

A Conceptual Review on the Applications of Renewable Energy Sources towards Environmental Sustainability

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Abstract

The depletion of non-renewable resources is a pressing global concern, as finite reserves of fossil fuels and minerals face the looming threat of extinction. Overexploitation and increasing global demand for energy and raw materials have accelerated the depletion of non-renewable resources, contributing to environmental degradation and geopolitical tensions. The impending risk of exhaustion raises questions about the sustainability of current consumption patterns and underscores the urgent need for transitioning to renewable alternatives. This study explores renewable energy sources and their applications, emphasizing their sustainability and eco-friendliness compared to fossil fuels, which contribute to environmental pollution and health issues. The paper delves into various types of renewable energy, starting with solar energy, harnessed through photovoltaic cells and passive solar methods. Wind energy, generated by wind turbines, is highlighted for its cost-effectiveness and purity. Geothermal energy, utilizing heat beneath the Earth's surface, and hydro power energy, produced through water flow, is also discussed. Tidal energy, generated from tides without emitting greenhouse gases, is presented as an eco-friendly option. The paper promises an in-depth understanding of applications of renewable energy sources along with their benefits and shortcomings. It highlights the measures taken to mitigate environmental harm and concludes by stressing the role of renewable energy in addressing current environmental challenges.

Keywords: Sustainability, Renewable Energy Sources, Conservation, Environmental Up gradation, Environmental Challenges.

1. Introduction

This research deals with the concept of the renewable energy in general. In the 21st century, it has become a necessity to make more use of the renewable energy sources. The word 'renewable' means 'something that will always exist', indicating the lifetime supply of a particular substance, or form; thereby being sustainable. All the people in the world are well aware of the fact that how fast and uncertain the climatic, economic, social, technological and environmental situations can get. Nobody ever imagined the coming of the Covid-19 pandemic and then we realized that how a single virus can change the whole world, bringing it upside down, and changing the lives of not only the common man, but also the renowned businessmen, and all the people living in this world.

Future is uncertain. Therefore, it is very important to discuss about the necessity of the renewable energy sources and where they can be applied in our daily lives to create a better future for our future generations. Renewable energy is one of the cleanest forms of energy existing on this planet. These energies have enough abilities to be used anywhere at any time because they neither produce the harmful greenhouse gases which are a major reason for the climatic changes, nor they produce any kind of polluting emissions. The biggest advantage to make use of renewable energies is that they do not spread and allow and greenhouse gases when they are in use and generating energy for particular purposes. This prevents the environmental degradation. The fossil fuels present in the world will not always be available, and can never fulfill the long-term goals of the country supplying them. Those countries will only make money after supplying the fossil fuels but cannot justify the usage of fossil fuels because fossil fuels promote environmental degradation and these are unclean forms of energy. Hence, supply of the fossil fuel is not guaranteed forever, thus bringing a question mark to the lives of the future generations. However, on the other hand, renewable energy sources are guaranteed forever because these are the most natural forms of energy available in the world. The Sun, wind, water are some natural things that are already gifted to us by the nature. Therefore, supply of these energies can never be felt short of. Moreover, renewable sources of energy are cheaper than other sources of energy. Even after being so beneficial, the wind and the solar energies are the cheapest sources of energy. Hence, we can say that the renewable sources of energy are not only beneficial environmentally, but also economically because we are also achieving the economies of scale through renewable sources of energy, which is not achieved by other sources of energy. Besides, renewable energy sources can be recycled, or produced as quickly as they are used. Hence, it is now advised to increase the use of renewable (non-conventional) sources of energy and be less dependent of the other sources of energy.

This research is undertaken to spread more knowledge and importance about the non-conventional sources of energy and their applications in our daily lives so as to achieve the objective of sustainable development which has become extremely important in today's world.

2. Literature review

Eleni K. Stigka, John A. Paravantis ,Giouli K. Mihalakakou, The aim of this study was to direct the replacement for fossil fuels in electricity production with the public acceptance of renewable sources of energy. In this paper, the authors analyzed the parameters that influence energy behavior of consumers in particular, along with their respective interests, of what they think about the environmental impact of using fossil fuels to produce energy and if they are willing to reduce it. The authors laid emphasis on the social acceptance of the renewable energy sources, of what they call RES. They further compared the renewable energy for European Union (EU) countries in 2010 and commitments for 2020. They obtained these outcomes like how the concurrent increase in energy demand and the negative impact of fossil fuels on the environment underscores the need for energy production from RES and although renewable energy is spreading, it still represents a small part of the energy mix internationally. The researchers also analyzed that how in the areas experiencing economic difficulties, investments in renewable energy may provide an economic boost. The use of RES provides a good balance between economic, technical and environmental considerations, and contributes to a more sustainable development that will favor future generations.

Ayhan Demirbas, described the potential applications of renewable energy sources to replace fossil fuel combustion as the prime energy sources in various countries, and further discusses problems related to the biomass ignition in boiler power systems. Brief summaries of the basic concepts involved in the combustion of biomass fuels are presented in the paper. He also tells that the renewable energy sources (RES) supply 14% of the total world energy demand. According to him, RES are biomass, hydropower, geothermal, solar, wind and marine energies, and the renewable sources of energy are the primary, domestic and clean or inexhaustible energy resources. He further examines that the biomass combustion systems are non-polluting and offer significant protection of the environment. The reduction of greenhouse gases pollution is the main advantage of utilizing biomass energy.

Raju Bhoyar , Sachin Bharatkar, discussed about the Potential of MicroSources, Renewable Energy sources and Application of Microgrids in Rural areas of Maharashtra State India. They concluded that Rural Electrification Corporation India has been constantly acting towards stimulating the rural areas in Maharashtra. However, rural consumers are yet facing large scarcity of energy due to shortfall in conventional generation. As worldwide research on distributed generation is going on and potential of distributed energy resources have been utilizing with the application of microgrid. An attempt is made to predict the potential of distributed energy resources in Maharashtra India and suggested to use distributed generation with the application of microgrid through the case study.

J.Jurasz, F.A. Canales, A.Kies, M. Guezgouz, A. Beluco, reviewed the complementarities of renewable energy sources which involved the discussion of concept, metrics, application and

future research directions. The authors concluded that there were many geographical areas for which variable renewable sources energetically complementarily has not been evaluated yet (mostly parts of Africa and Asia). The authors discussed that the climatic change will have a major impact on the renewable sources of energy. They emphasized that the research should not only be conducted on the basis of historical or previous datasheets but it is also to be kept in mind that they consider the future value models regarding the renewable sources. According to the authors mentioned, major studies have focused their part on the solar, wind and hydro energies, so it will be great if the focus will be led on the other sources of energy as well such as wave energy, tidal energy, etc. First, they gave the definition of the complementarities concept, then conducted research on complementarities, followed by Quantifying energetic complementarities: indices, metrics and other approaches, correlation, indices and time complementarities index.

Dunn, PD, argued upon the development and conversion of renewable sources of energy. The authors took into consideration renewable energy and its application, renewable energy sources existing in the world, non-conventional energy and its conversion, then discussed in detail about the kHeat engines- which associates with the conversion of heat to mechanical energy and refrigeration. They also mentioned about the internal combustion engine: conversion of chemical to mechanical energy, storage of renewable energy and gave a detailed description about the major applications of some renewable sources of energy which include direct solar energy, biomass conversion, wind energy and hydro power in particular, about where and how they can be used. The objective of this study was to bring into light the renewable sources of energy and then discussing about the applications of some renewable sources of energy. If an emphasis will be given on presenting the real picture of the massive renewable energy potential, it will be possible to attract foreign investments to indicate a Green Energy Revolution in India.

Anil Singh Yadav, J. L. Bhagoria, this research was carried out to present an evaluation about the application of various non-conventional & renewable energy sources. They mainly focused on the applications of the solar energy. Generally, this paper is the study of about six broad types of renewable energy sources, their characteristics, nature, features and typical application namely solar energy, wind energy, bio energy, hydro energy, geothermal energy, wave and tidal energy. The researchers came to a conclusion that the mainstreaming of renewable sources is very crucial. Security of the energy supply, economic growth and environmental protection are the national energy policy drivers of any country of the world. Because of the high prices of crude oil, the need to boost the efforts for further development and promotion of renewable energy sources has been felt world. Promoting consumption, improvement and innovation, and vital investigation in renewable energy technologies, resolving the barriers to development and growth, and commercial utilization and intake of biomass, hydropower, solar and wind technologies, promoting straight (direct) biomass ignition(combustion) and biomass gasification technologies, promoting the development and manufacture of small wind electric generators, and

enhancing the regulatory/tariff systems so as to mainstream renewable energy sources in the national power system are some specific actions required.

Rolf Wustenhagen, Maarten Wolsink, Mary Jean Burer, introduced the unique subject on Social Acceptance of Renewable Energy Innovation. They focused on the social acceptance of the renewable sources of energy. The authors distinguished the social acceptance into three divisions namely community acceptance, socio-political acceptance and market acceptance. Numerous indicators make obvious that social acceptance for non-conventional energy technologies and policies are high in many countries. Many of the barriers for achieving unbeaten projects at the execution level can be taken into consideration as a demonstration of lack of social recognition. Community acceptance refers to the definite acceptance of citing decisions and renewable energy projects by limited stakeholders, predominantly inhabitants and restricted authorities. Market acceptance explains the acceptance of inventive products by consumers through a communication method among individual adopters and their environment. Although energy technologies persist to be bound to infrastructures that make them essentially more complex and difficult for dispersion of innovation than other products, by means of the insights from this writing can be useful to acknowledge market acceptance of technologies like micro cogeneration, solar thermal collectors and other energy technologies on the building level.

Hui-Ming Wee, Wen-Hsiung Yang, Chao Wu Chou, Marivic V. Padilan, This study provides administrative insights to governments, researchers, investigators and stakeholders for the beginning of renewable energy usage, and suggestions for overcoming the hindrances to its growth and development. Due to the exhaustion of conventional energy resources, such as crude oil, coal, and natural gas, many initiatives all over this world have directed the proficient use or substitution of these resources. A large number of non-conventional energy sources have been introduced as alternatives to conventional sources to guard ecological resources and to advance the quality of life. This research takes into consideration renewable energy sources from a supply chain perspective and presents an analysis of renewable energies emphasizing on four main components: renewable energy supply chain, renewable energy performance, and barriers and strategies to its growth and development.

Omar Ellabban, Haitham Abu-Rub, Frede Blaabjerg, presented in their study how renewable energy resources are presently being used, technical and scientific developments to improve their use, their future projection, and their consumption. Conclusions arose that because of the scarcity of inexhaustible and unlimited resources, and environmental problems caused by the emissions, conventional power generation based on fossil fuels are usually considered to be unsustainable (not thinking about future generations) in the long term. As a consequence, many efforts are made universal for introducing more non-conventional energies in the energy mix. Renewable energy resources are modern options for electricity generation and their abilities are vast enough because they can meet the world's energy demand many times over. This paper presents an advanced and detailed present status and future projection of major renewable energy resources, as well as their benefits, growth, investment and deployment.

3. Renewable Energy Sources and Applications

3.1 Renewable energy sources

As we know that renewable energy is generated from natural resources and we can also say that these resources are naturally refilled. These are those energies that can be used without using the accessibility in the future. As we know that know a day, we all use fossil fuels to heat and power our homes and also use fuel on cars. These types of fuels create problems in or environment as we can use the coal, oil, ad natural gas but the supply of these fuels is very less.

There are most popular renewable energy sources:

1. Solar energy

Solar energy is that type of energy that can use the SUN power so that it can generate energy for industries, transportation as well as electricity. This energy is very important source of renewable energy as these energies can be divided into two parts either these energies are active or passive as depending that they how to capture their energy from sun and how they distribute the solar energy so that it will cover into solar power.

Active solar techniques in the solar energy include the use of Photovoltaic systems, concentrated solar power and solar water heating to produce the energy.

Passive solar techniques include the material with favorable thermal mass, providing building to the sun and also designing spaces that naturally circulating the air.

2. Wind energy

Wind energy or wind power is the one of the same things as it also helps to generate the electric generators through wind turbines and also helps to other work like milling or pumping. It is also the one of the renewable source of energy and sustainable also because it does not have much impact on environment compared to burning of fossils fuels.

This is the one of the most cost competitive renewable electricity for the market who needs bulk of power. It is also the one of the well suited to remote and distribution areas.

3. Bio mass energy

Biomass energy is also helps to produce the electricity or heat by the use of plant and animal materials and also there are various industries these processes are used as raw substance for the range of products. The size of the biomass mass sources is quite large at a global scale. It also does not have bad impact on environment as these sources help to reduce the costs of energy produced from biomass. The products which are used for the energy is include wood or forest residue, waste food crops, yard waste, animal farming, some of the energy crops also be grown or human waste from the sewage plants.

4. Geothermal energy

Geothermal energy is that energy which is deviated from the heat present in the surface of the earth. This type of energy should be carried by the water and steam to the earth's surface. It shows that it can be used for the process like heating and cooling of different things and also helps to generate the clean electricity.

We can also capture the geothermal energy by using geothermal power plants, these are those plants which used the heat down to the earth and help to generate the steam to make the electricity and there are also geothermal heat pumps which helps the people to tap the heat close to the earth surface due to which provide heat for buildings.

5. Hydropower energy

The name basically suggest that it is related to water as it also helps to produce electricity when the water flows then the energy is produced which helps to make electricity. This is also known as the hydroelectric or hydropower. There are dams on rivers which help to store water in the reservoir. There are also some hydroelectric power plants which uses a small canal to waterway the river water through a turbine. As sometime the flow of water is more than the water in reservoir should not capable of handling it then the water should be used for other purposes like irrigation, flood control, and also for water supply.

There are also mini hydro facilities which provide opportunities for the remote power generation and also offer the low rate of operating cost and the high reliability. This type of system is very fast and consumes the less time and also provides the local labor which will enhance employment opportunities among people.

6. Tidal energy

Tidal energy is that type of energy which helps to produce electricity by converting the energy from tides into the useful forms of power. This energy is used less but we can say that in future it has more potential to generate large level electricity. We know that these tides are more expected than the sun and the wind.

It is a clean and the renewable energy which do not produce any of greenhouse gases as it only helps to produce the electricity. Tidal energy is only applicable for big and commercial scale projects. We can also say that the tides provide a large amount of energy so that National Renewable Energy Laboratory estimated that it has the potential to provide one-third of the electricity to the United States when it is needed.

These are different types of renewable energy sources which can provide electricity. These all energies make the electricity in their different ways or in their different forms.

3.2 Applications of renewable energy

So there some application of the renewable energy sources which can tell us that how we can use this energy in our life or in daily routine or also we can say that how these types of energy can be utilized by the people.

1. Application of solar energy

- There are many different ways to use the solar energy can be derived in two ways heat and light. There are many products which used the solar energy these types of products are known as solar appliances. Fr example we can say that when we hang our clothes outside to dry out then solar heat helps to dry out our clothes so in this we can use the solar energy in our daily routine works also. We can also study about the photosynthesis in which plants need sunlight to make their own food this also the one of usage of the solar energy.
- Industries are also applied the solar energy as they need power for radio and TV stations and they also used solar energy so that it can supply the power to their lighthouse and also warning the light for aircraft.
- Solar energy also helps in the transportation by providing the lights to the buses and to the light rails.

2. Application of wind energy

- Wind energy helps to run the pumps to draw water from the ground through the wind mills.
- Wind energy also used to push the sailboat in river and seas to transport men and materials from one place to another.
- Wind energy also helps to run the flourmills to grind the grains like wheat and corn converted into the flour.

3. Applications of biomass energy

- In this energy is stored in biomass fuel due to which natural decomposition is mainly avoided.
- We also use biomass energy by using the small stoves for heating and for the cooking purposes in homes whereas there our large power plants which are utilized to produce the electricity.
- In residential area the biomass can be used for cooking in which wood is the material which is commonly used but now a days there are new designs of stove come in which the amount of fuel which is needed is very less.
- There are many industries and businesses uses biomass for many of different purposes like electricity generating, hot water heating and space heating.

4. Applications of geothermal energy

- In these two main applications are there
 1. Heat Production
 2. Power Production
- Geothermal is also the one of the applications used for cooling, heating and also producing the hot water.
- In geothermal energy heat production helps to warm the water for mining in the cold weather and also help in fish farming.
- Power production produce steam which helps to dry farm products like food canning in the geothermal energy.
- Power production helps to evaporate the sugar refining and distillation of fresh water.

5. Application of hydropower energy

- As we know when water falls on the turbine it rotates and produces electricity.
- This type of energy helps in various productions of many materials goods which include paper, textiles, and other many metal products.
- Hydropower plants also provide the power to the textile industry.
- It also prepares fiber for spinning and also helps to operate the different thing at the same time.

6. Application of tidal energy

- Tidal energy is used to crush grains because of these energy turbines which result in this process.
- Tidal energy is also store energy as there are many hydro electronic dams which have very large capacity to store the energy.
- Tidal barrages also provide protection to the areas which are near to seas in high storms as it also provides an easy way of transportation method.

These are the some applications of renewable sources of energy as this shows that it should provide many use or many ways that it should be applied by the people and these types of resources can help our industries in different way .The method of providing electricity is different in every sources of energy.

4. Conclusion

So after this huge research which has been discussed in above paper we conclude from that how renewable source of energy is generated how it is helpful for our environment and we all should prefer renewable source of energy instead of the fossil fuels. These types of energies can be used anywhere as they are the cleanest form of energy and they neither produce greenhouse gases. They protect the environment from getting degrade they are the guaranteed source of energy, as they all are natural like sun, wind, water, heat, etc so the supply of this energies never felt be short. And the best thing about this energy is that they can be recycled there are so many types of renewable source of energy, solar energy is one of them with the help of sun we can generate electricity for different industry units, business, transportations. And further this energy is divided into two that is active and passive in active we get to know the use of photovoltaic system and in passive include material like thermal mass. New solar panels should be activated so that electricity can be produced and each and every house should be light up. Next, we came on wind energy is the most competitive renewable source for the market it also help in producing electricity. It is suited for remote and distribution areas. Wind energy help to run the pumps to draw the water with the help of wind mills. It is helpful for grinding grains as well in flourmill. The product which are used in generating biomass energy are wood or forest residual, waste of crops, human waste so all the above is natural so it is not harmful for environment. Biomass energy is most common in villages as it is used for heating up the stoves for cooking and many industry uses biomass energy for generating electricity, heating, space heating etc. With the help of geothermal energy electricity can be produced and also used in the process like heating and cooling of different things. It also helps to evaporate the sugar refining and distillation of fresh water. The heat produced by geothermal help in warming up the water, dry the farms, help in mining. Hydro energy from its name it is very clear with help of water which energy is created so hydro power plants should be set up as it help to textiles industry as well and important industries like paper ,and metal. Last but not the least tidal energy that is used in crushing grains it also store the energy and provide protection to the areas which are near to seas. So from the above research we get to know how much renewable resources are important and helpful for our environment as now days our environment is getting polluted that it will become difficult to get fresh air in few time so it is our duty to use that types of product or that types of energy which can be recycled and that is eco friendly we owe this motherland from our ancestors so it is our duty to give beautiful , green earth to our future generation .and we should try not to waste natural resources and teach other as well how to do the best use of the resources. If this resources will not be left on the earth so what will we do, our survival will be difficult so it is our responsibilities to inbuilt the habit of saving water, electricity, money in children.

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