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Must Nuclear Energy be Increased on Brazilian Energy Mix in a Post-COVID-19 World?

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Abstract

This paper aims to discuss the convenience and feasibility of increasing the nuclear energy participation on the Brazilian energy mix, amid a national context of climate change, scarcity of natural resources necessary to baseload energy generation, particularly hydropower, discussions on a possible restart and expansion of Brazilian nuclear program, whilst the population still suffers socioeconomic impacts resulting from COVID-19 pandemic as well as the pre-pandemic economic crisis. The work proposes four analysis axes: environmental factors, economic, safety/legislation and technological aspects, and through bibliographic research in scientific articles published in journals, theses, dissertations, laws, regulations and international recommendations, it was possible, as a result of the research, to draw an overview of a possible future expansion of the Brazilian nuclear program and list advantages and challenges of using the nuclear alternative when compared to other energy sources.

Keywords: Nuclear energy, Brazilian Energy matrix, safety nuclear

1. Introduction

Modern civilization is possible because people have learned how to change energy from one form to another and then use it to work. In this context, energy and energy matrix can be understood as measurable and calculable values, which enable the achievement of the most diverse goals of society, facilitating human work and economic growth, enabling poverty reduction, (L3 eia, 2020; L4 Le, 2019).

The energy that is used on a daily basis to meet energy needs, whether from a country, state, or the world, using the different types of energy sources that we have, in different proportions, depending on the case, form what we call of energy matrix, that is, the set of available sources, to meet the need (demand) of energy in a given situation or location (L1 epe, 2021; L2 La Fondation, 2020), enabling economic development and seeking in the measure of possible this to be a clean and sustainable matrix.

To achieve sustainability, in energy terms, it is necessary that human society currently face the challenge of initiating a major transformation of the energy matrix, due to the possible catastrophic effects of climate change, if not, with little time for an effective implementation [Seneda1].

Alternative clean energy generation technologies, such as solar photovoltaic (PV) and wind, are currently the flagship in the implementation of energy mix changes, both with a growing percentage on the national energy mix on Brazil; however, these alternatives need further development in terms of reducing the effects of intermittency, increasing the capacity factor in order to make them truly attractive for replacing baseload of the national system, which currently relies on hydropower, an alternative highly dependent of climate conditions [Seneda2]. Other challenging aspect of solar PV and wind energies is their supply dependence - solar panels and magnets based on rare earths, from producing countries such as China, the United States, and others, is still a problem to be overcome, in addition to its need for large areas for high energy production needed by cities and agriculture [Seneda3].

With the arrival of the COVID-19 pandemic brought a new context in which the economical crisis, that on one hand reduced the energy demand for industrial and commercial applications, on the other hand resulted on scarcity on global supplies, owing to a myriad of factors such as logistics difficulties, reduced manufacturing capabilities and political issues[Luiz 4].

Amid this challenging context, this paper aims to discuss the convenience and feasibility of increasing the nuclear energy participation on the Brazilian energy mix, considering factors such as climate change, scarcity of natural resources necessary to baseload energy generation, particularly hydropower, discussions on a possible restart and expansion of Brazilian nuclear program, whilst the population still suffers socioeconomic impacts resulting from COVID-19 pandemic as well as the pre-pandemic economic crisis.

2. Methodology

On the aim of answering the question: nuclear energy must be increased in the Brazilian energy mix? The work proposes four analysis axes: environmental factors, economic, safety/legislation and technological aspects, and through bibliographic research in scientific articles published in journals, theses, laws, regulations, and international recommendations. In terms of environmental aspects, the paper provides a discussion in terms of emissions of greenhouse gases of nuclear energy, considering here those established, Uranium-based Generation II and Generation II+, to other energy alternatives, as long as increases the country´s need to achieve the goals of international agreements to reduce CO_2 from burning fossil fuels, forcing a strong National Energy Policy focused on clean sources.

Regarding economical aspects, costs of building, operation and decommissioning are compared, during the life cycle of the different energy sources. In terms of safety and legislation, regulatory regimes are broadly compared, focusing on safety and security requirements.

On technological aspects, special attention is given to an overview on the abundant natural resources that make Brazil one of biggest reserves of U, Th and Li minerals, in addition to knowledge and mastery of the nuclear fuel cycle, considering that its beginning was in the 40s with ORQUIMA's pioneers, passing through the interaction of Universities with several institutes of CNEN, Brazilian Navy, and other industry sectors. On Figure 1 a flowchart of the study is shown:

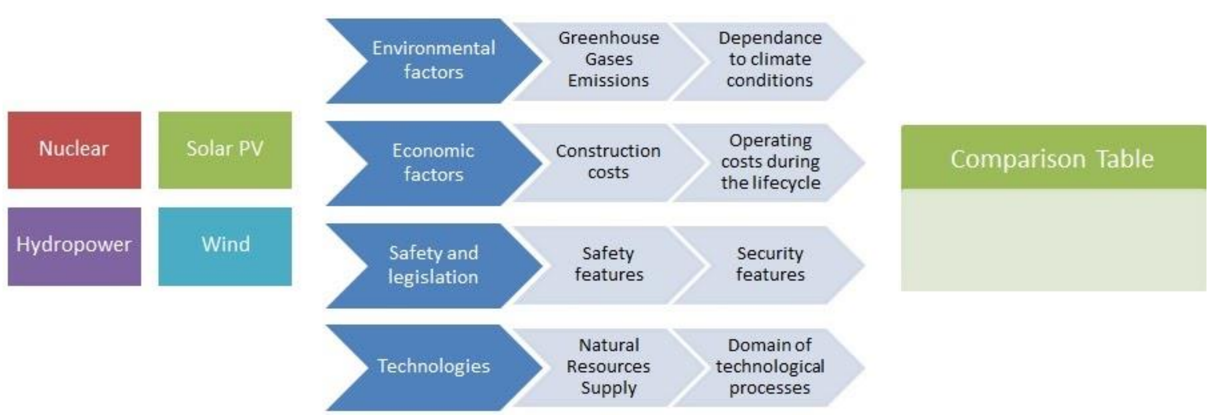

Figure 1. Structure of methodology steps for this study.

4. Conclusions

From the results obtained on the study, it was possible to draw an optimistic overview on the future use of nuclear energy in Brazil. The nation has several unique features (resources, technology, legislation) that make possible a sustentable use of nuclear energy. This alternative should be seriously considered to be increased amid the national energy mix.

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