

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



**IN RE:** HIGHLY EFFICIENT FOSSIL  
GENERATION DEFINITION

**CASE NO.:** CEPR-MI-2016-0001

**SUBJECT:** Definition Proposal.

**RESOLUTION**

On February 5, 2016, the Puerto Rico Energy Bureau ("Energy Bureau") issued a Resolution in the instant case proposing a definition for the term "Highly Efficient Fossil Generation", in accordance with Section 6B of Act 83 of May 2, 1941<sup>1</sup> and Article 6.29 of Act 57-2014.<sup>2</sup> The Energy Bureau invited interested parties to submit written comments regarding the proposed definition. After reviewing the filed comments, the Energy Bureau revised the original analysis and hereby amends the proposed definition as detailed herein.

**Highly Efficient Fossil Generation**

A generation unit is considered "Highly Efficient" if it meets the following **two requirements**:

- (1) The yearly unit total cost of generating electricity cannot exceed \$100/MWh (i.e. \$0.10/kWh).
  - a. For units owned and operated by the Puerto Rico Electric Power Authority, the total cost shall include fuel, O&M, capital additions, and any other costs directly related to the unit.
  - b. For units owned or operated by other parties selling power to PREPA or its successor, the cost per MWh shall be the price charged by the seller.
- (2) The average annual rate of carbon dioxide emissions from the generating unit, as measured in pounds per megawatt-hour (lbs/MWh), is lower than the United States nationwide average for plants with the same primary fuel and primary fuel generation category as reported in U.S. Environmental Protection Agency's Emissions & Generation Resource Integrated Database ("eGRID")

<sup>1</sup> The Puerto Rico Electric Power Authority Act.

<sup>2</sup> The Puerto Rico Energy Transformation and RELIEF Act, as amended.

(or successor source) for the most recent year in which data is available.<sup>3</sup>



The average annual rate of carbon dioxide emissions for the most recent year in which data is available are as follows:

<b>Fuel Type</b>	<b>Average annual rate of CO<sub>2</sub> emissions (lbs/MWh)</b>
Coal	1,998
Residual Fuel Oil	1,720
Diesel Fuel	2,161
Natural Gas	1,201

To establish the yearly unit total cost limit, the Energy Bureau defined a reference efficient fossil-fueled generator, and estimated its cost. The selected reference efficient fossil-fueled generator was a new combined-cycle plant fueled with Liquefied Natural Gas ("LNG"). Due to the small size of the Puerto Rico electric system, the Energy Bureau limited the size of the reference unit to 150 MW, which would include some of the units discussed in the Puerto Rico Electric Power Authority ("PREPA") 2015 Integrated Resource Plan.<sup>4</sup> Attachment A to this Resolution contains a detailed calculation of the aforementioned limit.

The Energy Bureau selected eGRID as the data source to establish the CO<sub>2</sub> emissions limit since it is a comprehensive data source on the environmental characteristics of almost all electric power generated in the United States. It shows plant-level generation and emissions for a number of pollutants including CO<sub>2</sub>, allowing for calculation of emission rates by fuel type. Moreover, eGRID is publicly available, trusted and will update over time, making it viable and trustworthy.

The Energy Bureau invites all interested parties to submit their written comments regarding the proposed definition, on or before September 28, 2018. All comments must be presented via email ([comentarios@energia.pr.gov](mailto:comentarios@energia.pr.gov)), through regular mail (Seaborne Plaza, 268 Muñoz Rivera Ave, Plaza Level Suite 202, San Juan P.R. 00918) or in person, at the Energy Bureau Clerk's Office located in the aforementioned address.

Be it published.

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<sup>3</sup> As of today, the most recent year in which eGRID data is available is 2016.  
See <https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid>.

<sup>4</sup> See Integrated Resource Plan Volume I: Supply Portfolios and Futures Analysis, August 17, 2015, § 3.2, pp. 3-3 to 3-10.



Edison Avilés Deliz  
Chairman

Ángel R. Rivera de la Cruz  
Associate Commissioner

Lillian Mateo Santos  
Associate Commissioner

Ferdinand A. Ramos Soegaard  
Associate Commissioner

### CERTIFICATION

I hereby certify that the majority of the members of the Puerto Rico Energy Bureau has so agreed on August 30, 2018 and I have proceeded with the filing of this Resolution. For the record, I sign this in San Juan, Puerto Rico, today August, 30, 2018.

María del Mar Cintrón Alvarado  
Clerk



## Attachment A – Reference Efficient Fossil-Fueled Generator and the calculation of the yearly unit total cost of generating electricity limit.



Three parameters were considered to calculate the generation cost for the Reference Efficient Fossil-Fueled Generator: total fixed O&M cost, variable O&M cost and fuel cost.

Reference Generator: Siemens SCC-800

Plant Characteristics:<sup>5</sup>

- Heat rate: 8,031 Btu/kWh
- Fixed O&M: \$23/kW-year (2015\$)
- Variable O&M: \$3/MWh (2015\$)
- Capital Cost: \$1,648/kW (2015\$)
- Forced outage rate: 2%
- Maintenance outage rate: 4.1%

After adjusting the Fixed O&M, Variable O&M and Capital Costs from 2015 to 2018 dollars,<sup>6</sup> the costs are as follow:

- Fixed O&M: \$24.41/kW-year (2018\$)
- Variable O&M: \$3.28/MWh (2018\$)
- Capital Cost: \$1,749.32/kW (2018\$)

The annual cost of capital can be calculated by multiplying the Capital Cost by a carrying charge (i.e. capital recovery factor). The annual carrying charge is difficult to determine at this time, due to the uncertainty in PREPA's future cost of borrowing and in the nature of the entity that may be financing future generation in Puerto Rico. Pending resolution of PREPA's financial and operational status, we assume a 10% cost of capital (which would include taxes, if new generation is owned by for-profit corporations) and a 30-year life. Under these assumptions, the carrying charge is 10.61%. Therefore, the yearly Capital Cost is \$185.60/kW-year.

The total fixed cost is the sum of Fixed O&M and Capital Cost. Therefore, the total fixed cost is equal to \$210.01/kW-year. Based on the expected outage rate (6.1%), the actual total fixed cost can be calculated as follows:

$$\text{Actual Fixed Cost} = \frac{\text{Total Fixed Costs}}{1 - \text{Outage Rate}}$$

<sup>5</sup> See Integrated Resource Plan Volume I: Supply Portfolios and Futures Analysis, August 17, 2015, § 3.2, Tables 3-2 and 3-5.

<sup>6</sup> The national inflation rate from 2015 to 2018 is approximately 6.148%. See in general, Bureau of Labor and Statistics, Consumer Price Index; <https://www.bls.gov/cpi/>.



$$\text{Actual Fixed Cost} = \frac{\$210.01/\text{kW} \cdot \text{yr}}{1 - 0.061}$$

$$\text{Actual Fixed Cost} = \$223.65/\text{kW} \cdot \text{yr} = \$25.53/\text{MWh}$$

Cost of fuel is a variable and somewhat unpredictable parameter. However, we based our analysis on the historical and future Henry Hub spot prices for Natural Gas (“NG”) and the current NG price structure between the Puerto Rico Electric Power Authority and its provider for the Costa Sur site.

The current PREPA NG price is determined by a formula indexed to Bunker Fuel prices and Henry Hub spot prices.<sup>7</sup> Going forward, it is reasonable to expect NG prices to be indexed only to U.S. NG prices. Therefore, it was assumed that the cost of fuel for the Reference Efficient Fossil-Fueled Generator would follow the gas-based formula:

$$\text{NG Cost} = 1.15\text{HH} + \$5.95$$

Where HH is the final settlement price for the Henry Hub NG futures contracts (in US\$/MMBtu).<sup>8</sup>

The 5-year historical Henry Hub NG spot price average is around \$3.17/MMBtu,<sup>9</sup> whereas the future prices in the next several years ranges from \$2.53/MMBtu to \$3.05/MMBtu. A spot price of \$3/MMBtu was used for the purpose of this analysis. Therefore, the NG Cost for the Reference Efficient Fossil-Fueled Generator is:

$$\text{NG Cost} = 1.15\text{HH} + \$5.95$$

$$\text{NG Cost} = 1.15 \times \$3 + \$5.95$$

$$\text{NG Cost} = \$9.40/\text{MMBtu}$$

Using a heat rate of 8,031 Btu/kWh (which is equivalent to 8.031 MMBtu/MWh), the total fuel cost for the Reference Efficient Fossil-Fueled Generator is:

$$\text{Total Fuel Cost} = 8.031 \text{ MMBtu/MWh} \times \$9.40/\text{MMBtu}$$

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<sup>7</sup> See Amendment No. 3 to the Natural Gas Sale and Purchase Agreement between Gas Natural Aprovevisionamientos SDG, S.A. and Puerto Rico Power Authority Dated 28<sup>th</sup> March, 2012; available at <https://aepr.com/Documentos/Ley57/CONTRATOS%20GENERAL/2012-P00107C%20GAS%20NATURAL%20APROVISIONAMIENTOS%20SDG%20SA.pdf>.

<sup>8</sup> *Id.*

<sup>9</sup> See U.S. Energy Information Administration, <https://www.eia.gov/dnav/ng/hist/rngwhhdM.htm>.

$$\text{Total Fuel Cost} = \$75.49/\text{MWh}$$

Summarizing these results:

<b>Cost Category</b>	<b>Cost (2018\$)</b>
Actual Fixed Cost	\$25.53/MWh
Variable O&M	\$3.28/MWh
Total Fuel Cost	\$75.49/MWh
Total	\$104.30/MWh

Therefore the generation cost for the Reference Efficient Fossil-Fueled Generator is \$104.30/MWh or \$0.1043/kWh.

For the purpose of the definition, the limit of \$100/MWh (or \$0.10/kWh) was selected.