

Renewable Energy Sources: An Overview of Clean Alternatives

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ABSTRACT

A study was conducted on renewable energy sources in a global context. The investigation began by addressing the issue of the abundance of these resources worldwide, highlighting their intrinsic importance in the transition from a fossil fuel-dependent energy matrix to a more sustainable and environmentally friendly one. Next, the evolution and notable advancements that these energy sources have experienced in recent years were examined in detail. To illustrate this evolution, a graph was presented that clearly and objectively demonstrates the constant growth of renewable energies over the past five years, signaling significant progress towards a greener and more resilient energy matrix. Finally, the classification of the main renewable energy sources was explored, including solar, wind, geothermal, oceanic, bioenergy, and hydroelectric, highlighting the individual roles they play in reducing greenhouse gas emissions and driving the search for cleaner and more sustainable energy solutions for the future. As a result, this work offers a comprehensive and up-to-date view of the state of renewable energy sources in the global context, highlighting their growing importance in a world increasingly aware of environmental issues and constantly evolving energy needs.

Keywords: Energy Plans; Renewable Energies; Clean Energy Matrix; Energy Transition.

INTRODUCTION

The growing global demand for energy results from various factors, including population growth, economic development, and technological advancement. This leads to a greater utilization of energy resources. To meet this growing demand while simultaneously mitigating environmental impacts, the transition to renewable energies stands out as a natural response.

According to the Renewable Energy Market Update 2023 by the International Energy Agency (IEA), although renewable sources face technological, market, financial, and geopolitical challenges that limit their full development potential, they play a crucial role in diversifying the energy matrix. This is essential to meet the growing energy demand without exacerbating climate change, even if this expansion does not occur in a fully dynamic and rapid manner.

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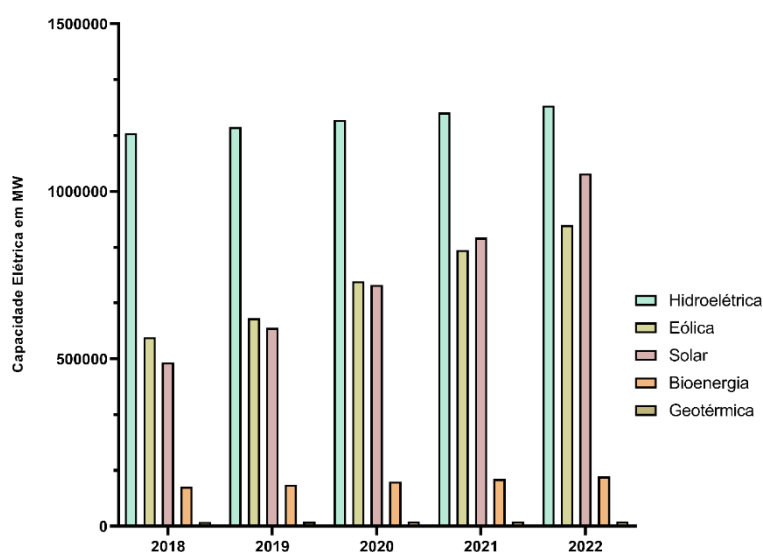
METHODOLOGY

The research was conducted in distinct stages, with the aim of understanding the six main sources of renewable energy. A bibliographic survey was conducted covering articles related to renewable energy sources to understand an overall picture. Next, governmental and non-governmental websites were consulted for the analysis of data related to each source.

Evolution and Advances in Renewable Energy Sources

Among the renewable energy sources that stand out the most, hydroelectric, solar, and wind power dominate the current market, thanks to their long history of use as well as rapid technological advancement (IEA, 2022). The growth of renewables in the last 5 years can be seen in Graph 1.

Graph 1: Increase in Renewable Sources Worldwide in the Last 5 Years



Fonte: [IRENA](#) - adaptado pelo autor

The global energy matrix has approximately 15% of its energy produced from renewable sources, which is still low compared to the final goal, which is a fully renewable energy matrix, aiming to end the increase in global temperature, so that it does not reach 2°C above the ideal temperature.

As an example of the effort to increase the share of renewable energies in the global energy matrix, the NetZero 2050 project can be mentioned, whose goal is to completely eliminate carbon dioxide emissions by the year 2050 (IEA, 2021).

Classification of Renewable Energy Sources

The following classes of renewable energy sources are distinguished: solar, hydro, wind, biomass, oceanic, geothermal.

Solar Energy

The solar energy market is in constant growth, and universities are increasingly directing their research towards solar energy at the expense of other renewable energy sources. The solar industry is progressing steadily, driven by cost reductions and rapid technological advancements. (IEA, 2022; IRENA, 2021; BOGGIAN, RIBEIRO, VITAL, DUTRA AND SILVA, 2022).

Among the available renewable energies, solar energy could definitely be the best option for future demands, as it is superior in terms of availability, cost-effectiveness, accessibility, capacity, and efficiency compared to other sources.

Hydroelectric Energy

Hydropower is currently the main source of renewable energy in the electricity sector. In Norway, for example, about 99% of electricity is generated by hydroelectric plants (IRENA, 2021).

The infrastructure required for hydroelectric power generation can cause negative impacts on ecosystems. For this reason, small-scale hydropower is considered a more ecological option (IRENA, 2021).

Wind Energy

Wind energy is generated by converting the kinetic energy of the wind into electrical energy. This process is carried out through wind turbines, in which the blades are driven by the force of the wind, generating mechanical energy. This energy is then converted into electricity through a transmission system, making it ready for use (IEA, 2022; IRENA, 2021).

The growing concern for sustainability and the need to diversify energy sources have driven global interest in wind energy (IEA, 2022; IRENA, 2021).

Bioenergy

Bioenergy is the term used to describe the energy obtained through the conversion of biomass. This process involves the use of methods and technologies to transform biomass into ready-to-use forms of energy, such as electricity, heat, liquid biofuels (like ethanol), and biogas (IEA BIOENERGY, 2020).

From biomass, a variety of by-products are generated, including vegetable oils and biofuels. Biomass resources available in a renewable manner and used directly as fuel or converted into other forms or energy products are often referred to as "feedstocks." This includes dedicated energy crops, agricultural crop residues, forest residues, algae, wood processing residues, and urban waste (IEA BIOENERGY, 2020).

Oceanic

Ocean energy is obtained through technologies that capture the kinetic and thermal energy of seawater, as well as the energy from waves and tidal currents. Although ocean energy systems are still in the early stages of development, there are already prototypes of devices for harnessing waves and tidal currents in the testing phase (IRENA, 2021).

Geotherma

Geothermal energy is a form of energy that originates from the heat present inside the Earth and is obtained through the utilization of geothermal heat sources, such as geysers, hot springs, and underground vapors (IRENA, 2021). The root of geothermal energy is deeply connected to the internal structure of our planet (IRENA, 2021).

CONCLUSION

In this work, renewable energy sources were explored in a global context. The abundance of these resources, their evolution in recent years, and the classification of the various available sources were discussed. These clean alternatives play a crucial role in the pursuit of a sustainable energy future.

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