Renewable Energy Sources – A Review

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RENEWABLE ENERGY SOURCES – A REVIEW

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The development of technology combined with the surge in population has led to a new era of living that has increased energy demand. Fossil fuel has been the main energy source for so many years, but it is no longer sustainable with its depletion and negative consequences. A need has arisen for a replacement resource to replace the depleting fossil fuels using right now. This need is what pushes us towards renewable energy. An examination of renewable energy sources: their uses, potentials, and limitations, as well as their effects on the climate and human health, is presented in this work. As final recommendations, the paper outlines policies and strategies to address climate change and fully integrate renewables as a sustainable energy source.

Introduction

Our lives are now almost entirely powered by energy or controlled by energy. The energy demand has increased tremendously over the years because of the increasing population. A prediction states that by 2050, the global population will reach nine billion. According to the US Energy Informative Administration (EIA), energy consumption is expected to surge by nearly half between 2018 and 2050.
For the past several decades, fossil fuels have been the dominant source of energy. They have played a significant role in every sector of modern society, generating about 80% of the energy worldwide. However, its negative impact on the environment is also not a secret. Fossil fuel sources are the primary source of greenhouse gases, causing global warming and climate change. According to EPA (Environmental Protection Agency), 65% of total greenhouse gas is carbon dioxide (CO2) emission that comes from fossil fuels. Among the key factors in reducing our dependence on fossil fuels in recent years is renewable energy. Shortly, renewable energy sources will grow rapidly and will potentially become the primary source of energy, reducing over-dependence on fossil fuel.

Renewable Energy Sources

Renewable energy means collecting energy from natural resources that are replenished over time, like sunlight, wind, tides, waves, etc. Fossil fuels, on the other hand, are being used far faster than they are being replenished. While the majority of renewable energy is considered sustainable, there are some that are not, for instance some biomass.

Renewable energy sources are all types of sources of energy which can be continuously replenished, are renewable, and never run out. In industry, households, transportation, etc., they are used to generate electricity.

Advantages and disadvantages

The advantages of renewable energy are numerous. The environment is subsequently less affected by greenhouse gases due to renewable energy having zero carbon emissions. Equipment requires little maintenance. Renewable sources are widespread throughout the globe, so they are considered more reliable as a source of energy than fossil fuels. Greenhouse gas emissions are lessened by using renewable energy. They also improve economy by generating jobs and stabilizing energy prices.

In addition to their major advantages, renewable energy sources also have some disadvantages. The initial setup costs are very high. High storage costs pose a problem for storing energy. Renewable energy is dependent on weather conditions that may be unpredictable, causing energy shortages. There is a need for a large area for installing renewable energy technologies.It is recommended that renewable energy sources take the place of fossil fuels despite a few minor obstacles that must be overcome in order to address the world's energy demand and replace it with cleaner energy sources.

Solar Energy

A solar power system is one that converts the energy of the sun into thermal or electrical energy. Solar energy is the most abundant and cleanest form of renewable energy. This energy can be harnessed by solar technologies to generate electricity, light, and heat water for various commercial and domestic uses.

There are three main ways to harness solar energy

1. Photovoltaics: With photovoltaics, sunlight is directly converted into electricity through an electronic device known as a solar panel, which can be used for a diverse range of purposes.
2. Solar heating and cooling (SHC): SHC uses the sun's heat to heat water or space.
3. Solar concentrator power (CSP): CSP utilizes the heat generated by the sun in order to power traditional electricity generating turbines.

Solar energy is able to produce and supply an endless supply of energy that can last for thousands of years, eliminating fossil fuel use permanently. It is estimated that the sun can provide more energy than 7500 times the planet's energy needs. Despite all of the benefits of solar energy, it has a limited contribution toward meeting global energy demands because of high installation and storage costs, land use problems, and weather issues.

Wind Energy

Wind energy is the use of wind to provide electric power using a wind turbine to turn generators. Wind power is an increasingly popular sustainable, renewable energy source that impacts environment much less than burning fossil fuels and other types of renewable sources.

With its low carbon footprint and no greenhouse gases emission (GHG), wind energy is among the cleanest forms of energy. Because wind blows everywhere, wind energy is a safe and reliable form of energy.

There are some downsides of wind energy such as direct or indirect impact on wildlife especially migratory birds, noise in the surrounding area and disturbance in telecommunication signals etc.

Bioenergy

Bioenergy refers to electricity and gas that is generated from organic matter, known as biomass. This can be anything from plant and timber to agriculture and food waste and even sewage. Bioenergy includes the production of fuel from organic matter as well. Energy from biomass can be used for electricity, heating, and transportation, and can be replenished anywhere. Around seventy-five percent of the world's renewable energy is composed of biomass energy due to its potential and wide use [7]. Also, it is carbon-neutral, meaning that it adds no net carbon dioxide to the atmosphere. In addition, it reduces the level of trash in the ground by as much as 90 percent by burning solid waste. Biomass fuels, on the other hand, are not completely clean and can also cause deforestation. They are also less efficient than fossil fuels. But proper management and planning of its disadvantages will improve its potential.

Geothermal Energy

Geothermal energy is a form of renewable energy derived from the earth's core. Radioactive decay and heat generated during planet formation account for the origin of this energy. Earth's core contains rocks and fluids that store thermal energy. It is a reliable, sustainable, and cost-effective source of energy. It is also environmentally friendly with a huge potential to generate electricity. Geothermal energy's main disadvantages are its initial cost and release of greenhouse gases during energy production. In addition, it is location-restricted, which makes investors think twice.

Hydropower

Hydropower, or water power, is generated by falling or rapidly moving water. With dams or without dams, hydropower plants fall into two categories. Using hydropower plants with dams, a large amount of water can be stored that can generate a large amount of power. Hydropower plants without dams produce little power and are the ideal means for harvesting power from water. Hydropower is a clean and non-polluting source of energy. It operates at a low maintenance cost. It has a 90 percent conversion rate, making hydropower one of the most efficient sources of energy.Hydroelectricity has a number of disadvantages, including damaging aquatic habitats, emitting carbon and methane, having a high initial cost, and causing floods due to sudden releases of water.

Climate change and renewable energy sources

Since the beginning of the decade, climate change has been a hot topic. Continually rising temperatures have prompted many leaders, governments, and other

organizations to be concerned about climate change. This climate change is caused by the exploitation of the environment to fulfill global energy needs. A significant source of climate change is fossil fuels, which produce a high amount of greenhouse gas emissions. Thus, fossil fuel use must be reduced, which can be accomplished by using renewable energy sources. In most cases, there is almost no waste or greenhouse gas emissions generated by the production of energy from renewable sources. Unlike traditional energy sources, renewable energy sources do not operate out of resources over time. In fact, renewable energy sources can provide more energy than the world needs to meet its energy demands. Since climate and renewable energy sources are interconnected, climate change impacts these sources as well. For example, climate change positively impacts hydropower and negatively impacts biomass and bioenergy.

Human health and renewable energy sources

Several studies have shown that the combustion of fossil fuels causes serious health issues through emissions of CO2, particulate matter, and other pollutants. The reason for this is specifically air pollution, which can result in respiratory diseases. The World Health Organization estimates that 7 million people die from air pollution every year due to the damage it causes to respiratory organs. By switching to renewable energy sources from fossil fuels, human health will be improved since each renewable energy source reduces the emission of greenhouse gases and other harmful pollutants, which in turn improves the air quality and benefits human health.

Renewable energy

Globally in 2015 and 2016, humans consumed 19.3% of the world's energy and generated 24.5% of its electricity according to REN21. Among these sources of energy, 8.9% come from biomass, 4.2% from heat energy (modern biomass, geothermal and solar heat), 3.9% come from hydroelectricity, and 2.2% come from other forms of energy generation. Worldwide, renewable energy investments in 2017 totaled US$279.8 billion, with China representing 45% and the United States and Europe each accounting for approximately 15%. There were approximately 10.5 million jobs associated with the renewable energy industries. The cost and efficiency of renewable energy systems are rapidly increasing, and their share of total energy consumption is rising too. About two-thirds of the world's new power generation capacity was renewable as of 2019. The increase in coal and oil consumption is expected to end by 2022. In most countries, solar photovoltaics and onshore wind are the cheapest means of generating electricity besides coal.

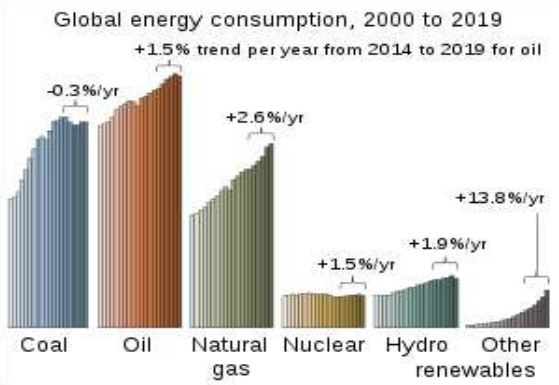

Figure 1. Global energy consumption from 2000 to 2019

Currently, renewables contribute over 20 percent of the national energy consumption of at least 30 nations around the world. There is strong speculation that the domestic market for renewable energy will continue to grow strongly over the next decade. Iceland and Norway are among the countries that generate all of their electricity using renewable sources already, and many others have set a goal to become 100% renewable by 2050. At least 47 countries already produce more than 50% of their electricity through renewable sources. In contrast with fossil fuels, renewable energy resources are widespread. Energy security, climate change mitigation, and economic benefits are the results of the rapid deployment of renewable energy and energy efficiency technologies.

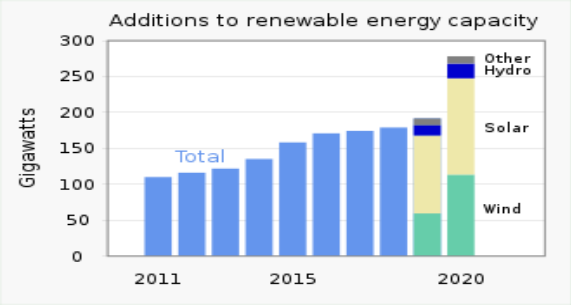

Figure 2. Increase in Renewable energy capacity by 2020

Renewable technologies tend to be large-scale, but they can also be applied to rural regions and developing countries, where energy is often vital. Most renewable energy technologies generate electricity, so renewable energy deployment often involves further electrification, which is highly efficient and provides a variety of benefits, including the ability to convert electricity into heat or mechanical energy with high efficiency. Furthermore, the electrification of homes with renewable energy represents an opportunity to significantly reduce primary energy usage.

Developing renewable technologies

The world's population is growing, increasing the energy demand. However, with the continuous depletion of fossil fuels, new sources of energy have to be found in addition to renewable energy sources already available. Research in this area is developing and ongoing. Cellulosic ethanol, hot-dry-rock geothermal power, and marine energy are among the renewable energy sources in development. The environmental

impact and potential of these sources are still being studied. Though they have great potential, nevertheless, they require thoughtful research, development, and funding.

Future projections

Renewable energy technologies are becoming more affordable as a result of technological advancement, market demand, and competition. It is expected that in upcoming years the cost of renewable energy technology will be nearly equal to the fossil fuel and two-third of the global energy demand is fulfilled by renewable energy sources. According to a report by Bloomberg New Energy Finance, by 2050 about 50% of the global energy demand is fulfilled through solar and wind energy while fossil fuels use will be reduced 11%.

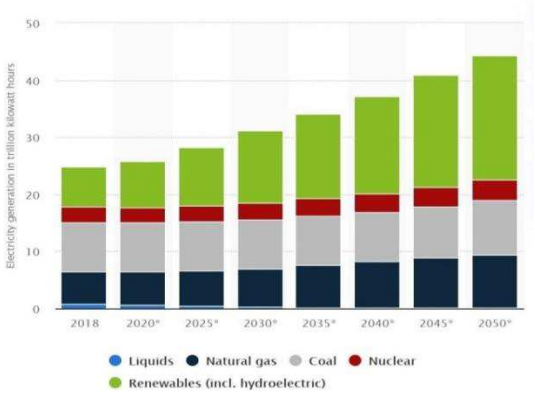

Figure 3. Projection of various renewable energy sources growth by 2050

The reduction in price of renewable energy will also affect the cost of electricity generated from renewable resources. Energy from renewable sources will sooner or later become the most cost-effective method of generating power. Aside from power generation, renewable energy also reduces air pollution-related deaths, as well as greenhouse gas emissions, which will directly address global warming.

Suggestions

1. Governments and policymakers are required to strive for the integration and growth of renewable energy sources within the total energy supply and demand.

2. Fossil fuels still dominate the energy sector, so the government should focus there and build energy-efficient strategies that should be undertaken in these sectors to control greenhouse gases.

3. Lowering the cost of initial setup and increasing storage capacity are some steps to increase renewable energy sources usage worldwide.

4. It is vital that both individuals and countries become more aware of climate change and energy sources in order to utilize them properly

5. Countries with proper resources should help other countries who are lacking behind in the research and development of renewable energy sources.

Conclusion

Fossil fuels are depleting gradually and negatively impacting the environment. Switching to renewable energy sources is necessary to limit their negative impact. These are the energy sources that do not deplete with time and provide nearly unlimited energy. A variety of RES are available, including solar, wind, hydropower, geothermal, and bioenergy. Renewable energy sources have numerous advantages such as reducing air pollution, stabilizing energy requirements, and reducing greenhouse gas emissions. In terms of disadvantages, the weather dependency and initial cost are their biggest obstacles. Transition to RES from fossil fuels has a positive impact on the climate. Additionally, it has positive effects on human health and economics. According to the REN 21 report, renewable energy accounted for 19.3% of energy consumption in 2017, and biomass contributed 8.9%. Renewable energy is consistently growing, and, by 2050, it is expected that two-thirds of global energy production will be derived from renewable sources. In spite of all this, RES have increased CO2 emissions in recent years.
In summary, it is just as important for energy production to save and control energy requirements at the same time.

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