International Journals of Advanced Research in Computer Science and Software Engineering
ISSN: 2277-128X (Volume-8, Issue-12)

Research Article | **December 2018**

Renewable Energy: A Primer

Matthew N. O. Sadiku, Philip O. Adebo, and Sarhan M. Musa
Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX77446, United States
Email: sadiku@ieee.org; philip.adebo@gmail.com; smmusa@pvamu.edu

Abstract: ***In this modern society, energy is indispensable; it powers almost everything we use. The energy industry is undergoing an unparalleled transformation which is directly associated with the uptake of renewable energy. Renewable energy is derived from energy resources that are naturally and constantly replenished. This includes hydroelectric power, solar energy, wind energy, fuel cell, geothermal energy, and biomass energy. This paper presents a brief introduction to renewable energy.***

Key Words: energy, renewable energy, renewable energy policy

I. INTRODUCTION

Energy is critically important for economic growth and social progress in the modern society. Since the energy crises in the 1970s, the development of renewable energy has received great attention [1]. Although world energy demand is growing, conventional energy sources are limited. In the 21st century, the energy sector faces by two challenges: sustainable economic development and global climate change [2]. To avoid catastrophic damage to our planet, it is advisable to move to an environment with sustainable energy sources.

There are four major forms of energy utilization: electricity, gas supply, heat supply, and fuel. Renewable energy comes from natural resources such as sunlight, wind, rain, tides, and geothermal heat, which are renewable (naturally replenished) forms of energy. It relies upon the natural forces at work on the earth. It is often inexhaustible in duration but limited in the amount of energy available per unit time. Renewable energy often displaces conventional energy in four important areas: electricity generation, water cooling/ heating, transportation, and rural energy services [3].

Renewable energy sources are attractive option because they have limited negative environmental impact when compared to fossil fuels. Energy from fossil fuels such as coal, peat, oil, and gas is nonrenewable because it draws on finite resources that will eventually dwindle. Concerns for climate change, rising oil prices, and enormous pressure on both governments and industries are driving increasing renewable energy legislation and commercialization.

II. RENEWABLE ENERGY SOURCES

Renewable energy sources can be the major energy supply option in low-carbon energy economies. Renewable energy options include solar energy, wind energy, biomass, and hydroelectric energy, and wave energy [4, 5]:

- *Solar Power:* This is the most readily available and free source of energy since prehistoric times. It involves converting the energy of sunlight directly into electricity using solar cells. Solar-thermal technology uses tracking mirrors to concentrate sunlight onto a receiver, which may be centralized or distributed. The receiver absorbs solar energy as heat which drives a turbine generator.
- *Wind Power:* Wind turbines typically consist of rotor blades mounted on a tower and connected by gears to a drive shaft that spins a generator. The energy derived from wind is very sensitive to wind velocity and varies with the square of the velocity. Wind powers is widely used for electric power generation in remote areas.
- *Biomass Fuel:* Biomass refers to all the earth's living matter. Biomass resources include material derived from growing plants or from animal manure, such as wood wastes, waste paper, sawdust, grass, etc. Carbon dioxide is emitted whenever biomass materials are burned. Plant biomass can be used as energy supply to small-scale industries.
- *Hydropower:* The power plant uses falling water to generate electricity. This implies the conversion of dynamic energy into electricity. Using water wheels to harvest the energy flowing in streams, rivers, and waterfalls is old. The first hydroelectric plant was built at Niagara Falls in 1879.
- *Wave Energy:* The wave energy depends strongly on wind speed of ocean waves. This irregular energy source uses pneumatic systems to pressurize air, which is then passed through an air turbine to generate electricity. This form of energy is not common because the investment is too large to justify the savings in energy.

Renewable energies are regarded a constant, clean source of energy and can be exploited for the current generations. In the future, renewable energy will provide abundant energy with extremely low levels of emission of harmful substances into the environment.

III. BENEFITS

The major benefits of renewable energy include local availability, no need for elaborate arrangements for transport, environment-friendly, less pollution, less greenhouse gas emission, energy security, job creation, business opportunities, sustainable development, a diminished share from fossil fuels, etc. Renewable energy can alleviate poverty by providing energy for the household and contribute to education by providing electricity to schools. The huge potential of renewable energy sources is enough to meet the global energy demand many times.

Renewable energy helps in reducing greenhouse gas emissions. Renewable energy resources such as solar or wind energy can be used to provide off-grid electrification to remote areas.

IV. CHALLENGES

The greatest barrier to the widespread adoption of renewable energy is political, not technological. The success of renewable energy policy is largely dictated by the national commitments and strategies. Next to that is the high initial cost associated with the renewable energy implementation. Reducing the energy price to a competitive level is challenging. Noneconomic factors, such as regulatory, statutory, behavioral, and cultural factors, hinder the adoption of renewable energy technologies. Another challenge is reducing the price of renewable energy to a competitive level. Some critics consider renewable energy system as a costly luxury item and affordable only in the affluent developed world.

The intermittent nature of renewable energy leads to a mismatch between when these sources generate energy and when the energy is needed. It is challenging to use these sources because they are not always available. Their intermittency causes variability in electricity generation and technical issues impairing power grid stability and supply reliability.

Other barriers include lack of subsidies in renewable, high initial capital cost, inadequate legal frameworks for renewable energy power sources, a lack of access to credit for both consumers and investors, and the lack of sufficient technical, geographical, and/or commercial information by market participants to make informed decisions [6].

V. CONCLUSION

Renewable energy sources are sources of energy that are constantly replenished through natural on-going processes. Renewable energy technologies are rapidly becoming more efficient, more economical, and cheaper due to technological advances, the benefits of mass production, and market competition. The growing demand for renewable energy technologies results in new employment markets. Due to a large demand for engineers with skills in this field especially in developing countries, colleges should integrate renewable systems in their curricula [7, 8].

The evolution of renewable energy has exceeded all expectations locally and globally. The extent of the eventual integration of renewable energy sources into existing energy supply systems is not easy to foresee. Energy will play an important role in the world's future. For more information on renewable energy, one should consult the books in [9-13] and several other books available in Amazon.com. One should also consult several journals on renewable energy*: Renewable Energy, Energy Policy, Solar Energy, Energy Sources Renewable and Sustainable Energy Reviews,* and *IEEE Transactions on Sustainable Energy.*

REFERENCES

[1] M. Tükenmez and E. Demireli, "Renewable energy policy in Turkey with the new legal regulations," *Renewable Energy*, vol. 39, 2012, pp. 1-9

[2] E. Foster et al., "The unstudied barriers to widespread renewable energy deployment: Fossil fuel price responses," *Energy Policy*, vol. 103, 2017, pp. 258–264.

[3] "Renewable energy," *Wikipedia*, the free encyclopedia https://en.wikipedia.org/wiki/Renewable_energy

[4] E. A. Torrero, "Renewable energy resources," *Kirk-Othmer Encyclopedia of Chemical Technology*. John Wiley & Sons, 5th ed., 2004.

[5] A. Demirbaș, "Global renewable energy resources," *Energy Sources*, vol. 28, no. 8, 2006, pp. 779-792.

[6] T. Urmee, D. Harries, and A. Schlapfer, "Issues related to rural electrification using renewable energy in developing countries of Asia and Pacific," *Renewable Energy*, vol. 34, 2009, pp. 354–357.

[7] M. A. El-Sharkawi, "Integration of renewable energy in electrical engineering curriculum," *IEEE Power & Energy Society General Meeting*, 2009, pp.1-4.

[8] H. Lucasa, S. Pinningtona, and L. F. Cabeza, "Education and training gaps in the renewable energy sector," *Solar Energy*, vol. 173, 2018, pp. 449–455.
[9] G. Boyle (ed.), *Renewable Energy*. Oxford University Press, 2004.
[10] V. C. Nelson and K. L. Starcher, *Introduction to Renewable Energy*. Boca Raton, FL: CRC Press, 2nd Edition, 2015.
[11] D. L. Klass, *Biomass for Renewable Energy, Fuels, and Chemicals.* San Diego, CA: Academic Press, 1998.
[12] J. Palmer et al. (eds.), *The Renewable Energy Landscape.* New York: Routledge, 2017.
[13] A. F. Zobaa and R. C. Bansal (eds.), *Handbook of Renewable Energy Technology*. Singapore: World Scientific Publishing, 2011.

ABOUT AUTHORS

Matthew N.O. Sadiku is a professor in the Department of Electrical and Computer Engineering at Prairie View A&M University, Prairie View, Texas. He is the author of several books and papers. His areas of research interest include computational electromagnetics and computer networks. He is a fellow of IEEE.

Philip O. Adebo is an instructor at Texas Southern University. He is currently working towards a PhD in Electrical and Computer Engineering Department, Prairie View A&M University with emphasis on power systems. His research interests include power and optimization of power systems.

Sarhan M. Musa is a professor in the Department of Engineering Technology at Prairie View A&M University, Texas. He has been the director of Prairie View Networking Academy, Texas, since 2004. He is an LTD Sprint and Boeing Welliver Fellow.

