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GHG mitigation in the electricity production system in Canary Islands: A proposal for a management and optimization tool in generation.

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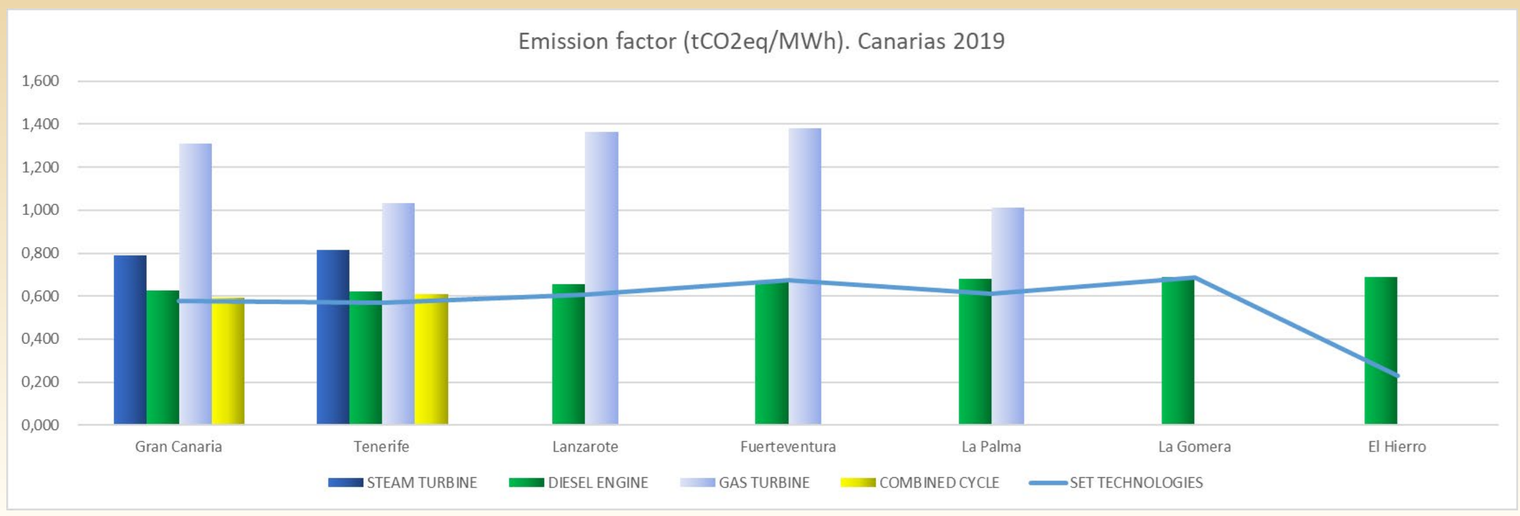
Abstract

The penetration of renewable energies in island environments poses a series of challenges such as stability, demand response and guarantee of supply, among others.

Throughout this work, a study methodology will be presented based on conditions of electricity demand in the Canary Islands and their electricity production system to mitigate the emission of greenhouse gases and improve the penetration of renewable energies in island electricity systems.

Based on the initial data, a tool will be proposed that optimizes the energy production system through combustion technology (non-renewable) and combines it with the production of energy through renewables that meet expectations both in dynamic response, safety, scaling and integration with renewable energy systems, in terms of efficiency and power. Resulting in a series of cases, under different operating conditions, providing different scenarios and an expansion of up to 36.78% of the renewable installed capacity in the Canary Islands (70% in Gran Canaria) with a reduction of 65.13% of tCO_{2eq} and a reduction in fuel consumption of 71.45%.



Methodology

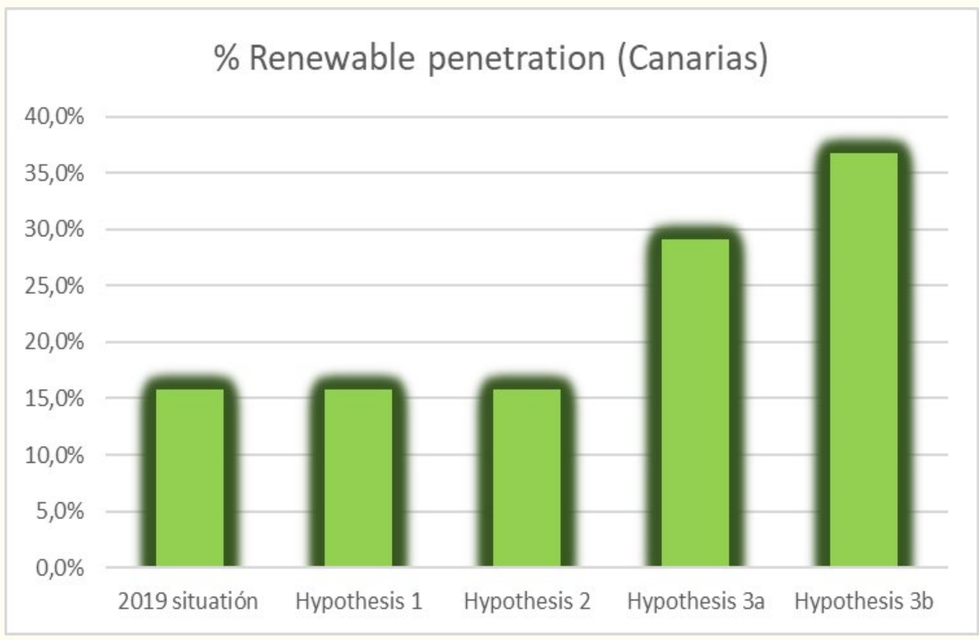
$$E=\{[ax\alpha1+a'x(1-\alpha1)]xA+[bx\alpha2+b'x(1-\alpha2)]xB+[cx\alpha3+c'x(1-\alpha3)]xC+[dx\alpha4+d'x(1-\alpha4)]xD\}x(1+\beta)$$

Technologies				Definition of parameters.
Steam turbine	Engines diesel	Gas turbine	Combined cycle	
a´	*b´*	*c´*	*d´*	Studied value of this technology running on 100% usual fuel
a	*b*	*c*	*d*	Studied value of this technology running on 100% natural gas
α1	*α2*	*α3*	*α4*	% use of natural gas in this technology
A	*B*	*C*	*D*	% of operation of this technology
Renewable		*β*		% contributed from this technology calculated on the total contributed by the rest of technologies not including renewables.
		R		% contributed from this technology calculated on the total contributed by all technologies, including renewables.

A tool is proposed that helps to regulate and optimize the energy production equipment and describes the different existing combinations in achieving an energy production that meets the demand, all this optimizing fuel consumption, reducing GHG emissions, increasing the penetration of renewables and reducing the CO_2 emission factor, (tCO_{2eq}/MWh).

Results

As a result, we obtain a series of improvements with the optimization of equipment increase in the penetration of renewable energies, all this necessarily entails the reduction of tCO_{2eq}

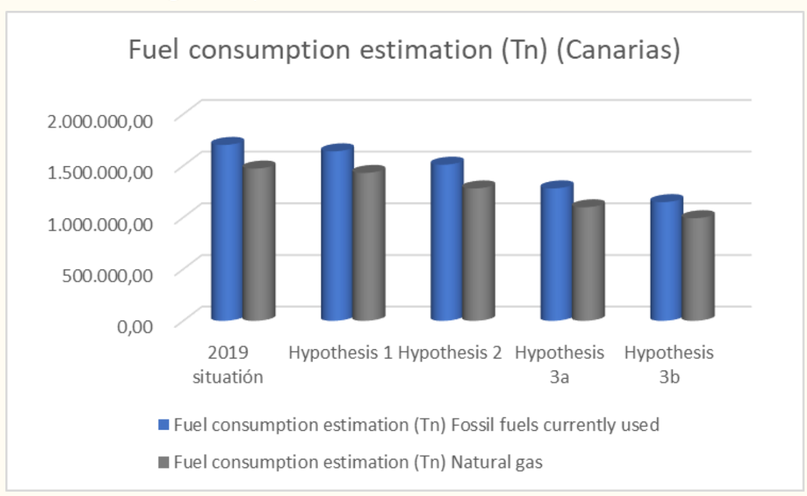


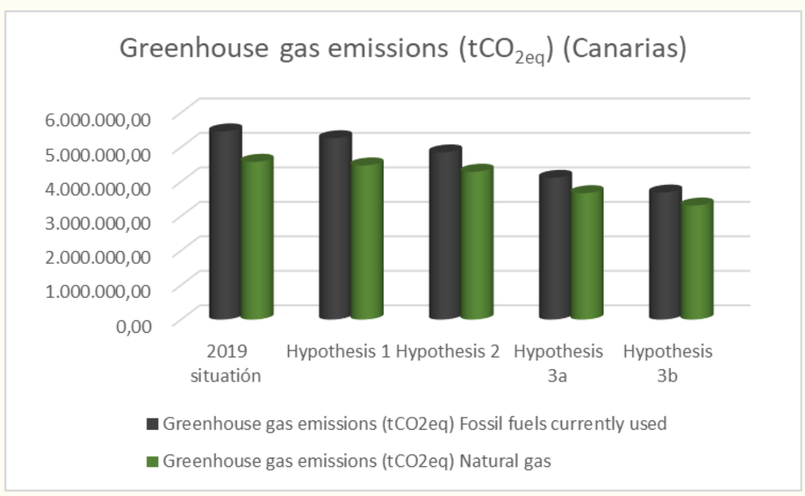
Conclusion

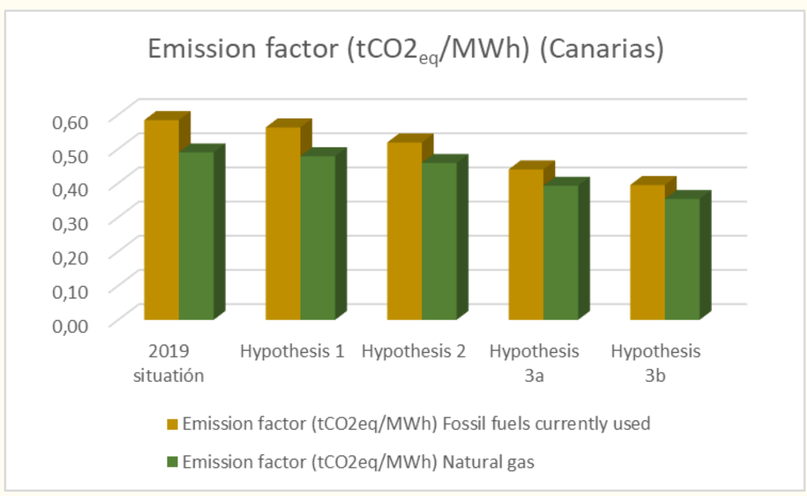
There are several measures that can be taken as a result of the result of this study through the tool proposed to achieve our environmental objective. All these measures to be taken depend in turn on several factors:

Economic factor: The measures to be taken can be very expensive with a satisfactory result or less expensive and also obtain to a lesser degree a satisfactory result. Although not always the investment is directly proportional in a linear way to the result.

Temporal factor: If we take into account this factor we can find several situations ranging from the immediacy of the actions to be taken or the other extreme that is to go to several years of delay in achieving completion of that action, and of course all intermediate situations are also valid.







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