International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 04, April 2026)

Affordable and Clean Energy: Challenges, Opportunities, and Pathways toward Sustainable Development

Katore Sandeep.S[1], Gund Sanskar Somnath[2], Dhoble Chaitanya Janardhan[3]

[1]*Assitant Professor,* [2,3]*S.E Mechanical Students, Dept. of Mechanical Engineering, Adsul's Technical Campus, Ahilyanagar, Maharashtra, India.*

***Abstract*-- Affordable and clean energy is a critical pillar of sustainable development and is recognized as Sustainable Development Goal 7 (SDG 7) by the United Nations. This research paper examines the global status, challenges, and future pathways for achieving universal access to reliable, sustainable, and modern energy. Despite advancements in renewable technologies, millions of people still lack access to electricity and clean cooking solutions. The study highlights renewable energy sources, policy frameworks, and technological innovations required to accelerate progress toward SDG 7.**

***Keywords*-- Affordable Energy, Clean Energy, SDG 7, Renewable Energy, Sustainability, Energy Access**

I. Introduction

Energy plays a fundamental role in economic growth, industrial development, and quality of life. The United Nations defined SDG 7 as ensuring **"access to affordable, reliable, sustainable and modern energy for all."** Despite global progress, access to energy remains uneven, especially in developing countries. Energy demand continues to rise due to population growth and industrialization.

The challenges in achieving SDG 7 include financial, pol icy, technological, and sociocultural barriers that impede un iversal energy access. These barriers are exacerbated by the global energy transition, which is not progressing fast enou gh to meet international climate and developmet objectives.

The report highlights the need for investments in clean e nergy solutions, such as solar, wind, and thermal, to ensu re universal access to affordable electricity by 2030. It also emphasizes the importance of expanding infrastructure and upgrading technology to provide clean energy in all develo ping countries.

Opportunities for accelerating progress include expanding decentralized renewable energy solution, tripling renewable energy capacity, and enhancing international cooperation to facilitate access to clean energy research and technology. These efforts are crucial for closing the energy access gap and promoting sustainable development.

Pathways toward sustainable development include investing in renewable energy technologies, improving energy efficiency, and promoting the use of clean cooking fuels and technologies. These actions are essential for reducing greenhouse gas emissions, improving air quality, and mitigating the impacts of the triple planetary crisis of climate change, nature and biodiversity loss, and pollution and waste.

By addressing these challenges and leveraging the opportunities, the world can work towards a more sustainable energy future, ensuring that everyone has access to affordable, reliable, sustainable, and modern energy services.

II. Objectives Of The Study

- To analyze the importance of affordable and clean energy
- To examine current global energy challenges
- To explore renewable energy solutions
- To suggest strategies for achieving SDG 7

III. Global Energy Scenario

- Around **685 million people still lack access to electricity** worldwide
- Over **2 billion people rely on traditional biomass for cooking**
- Fossil fuels still dominate global energy consumption

Renewable Energy Adoption Is Increasing But Remains Insufficient to Meet SDG targets.

IV. Importance Of Affordable And Clean Energy

4.1 Economic Development

Energy availability drives industrial growth, job creation, and innovation.

4.2 Environmental Sustainability

Clean energy reduces greenhouse gas emissions and combats climate change.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 04, April 2026)

4.3 Social Benefits

- Improves healthcare and education
- Enhances quality of life
- Reduces poverty

Energy is directly linked with multiple sustainable development goals.

V. Sources Of Clean Energy

5.1 Solar Energy

- Most abundant renewable source
- Converts sunlight into electricity using photovoltaic cells

5.2 Wind Energy

- Uses wind turbines to generate electricity

5.3 Hydropower

- Produces energy from flowing water

5.4 Biomass Energy

- Derived from organic materials

5.5 Geothermal Energy

- Uses heat from the Earth's core

Renewable energy technologies play a crucial role in achieving sustainability.

VI. Challenges In Achieving SDG 7

6.1 High Initial Costs

Renewable energy infrastructure requires large investments.

6.2 Lack of Infrastructure

Rural and remote areas lack proper energy distribution systems.

6.3 Policy and Financial Barriers

Weak governance and insufficient funding slow progress.

6.4 Energy Inequality

Developing countries face greater challenges in energy access.

VII. Technological Innovations

- Smart grids and energy storage systems
- Artificial Intelligence in energy management
- Internet of Things (IoT) for smart buildings
- Decentralized energy systems (microgrids)

These technologies improve energy efficiency and accessibility.

VIII. Government Initiatives And Policies

India Example:

- National Solar Mission
- लक्ष्य: 500 GW renewable energy capacity by 2030
- Promotion of electric vehicles and green hydrogen

Global cooperation is essential for achieving SDG 7 targets.

IX. Future Scope And Recommendations

- Increase investment in renewable energy
- Promote public-private partnerships
- Expand rural electrification programs
- Encourage energy-efficient technologies
- Strengthen global energy policies

X. Conclusion

Affordable and clean energy is essential for sustainable development. While progress has been made, the world is not on track to achieve SDG 7 by 2030. Strong policies, technological innovation, and global cooperation are necessary to ensure universal energy access.

REFERENCES

[1] United Nations (2019). Standards for SDG 7
[2] Bieszk-Stolorz & Landmesser-Rusek (2025). SDG7 Implementation Study
[3] Mazilu, I. (2025). SDG 7: Affordable and Clean Energy
[4] SDG-7 Research Paper (2022)
[5] Recent Review on SDG-7 Progress (2026)