

# TOWARDS A CLEANER AND GREENER WORLD: THE CASE FOR SUSTAINABLE RENEWABLE ENERGY

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## ABSTRACT

*The world needs a lot of energy to keep up with our growing population and the need for economic development. However, using fossil fuels harms the environment and contributes to climate change. Using renewable energy sources like wind, solar, and hydro power can help solve this problem. Renewable energy is sustainable and can meet the needs of future generations. It can also create jobs and help communities grow. However, there are challenges to using renewable energy, like not having enough information or resources, and creating too much waste. To overcome these challenges, we need better policies and more education about renewable energy. So, this paper is focusing more about renewable energy & its use.*

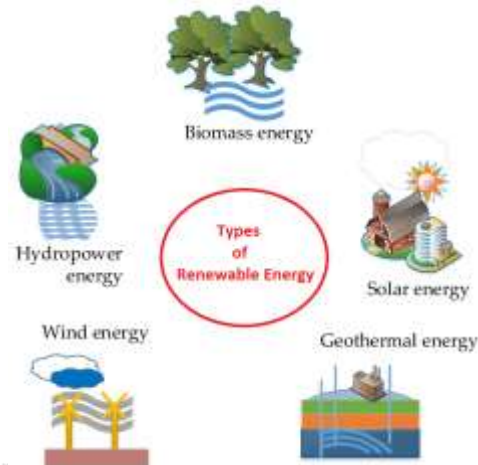
**Keyword** - *Renewable energy, fossil fuel, green house gas, solar energy, sustainability*

## 1. INTRODUCTION

Renewable energy refers to energy derived from natural sources that can be replenished continuously, such as solar radiation, wind, hydropower, geothermal energy, and biomass. The utilization of renewable energy sources is considered environmentally sustainable since they do not produce as much pollution and greenhouse gas emissions as non-renewable energy sources like fossil fuels. Renewable energy has gained increasing significance in recent times due to its wide availability and potential for long term cost-effectiveness.

## 2. RENEWABLE ENERGY SOURCES

The use of renewable energy is important for mitigating the effects of climate change caused by the release of greenhouse gases into the atmosphere through burning fossil fuels. Renewable energy sources do not emit greenhouse gases and, thus, do not contribute to climate change. For example, solar energy systems convert sunlight into electricity without releasing any harmful pollutants into the atmosphere. The adoption of renewable energy technologies is, therefore, crucial for reducing the impact of climate change, including extreme weather events and rising sea levels.



**Fig -1** Renewable Energy Sources

Wind turbines produce electricity by utilizing wind energy, which is a clean and ample resource. Hydroelectric power utilizes the movements of water to generate electricity, whereas geothermal energy utilizes heat from the earth's core. As technology advances and economies of scale are realized, renewable energy is becoming more cost-effective.

### 3. BENEFITS OF RENEWABLE ENERGY

Renewable energy has advantages but faces challenges. Wind and solar power, for example, rely on weather conditions and may not always be accessible, which complicates their integration into existing energy systems. Additionally, constructing the required infrastructure for generating and distributing renewable energy can be expensive.

Some of the benefits of using renewable energy are:

#### 3.1 Reduced greenhouse gas emissions:

Renewable energy is a more environmentally friendly option compared to coal and oil because it does not emit harmful greenhouse gases that contribute to climate change. Renewable sources produce either no or minimal amounts of these gases.

#### 3.2 Reduced air pollution:

Renewable energy sources, such as wind and solar power, are better for the environment than non-renewable sources like coal and oil. Burning coal and oil creates harmful pollutants, like sulphur dioxide and nitrogen oxide, which can make people sick with asthma and lung cancer. Renewable sources don't produce any air pollution, so they are a cleaner and healthier choice.

#### 3.3 Energy security:

Renewable energy is a safer option than non-renewable energy as it is more abundant and less likely to deplete. Dependency on non-renewable energy sources, such as oil and gas, can lead to supply issues and price increases due to geopolitical tensions. On the other hand, renewable energy sources, such as wind and solar power, are available universally and do not depend on location or external factors.

#### 3.4 Job creation:

Renewable energy is a form of energy sourced from natural resources such as the sun, wind, and water, which is eco-friendly and does not lead to pollution. Its usage has the potential to generate employment opportunities and stimulate economic growth. As of 2019, renewable energy employed approximately 11.5 million individuals worldwide.

#### 3.5 Cost-effectiveness:

Renewable energy, like solar and wind power, is becoming cheaper and more popular compared to non-renewable energy, like oil and coal. This is because technology is getting better and it's becoming cheaper to make more

renewable energy. So, governments, businesses, and people are starting to use more renewable energy instead of non-renewable energy.

### 3.5 Improved public health:

Using renewable energy instead of fossil fuels can be good for people's health. Breathing in polluted air from burning fossil fuels can cause respiratory diseases. So, by using renewable energy sources, we can reduce air pollution and make people healthier.

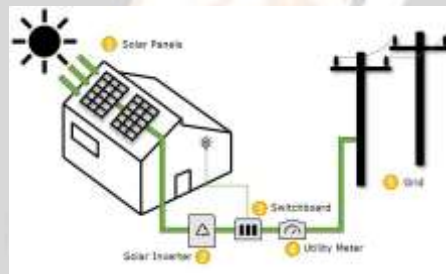
Overall, Renewable energy is a good thing for us to use because it helps the environment and makes our future more sustainable. More and more people and groups, like governments and businesses, are starting to use renewable energy to help reduce pollution and protect our planet.

## 4. RENEWABLE ENERGY AREAS

The future for clean energy looks good, as many countries are promising to switch to renewable energy sources. There are some important areas where we can expect renewable energy to grow as follow:

### 4.1 Solar Energy:

Solar power is becoming more popular as a source of renewable energy because it's getting cheaper and better. This means more people are using solar power for their homes, businesses, and even governments. Solar panels and batteries are improving, which makes it easier and more efficient to use solar power.



**Fig -2** Solar Energy

### 4.2 Wind Energy:

Wind energy is a type of renewable energy that is becoming more popular. It uses wind turbines to generate electricity. As technology improves, it's becoming cheaper to build wind farms. This means we'll likely see more wind energy projects being developed worldwide.



**Fig-3** Wind Energy

### 4.3 Energy Storage:

As we move towards using more renewable energy like wind and solar, it's becoming important to find ways to store the energy they produce. This is where energy storage systems come in - they help us store the energy produced by

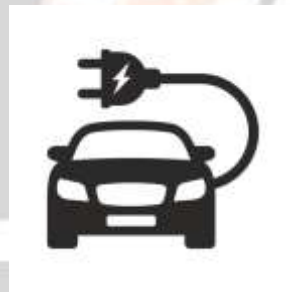
renewable sources when it's not needed right away, so we can use it later when we need it. Battery technology is getting better and better, which means we can store more and more energy in them.



**Fig-4** Energy Storage

**4.4 Electric Vehicles:**

More and more people are using electric cars, and they need clean energy to power them up. So, we might see more charging stations for electric cars that get their energy from things like the sun and wind.



**Fig-5** E-Vehicle

**4.5 Hydrogen Fuel Cells:**

Hydrogen fuel cells are an environmentally friendly energy source that is currently being developed. As the technology improves and becomes more affordable, we can expect to see an increase in projects utilizing this type of energy.



**Fig-6** Hydrogen Fuel Cell

**4.6 Bio Energy:**

The field of bio energy is expected to grow in the future, which involves generating energy from plant-based materials such as crops, trees, and other organic waste. This energy can be utilized to power homes, devices, and vehicles.

## 5. GLOBAL SCENARIO

There are different ways we can create energy that don't harm the environment and can be used over and over again. These are called renewable energies, and they come from things like the sun, wind, and water. Renewable energy is becoming more popular, and in 2017, it provided 8% of the world's electricity[2]. In Europe, renewable energy now makes up one-third of the total amount of energy used. In countries like China, the United States, India, and Japan, renewable energy makes up one-quarter to one-sixth of the energy used in their electricity grids.

Let's learn more about them below.

### 5.1 Solar Energy:

This type of renewable energy comes directly from the capture of solar radiation. Here, the solar radiation is absorbed by specific sensors and rebroadcasted following 2 possible operation modes:

- a. Capturing sun rays and directly converting them into energy through photovoltaic solar panels;
- b. Capturing, collecting and turning the sunlight into heat that warms up water or air.

#### 5.1.1 Examples of Solar Energy in the World:

It's estimated that in 2017, 6% of the worldwide generated energy came from solar sources. At the same time, solar power also contributed to 20% of the total energy growth in this same year[2]. Some of the most known sources of solar energy are:

- ✓ The Kurnool Ultra Solar Park in India. It has a total generation capacity of 1000MW and over 4 million solar panels installed.
- ✓ The Longyan Xia Solar Park in China that has a total capacity of 850MW and covers around 25sq km.
- ✓ The Kamuthi Solar Facility in India: it has a total capacity of 648MW and covers 10sq km.

### 5.2 Wind Energy:

Wind power is a type of renewable energy that harnesses the kinetic energy of wind to create mechanical movement, which is then transformed into electricity by a generator. It accounted for 4.4% of global power generation in 2017.

#### 5.2.1 Examples of Wind Power in the World

Some of the most known sources of wind power energy are:

- ✓ The Gansu Wind Farm in China. It is still under construction and it will be able to produce 20,000MW of power by 2020;
- ✓ The onshore Muppandal Wind Farm in India with a capacity of 1,500MW and over 3000 turbines;
- ✓ The Alta Wind Energy Center in the U.S. with a total capacity of 1,548MW that's expected to reach 3,000MW by 2040;
- ✓ The Walney Extension in the UK. It has a total capacity of 659MW and it's the world's largest offshore farm[2].

### 5.3 Hydro-Electric Power:

Hydro-electric power is generated by using turbines to transfigure the kinetic energy of water from different sources into mechanical energy.

### 5.4 Biomass:

Biomass is organic material from shops or creatures that contains stored energy, which can be converted into renewable energy through processes similar as direct combustion, biogas product, and biofuel creation using crops like sugar or sludge. In 2017, global biofuel product increased by 3.5%.

#### 5.4.1 Examples of generating energy from Biomass are:

Some of the most known biomass power plants in the world are:



- ✓ The Iron Bridge power station in the UK, which has a capacity of 740MW and uses wood pellets as the primary fuel.
- ✓ The Alholmens kraft power station in Finland has a 260MW energy generation capacity.
- ✓ The Polaniec power plant in Poland uses agricultural by-products and wood residues and has a 205MW capacity.

### 5.5 Geothermal Power:

The Earth generates and stores geothermal energy. In other words, radioactive materials decaying inside the Earth are emitting energy. Electricity can be created using directly or indirectly this energy, depending on the technology implemented. There are 3 main ways to use geothermal energy:

- a. Generating electricity directly from the Earth's heat;
- b. Producing heat directly from hot water boiling on the planet's surface;
- c. Using pumps over the shallow ground to heat (and also to cool) buildings.

#### 5.5.1 Examples of Geothermal Energy in the World

- ✓ The Darajat Power Station in Indonesia has 3 plants with a total capacity of 259MW.
- ✓ The Malitbog Geothermal Power Station in the Philippines has a capacity of 232MW.
- ✓ The Hellisheidi Geothermal Power Station in Iceland has a capacity of 400MW of thermal energy.

## 6. CONCLUSIONS

Energy is necessary for our daily lives to grow and be productive. However, using non-renewable energy sources harms the environment and affects our future. To solve this problem, we need to use renewable energy sources that are sustainable and help reduce climate change. This study aimed to see if renewable energy sources are sustainable and how switching from non-renewable sources to renewable ones can help reduce the impact of climate change. We conducted a research by analyzing papers related to this topic.

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