Environmental impacts caused by solar energy photovoltaics in Brazil

Impactos ambientais causados por energia solar fotovoltaica no Brasil

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ABSTRACT
The main aims of this article is to transmit and discuss information about the importance of correctly handling natural resources, minimizing the impacts caused to the extraction means and installations of solar photovoltaic systems. Studies related to this specific theme were investigated in order to compile information considered relevant for the composition of the research. Thus, crucial repercussions were obtained when it comes to photovoltaic solar energy, so it was possible to conclude that measures such as proper planning and disposal of materials are fundamental to reduce the impacts generated.

**Key words:** environment; environmental impacts; environmental education.

1 INTRODUCTION

Brazil has the fourth largest renewable energy production in the world and the participation of renewable sources in its energy matrix, according to the world Energy and Socio-economic Ranking Bulletin, released annually by the Secretariat for Planning and Development Energy (SPE) of the Ministry of Mines and Energy. However, even though they are sustainable and non-polluting sources, renewable energies cause environmental and socio-environmental impacts (BIZAWU; SOARES, 2018). As a party to this statement, it was necessary to review the literature on the topic, focusing on energy as it grows increasingly in the country, both on off-grid and on-grid systems.

The issue in question is becoming increasingly relevant due to the limitation of natural resources, the increase in tariffs and environmental impacts (JACOBI, 2002). In this way the Brazilian energy scenario has been looking at renewable energies, not only from the environmental point of view, but also on the economic and energy security in Brazil (SAUER, 2013).

In view of the availability and cost of energy directly affecting the population and the competitiveness of companies (TOLMASQUIN, 2007), and that climate change can cause severe environmental events, such as long periods of drought, Intense rainfall and increased global temperature, which puts at risk even survival in several regions of the planet (TEAM AKATU, 2013). In view of this scenario, actions for better use of clean energy forms are indispensable, seeking to promote means of generation with lower emission of pollutants (BORBA; NOVAK, 2018). Considering the commitment to expand the participation of renewable sources in the energy matrix, mainly solar source, the present study aims to present a panorama of solar energy in Brazil, since its...
geographic location provides a potential High, in addition to discussing proposals that could pass the existing obstacles and contribute to the increase in the participation of the source in our energy matrix.

For despite being considered a renewable source, it is not possible to completely eliminate the impacts caused to the environment since the extraction of raw material for the manufacture of photovoltaic cells, even the implantation and operation of a solar power plant. Given this, we will develop a study applied in a way that can be applied, regardless of the region of the country, measures that can mitigate such consequences.

2 MATERIAL AND METHODS

This research was carried out from a bibliographic review of the possible environmental impacts caused by the implantation of a solar energy park, with the main justification that it is necessary to disseminate information to an area until then Little widespread. The lack of information is evidenced by the scarcity of studies addressing the specific topic.

For Mucelin (2008) Physical and biological environmental changes over time modify the landscape and compromise ecosystems. For installations there is a need for extensive temporal and territorial operation, it is necessary to analyze and plan forms of applications that harm less the means of operation over the course of years.

In this way, the search for scientific productions was not restricted only to the final product of the solar plants.

3 RESULTS AND DISCUSSIONS

3.1 IMPACTS ON THE MANUFACTURING STAGE

Before the operation phase of the solar plants is necessary to start the production of solar photovoltaic modules, being these compounds mainly by silicon, which is an electrical semiconductor chemical element. According to Junqueira (2016), it is possible to pay attention to the possibility of generating socio-environmental impacts arising from the processes of silicon extraction and the transformation of metallurgical silicon to solar grade, which are potentially: emission of effects gases (including sulphur hexafluoride) and SO₂ (acid rain), the possibility of contamination of the water used in cooling processes, accident risks and environmental damage due to the use of corrosive chemicals, handling of Explosive substances (silane gas) and toxic gases, toxic waste generation (silicon tetrachloride), and others. Besides, according to Michael; Selvarasan (2017) for the treatment of various components needed in the production of panels, it takes a high energy expenditure and there are high values also when it comes to the emission of CO₂, especially for silicon has estimates
that are needed about 2355 (MJ/m²) of energy for the production of each solar module, in addition to the high release of carbonic gas, approximately 40.6 (kg CO2/m²).

3.2 IMPACTS ON THE INSTALLATION STAGE

In the next stage, the implantation of a solar plant, there is a great degradation of the landscape, considering that it is necessary to change the environment so that the basic needs of work and the insertion of the enterprises in certain regions are remedied. An example of these activities occurs in vegetation areas, where the local green area is removed. Resulting in a possible ecosystem imbalance because it can favor a process of erosion, which are intensified by natural factors such as rain and wind. Besides occupying a large area that would once serve as a natural habitat for wild animals. For this particular case, of the animals, Hernandez et al. (2014) suggests that the use of repatriation and translocation techniques, which as it explains, basically consists in capturing key native species of the impacted habitat and transferring them and released in previously inhabited reserve areas and also not inhabited by the species, respectively. However, not all species have the possibility of being translocated to other areas. Birds suffer greatly from this difficulty, presenting high mortality rates since many of their nests are destroyed even with eggs and puppies, making it difficult to reproduce them.

3.3 IMPACTS ON THE FINAL DESTINATION OF WASTE

Finally, improper disposal of solar modules can generate significant environmental impacts. These devices contain cadmium and lead, which can infiltrate the soil and, consequently, pollute the environment. Photovoltaic modules and other waste electrical and electronic equipment are composed of glass, aluminum, rare earth, brominated flame retardants (BFRs) and other hazardous substances (WIDMER et al., 2005; DIAS et al. 2016).

4. DISCUSSIONS

It is possible to deduce that even though it is considered a renewable source, photovoltaic solar energy somehow attacks the environment in which it is inserted. However, techniques can be employed to reduce the possible impacts that we can encounter when we want to work with this energy source. Therefore, it is necessary to continue boosting and developing researches that encompass not only the socio-economic viability of solar panels, but also their effects on the environment.

However, when talking about solar energy, it is necessary to bear in mind the great capacity that the sun has to supply the global energy demand, since according to Stevovic et al. (2019); Solangi
et al. (2011). The potential of solar energy is enormous: about 885 million of Terawatt-hour (TWh) per year, which reach the surface of the Earth, is 4200 times higher than the global consumption in the year 2035 second estimate of the International Energy Agency (IEA). So, this large capacity makes solar energy continue to be a very strong alternative source in the renewable energy sector.

Moreover, another attractive factor that weighs in its favor by overlapping the impacts caused by production and installation is the low cost of maintenance, convenience for residential facilities, rapid financial return and the ease of obtaining credit for Installation of these systems through funding to encourage energy consumption from renewable sources.

5 CONCLUSION

In order to make photovoltaic solar energy even more sustainable, we propose some mitigation measures, aiming to reduce the impacts caused from the installation phase until the power plant is deactivated.

Thus, the creation of a schedule that decreases the frequency of movement of the soil, avoiding the breakdown of particles that makes it less conducive to erosion would be an option. In addition, in order to make appropriate disposal of the waste generated, such as plates, cables and support structures, it is indicated to refer the materials to suppliers and manufacturers, thus controlling substances that harm the environment.

The operating temperature of the cells will always be greater than the ambient temperature due to the thermal exchange phenomena between the modules, their components and the environment. For this, the creation of a green belt around the plant, at an appropriate distance to not cause shadows in the panels, would facilitate the exchange of heat, balancing the local temperature and making the systems more efficient, besides contributing to the preservation of Local fauna and Flora.

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