued population declines due to persistent outmigration and precariousness cause a further slowdown in economy activity which further exacerbates outmigration trends and lowers the demand for electricity. With lower demand for electricity, the prospects of PREPA complying with operational requirements and obligations to workers and retirees will be severely impaired. Thus, this will destroy PREPA's ability to consistently provide its essential services. This situation has become a vicious cycle that threatens revenue collection and the finances of the Puerto Rico Electric Power Authority (PREPA).

The PREPA RSA is far from being reasonable, fair and equitable, and it is also not feasible from the perspective of the population of Puerto Rico. For instance, due to the significant differences in household income among different groups of people in Puerto Rico, the RSA will impact incomes and electricity consumption, specifically within the lowest-income group, as almost half of its income will be compromised to paying the electrical bills, if the rates increase, as the RSA pursues. Thus, this demonstrates that apart from lacking fairness and equitableness, the RSA is not reasonable as the increase in rates will make affording energy consumption much more difficult for the most vulnerable segments of the population particularly, children, the disabled, elderly populations, and the close to 44.6% of the population in Puerto Rico that lives below the federal poverty line of approximately $12,000 per person per year. The undue burden of higher electric costs, particularly on the most vulnerable segments of the population of Puerto Rico, threatens their ability to sustain themselves on the island, leads to more outmigration and, rather than solving, further exacerbates Puerto Rico's many overlapping economic, social, demographic, and fiscal crises and attempts against its economic recovery and long term viability.