RTET- 2K26", National Conference (June-2026)
Organized by Department of General Sciences and Engineering, AITRC Vita

International Journal of Science, Engineering and Technology
ISSN: 2348-4098, P-ISSN: 2395-4752

A Review Paper on Renewable Energy Sources

Prof.H.S Bhore[1] , Mr. Yashraj Sapkal[2], Mr. Chaitanya Sapkal[3], Mr. Aditya Shinde[4] , Mr.Harshavardhan Shinde[5], Ms. Vaishnavi Suryawanshi[6], Mr. Mayur Yadav[7], Ms. Payal Yadav[8], Ms. Amruta Shinde[9]

[1]Assistant Professor, General Sciences and Engineering, AITRC, Vita.
[2-9]Students, General Sciences and Engineering, AITRC, Vita.

Abstract- This paper reviews the importance of renewable energy sources in achieving sustainable development and reducing environmental problems. Renewable energy, such as solar, wind, hydropower, biomass, and geothermal energy, is derived from natural resources that are continuously replenished. Unlike fossil fuels, these sources are clean, eco-friendly, and help in reducing greenhouse gas emissions and climate change. The increasing global energy demand, along with the depletion of conventional energy sources, has made the transition to renewable energy essential. The paper discusses various types of renewable energy and their applications in power generation, buildings, and rural development. It also highlights the role of smart grids and energy storage systems in improving efficiency and reliability. Despite advantages like environmental protection and energy security, challenges such as high initial costs, intermittency, and technological limitations still exist. However, continuous advancements in technology and supportive government policies are making renewable energy more accessible and cost-effective. Overall, renewable energy plays a crucial role in ensuring a clean, secure, and sustainable energy future.

Keywords: Renewable Energy Sources (Solar, Wind, Hydropower, Biomass, Geothermal), Sustainable Development, Climate Change, Mitigation Energy Security, Fossil Fuel Depletion, Smart Grid Technology.

I.INTRODUCTION

The global energy landscape is currently undergoing a transformative shift as the rapid depletion of fossil fuels and the escalating threats of climate change necessitate a move toward sustainable alternatives. Traditional energy sources, including coal, oil, and natural gas, have historically driven industrial growth but are now responsible for significant environmental degradation, such as air pollution, acid rain, and global warming. As the world population and industrial sectors continue to expand, the demand for reliable energy is rising rapidly, making the reliance on limited and harmful fossil fuels increasingly untenable.

2. Renewable energy sources—derived from naturally replenished processes like sunlight, wind, water, biomass, and geothermal heat—offer a clean and inexhaustible solution to these challenges. Unlike fossil fuels, these sources produce little to no greenhouse gas emissions, significantly improving air and water quality while protecting public health. Furthermore, renewable energy enhances energy security by reducing dependence on imported fuels and stabilizing energy prices, as these natural resources are not subject to the same market fluctuations as traditional commodities.

3. While the transition to a renewable-based system faces hurdles—such as high initial installation costs, intermittency issues, and the need for advanced energy storage and smart grid integration—continuous technological advancements are making these systems more efficient and cost-effective. Governments

International Journal of Science, Engineering and Technology
ISSN: 2348-4098, P-ISSN: 2395-4752

worldwide are increasingly supporting this transition through strategic policies, investments, and global cooperation. Ultimately, the integration of renewable energy is not merely an environmental choice but a fundamental necessity for ensuring sustainable development, protecting natural resources for future generations, and building a secure, clean, and prosperous global future.

II. RELATED WORK

Renewable energy plays a major role in sustainable development. Today, the world is facing many problems like pollution, climate change, and shortage of natural resources. To solve these problems, we need cleaner and better energy sources. Renewable energy includes solar energy, wind energy, water (hydropower), biomass, and geothermal energy. These sources are naturally available and do not get finished, so they are very useful for long-term use.

In the past, most of the energy was produced using fossil fuels like coal, oil, and gas. But these fuels are limited and also harmful to the environment. Their use causes problems like air pollution, acid rain, ozone layer damage, and global warming. As the population and industries are growing, the demand for energy is also increasing. So, depending only on fossil fuels is not a good option anymore.

Sustainable development means using resources in such a way that future generations can also use them. Renewable energy helps in this because it is clean and reduces pollution. For example, solar and wind energy do not produce harmful gases, so they help in controlling climate change.

The paper also explains different environmental problems caused by human activities like industries, transport, and overuse of energy. These include air pollution, water pollution, waste problems, and climate change. Renewable energy can reduce these problems because it is eco-friendly.

Another important point is energy efficiency. This means using energy in a smart way so that less energy is wasted. energy systems can also be used locally, which means energy can be produced near the place where it is needed. This is helpful for rural and remote areas.

Technology has improved a lot, and now renewable energy is becoming cheaper and more efficient. The cost of solar and wind energy has reduced, so more people and countries are using them. Governments are also supporting renewable energy through policies and investments.

However, there are still some challenges like high starting cost, dependence on weather (sunlight and wind), and need for energy storage. But with continuous research and development, these problems are slowly being solved.

In conclusion, renewable energy is very important for our future. It helps protect the environment, provides long-term energy, and supports economic growth. Moving towards renewable energy is necessary to create a clean, safe, and sustainable world.

The research paper explains how renewable energy sources are becoming very important for the future because traditional energy sources like coal, oil, and natural gas are limited and cause pollution. As energy demand is increasing worldwide, there is a strong need to shift toward cleaner and sustainable energy options. Renewable energy comes from natural sources like the sun, wind, water, and biomass, which are continuously available and do not harm the environment much.

The paper discusses different types of renewable energy. Solar energy is obtained from sunlight and converted into electricity using solar panels. It is clean and abundant, but it requires large space and

International Journal of Science, Engineering and Technology
ISSN: 2348-4098, P-ISSN: 2395-4752

can be costly. Wind energy uses wind turbines to generate electricity and is one of the fastest-growing energy sources, especially in countries like India. However, it depends on wind availability may not be consistent. Biomass energy is produced from organic materials like plants and agricultural waste. It can be used to create fuels and electricity, but it has challenges like high cost and low energy density.

The paper also highlights the role of smart grids and power electronics. Smart grids are advanced electrical systems that improve the efficiency, reliability, and management of electricity. They help in integrating renewable energy sources into the power system, even though renewable energy can be irregular and unpredictable.

Overall, renewable energy has huge potential to meet future energy needs while reducing pollution and climate change. Although there are some challenges like cost, storage, and variability, continuous technological advancements and investments are making renewable energy more practical and effective. The paper concludes that increasing the use of renewable energy along with smart grid technology is essential for achieving a sustainable and secure energy future.

III. RENEWABLE ENERGY: SOURCES, INTEGRATION AND APPLICATIONS

This research paper explains the importance of renewable energy, its different sources, and how it can be used effectively in modern systems like buildings and power grids. Today, most of the world depends on fossil fuels such as coal, oil, and gas for energy. However, these sources are limited and cause serious environmental problems like pollution and climate change. Because of this, there is a strong need to shift toward renewable energy, which is clean, sustainable, and naturally available.

Renewable energy comes from sources like solar, wind, hydro, biomass, geothermal, and tidal energy. Solar energy uses sunlight to produce electricity through solar panels and is one of the most promising energy sources. Wind energy uses turbines to convert wind into electricity and is growing rapidly worldwide. Hydropower generates electricity from flowing water, while biomass energy comes from plant and animal waste. Geothermal energy uses heat from the Earth, and tidal energy uses ocean movements. All these sources are eco-friendly and can help reduce harmful emissions.

The paper also explains that renewable energy is not always constant, because it depends on natural conditions like sunlight and wind. To solve this problem, technologies like energy storage (batteries) and smart grids are used. Smart grids are advanced systems that manage electricity efficiently by balancing supply and demand and integrating renewable sources into the power system.

Another important part of the paper is the use of renewable energy in buildings. Buildings consume a large amount of energy, especially for heating, cooling, and lighting. By using renewable energy systems like solar panels, natural ventilation, and geothermal heating, energy consumption can be reduced. Both passive methods (like building design) and active systems (like machines and devices) can be used to improve energy efficiency.

The paper also highlights the economic and environmental benefits of renewable energy. It can create jobs, reduce dependence on imported fuels, and improve energy security. Although there are challenges like high initial costs, technical issues, and integration problems, continuous research and government support can overcome these barriers.

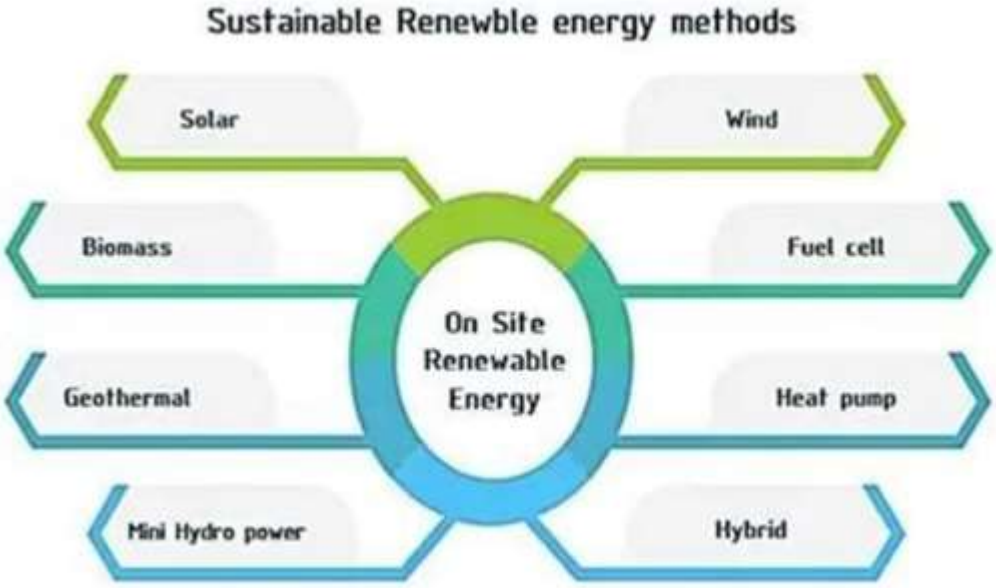
In conclusion, renewable energy is the future of power generation. It helps protect the environment, ensures sustainable development, and provides long-term energy solutions. Proper planning, technology, and policies are needed to increase its use and make it more effective in everyday life.

International Journal of Science, Engineering and Technology
ISSN: 2348-4098, P-ISSN: 2395-4752

IV. RENEWABLE ENERGY: ENVIRONMENTAL IMPACTS AND ECONOMIC BENEFITS FOR SUSTAINABLE DEVELOPMENT

This paper explains how energy plays a very important role in our daily life and in the development of any country. As population and industries are increasing, the demand for energy is also growing. However, traditional energy sources like coal, petrol, and gas cause pollution and harm the environment. This leads to problems like global warming and climate change. To solve this, renewable energy sources are becoming very important because they are cleaner and safer.

The main renewable energy sources discussed are solar, wind, biomass, hydropower, and geothermal energy. Solar energy comes from the sun and is clean, unlimited, and useful for electricity and heating. Wind energy uses moving air to generate electricity and is also pollution-free, but it depends on weather conditions. Biomass energy is produced from plant and animal waste and can be used as fuel, but it can also cause some pollution if not managed properly. Hydropower uses flowing water to generate electricity and is widely used, though it can affect ecosystems when dams are built. Geothermal energy comes from heat inside the earth and is reliable and eco-friendly.



V. COMPARATIVE ANALYSIS

Resource type	Non renewable	Partially renewable
Enviromental impact	High pollution	Moderate pollution
Carbon emission	Very high	Moderate
Energy efficiency	Moderate	High
Initial setup cost	Low	Moderate
Maintenance cost	High	moderate

VI. CHALLENGES AND FUTURE DIRECTIONS

Renewable energy has become essential due to the rapid depletion of fossil fuels like coal, oil, and gas, which currently dominate global energy consumption. These non-renewable sources are expected to decline significantly within the next century, making the transition to sustainable energy sources crucial. Renewable energy—derived from naturally replenished resources such as solar, wind, hydro, biomass,

International Journal of Science, Engineering and Technology
ISSN: 2348-4098, P-ISSN: 2395-4752

and geothermal—offers major benefits including reduced carbon emissions, improved air quality, and long-term sustainability.

Globally, renewable energy has been steadily growing, contributing about 18% of total energy consumption. Technologies like wind and solar have experienced rapid expansion, supported by increasing investments and technological advancements. Renewable energy is not only environmentally beneficial but also

In India, the need for renewable energy is especially urgent due to rapid population growth, rising energy demand, and dependence on fossil fuels. The country is expected to significantly increase its energy consumption by 2032, requiring major expansion in electricity generation and oil usage. To meet these challenges, India is focusing on renewable energy development, with an estimated potential of around 85,000 MW from sources like wind, small hydropower, and biomass, along with vast solar energy potential.

India has made notable progress in renewable energy deployment. Renewable sources contribute a significant share of installed energy capacity, with wind power leading the sector. Other achievements include expansion in biomass energy, small hydropower, solar heating systems, and biogas installations. Government initiatives such as the National Action Plan on Climate Change and the National Solar Mission aim to further increase renewable energy adoption through policies, subsidies, and incentives. The document also explores the relationship between energy consumption and economic growth, particularly in BRICS nations (Brazil, Russia, India, China, South Africa). While fossil fuels have historically driven industrial growth, renewable energy is essential for sustainable development. However, the transition may have short-term economic challenges, requiring strategic planning and investment.

Additionally, the study reviews renewable energy adoption in Gulf Cooperation Council (GCC) countries, highlighting barriers such as fossil fuel subsidies and bureaucratic challenges. Although renewable energy use is currently low in these nations, there is growing recognition of the need to diversify energy sources due to future economic and environmental risks.

In conclusion, renewable energy is critical for ensuring a sustainable and secure energy future. India and other developing economies must balance economic growth with environmental responsibility by investing in clean energy technologies implementing supportive policies, and encouraging global cooperation. Transitioning to renewable energy is not just an option but a necessity for long-term development and environmental protection.

VII. CONCLUSION

In conclusion, renewable energy is essential for meeting the growing energy demands while protecting the environment. It offers a sustainable alternative to fossil fuels by reducing pollution, greenhouse gas emissions, and dependence on non-renewable resources. The use of renewable energy supports economic growth, energy security, and improved quality of life, especially in rural and remote areas. Although there are challenges such as high installation costs, variability, and storage issues, ongoing research and technological advancements are helping to overcome these barriers. Government initiatives, policies, and global cooperation play a vital role in promoting the adoption of clean energy solutions. Increasing awareness and investment in renewable energy will further accelerate its growth. Therefore, shifting towards renewable energy is not just an option but a necessity for building a cleaner, safer, and more sustainable future for coming generations.

International Journal of Science, Engineering and Technology
ISSN: 2348-4098, P-ISSN: 2395-4752

REFERENCES

1. A. Ghatak, B. Roy, B. Malakar, D. Chakraborty, S. Dutta, D. Roy, and A. Pandey, "A Literature Review on Different Renewable Energy Resources," International Journal of Engineering Research & Technology (IJERT), vol. 9, no. 11, Special Issue – 2021, pp. 189–193, 2021.
2. Okeke, O.C., Ken-Onukuba, D., and Enwelu, C., "Renewable Energy: Concept, Technology and Uses," Journal of Advance Research in Mechanical and Civil Engineering,
3. T. Venukumar, T. Mohanlal, and L. B. Sekhar, "A Review on Renewable Energy Sources in Environmental Sustainability," International Journal for Research Trends and Innovation (IJRTI),
4. Neha and R. Joon, "Renewable Energy Sources: A Review," in Journal of Physics:
5. D. Parsa, "Renewable Energy and Sustainable Development: A Crucial Review," International Journal of Creative Research Thoughts (IJCRT),
6. Sani, G. D., Ibrahim, A., Sahabi, S., & Lailaba, B. B. (2019). Renewable Energy: Environmental Impacts and Economic Benefits for Sustainable Development. International Journal of Engineering Research & Technology (IJERT)
7. O. M. Mohammed, "Renewable Energy: Sources, Integration and Application: Review Article," J. Eng. Res. Rep., vol. 20, no. 12, pp. 143–161, Sep. 2021
8. J. Balaji and B. Bindu, "Review: Renewable Energy In India: Current Status And Future Potential," Int. J. Creat. Res. Thoughts (IJCRT), vol. 11, no. 11, pp. a641-a647, Nov. 2023.
9. P. R. Palaskar, P. N. Kardate, S. S. Ingale, K. V. Dhanorkar, and A. L. Pande, "Research Paper on Renewable Energy Systems," Int. J. Adv. Res. Sci. Commun. Technol., vol. 4, no. 3, pp. 448–450, Oct. 2024
10. Mishra, S. (2022). A Review Paper on Renewable Energy. IJFANS International Journal of Food and Nutritional Sciences, 11(6), 925-935.
11. A. Rakhmatov et al., "Advancements in renewable energy sources (solar and geothermal): A brief review," E3S Web of Conferences, vol. 497, p. 01009, 2024