

Renewal Energy Technology for Achieving Sustainability in the Nigeria Energy Sector

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Abstract: Access to renewable energy technology is an enormous challenge facing Nigeria because it is fundamental for the sustainable development of the energy sector in Nigeria. There is no doubt that environmental pollution afflicting Nigeria will persist unless the government diversifies its financial resources into the development and utilization of renewable energy – technology. This paper examines the principles and various types of renewable energy, policy, regulation, and legislation in Nigeria. The role and applications of renewable energy in Nigeria and the challenges to the effective use of renewable energy are discussed. The paper concludes by proffering solutions to the challenges of using renewable energy technology in Nigeria.

Keywords: Energy, Renewable Energy, Technology, and Sustainability.

I. INTRODUCTION

Renewable Energy often referred to as clean energy comes from natural sources or processes that are constantly replenished. For example, sunlight or wind keeps shining and blowing, even if their availability depending on time and weather. While renewable energy is often thought of as a new technology, harnessing nature's power has long been used for heating, transportation, lighting and more. Wind has powered boats to sail the seas and windmills to grind grains. Now that we have increasingly innovative and less – expensive ways to capture and retains wind and solar energy, renewable energy is becoming a more important power source.

Most renewable energy comes either directly from the sun. Sunlight or solar energy can be used directly or indirectly for heating and lighting homes and other buildings, for generating electricity, and for hot water heating, solar, and a variety of commercial and industrial uses (smart energy, 2019). The sun's heat drives the wind; whose energy is captured with wind turbines. Then the winds and the sun's heat cause water to evaporate, this water vapour turns into rain or snow and flows downhill into the rivers or stream, its energy is captured using hydroelectric power. Along with the rain and snow, sunlight cause plants

to grow. The inorganic matter that makes up those plants is known as biomass. Biomass can be used to produce electricity, transportation of fuels, or chemicals. The use of biomass is called bioenergy. Not all renewable energy comes from the sun. Geothermal energy taps the earth internal heat for a variety of uses, including electric power production. The Nigeria Research and Development Council (NRDC), (2018) defined renewable energy as a clean energy that comes from natural processes or sources that are constantly replenished. Chris (2013), viewed renewable energy as energy produced from sources that do not deplete or energy produced from sources that can be replenished with a human's lifetime.

Renewable Energy can, therefore, be considered as all forms of energy from renewable sources in a sustainable manner, which includes solar energy, wind energy, hydropower, Geothermal energy, and bioenergy.

II. TYPES OF RENEWABLE ENERGY TECHNOLOGY

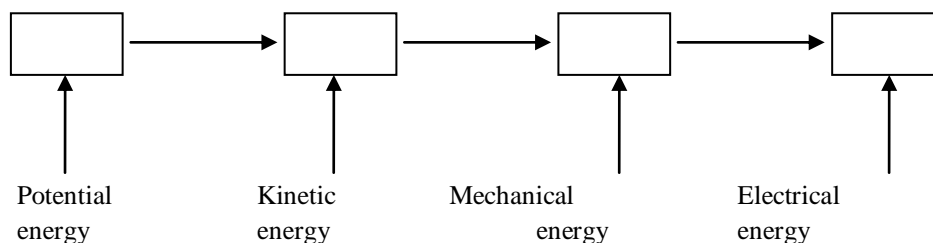
- i. **Solar Energy:** Human beings have been harnessing solar energy for thousands of years to grow crops, stay warm, and preserve foods.

Today, we use the sun's rays in many ways: to heat homes and business, to warm water or power devices. Solar or photovoltaic (PV) cells are made from silicon or other Semi-conductor materials that transform sunlight directly into electrical energy or electricity. Solar energy technology does not produce air pollutions, no running cost, it is located near the load hence transportation of power is not required over long distances. (Theraja 2003).

- ii. **Wind energy:** We have come a long way from the old fashioned windmills. Today, turbines as tall as skyscrapers with turbines nearly as wide in diameter stand at attention to produce electrical energy. Wind energy turns a turbines blade, which is coupled to an electric generator and produces electrical energy. The speed of wind varies; as such turbine speed also varies so that output frequency and voltage of the three-

phase alternator vary over a wide range. (Power Nigeria, 2019).

- iii. **Hydro-Electric Power:** In this method of Renewable Energy Technology, water from a higher height is passed through the penstock as controlled in the valve house into the turbine. The potential energy of the water stored at higher altitudes is first converted to kinetic energy. As the water reaches the turbine, it gains speed after losing the potential energy. The kinetic energy of the speedy water drives the water turbines, which converts it into mechanical energy. It drives the coupled generator which gives electrical energy output. (Theraja, B.L.& Theraja, A.K., 2019). A typical block diagram of the energy conversion process as designed by the Nation Renewable Energy Laboratory (2019) is shown below.



The powerhouse is located at a lower level below the water reservoir at a higher altitude. The difference between these two levels is known as the “Head”. Based on the “Head”, hydroelectric power station is categorized into.

- a. Low head up to 60 meters
- b. Medium head between 60 and 300 meters
- c. High head above 300 meters.
- iv. **Biomass Energy:** Biomass is an organic material that comes from plants and animals include crops, waste wood, and trees. When biomass is burned, the chemical energy released as heat can generate electric energy with a steam turbine. Biomass is often mistakenly described as a clean, renewable fuel and a greener alternative to coal and other fossil fuels for producing electrical energy. Many forms of biomass, especially from forests, produce higher carbon emissions than fossil fuel. Still, some forms of biomass energy could serve as a low carbon option under the right circumstances. For example, Sawdust and Chips from Sawmills could be low – carbon

energy sources. (Power Nigeria, 2019).

- v. **Geothermal:** If you have ever relaxed in a hot spring, you have geothermal energy. The earth's core is about as hot as, the solar surface, due to the slow decay of radioactive particles in rocks at the center of the planet. Drilling deep wells brings very hot underground water to the surface as a hydrothermal resource, which is then pumped through a turbine to generate electric energy. Geothermal plants typically have low emissions if they pump the steam and water they use back into the reservoirs, but there are concerns that they may increase the risk of an earthquake in areas already considered geological hot spots. (Power Nigeria, 2019).

III. RENEWAL ENERGY POLICY, REGULATION AND LEGISLATION IN NIGERIA

In 2003, The Federal Government of Nigeria approved a National Energy Policy, which encourages the optimum utilization of the

country's energy resources including renewable, for sustainable national development with the active participation of the private sector (David, 2009). For example, the following policies were articulated for solar energy, biomass, and wind.

- The nation shall aggressively pursue the integration of solar energy into the nation's energy and shall keep abreast of the worldwide developments in solar energy technology.
- The nation shall effectively harness nonfuel wood biomass energy resources and integrate them with other energy resources.
- The nation shall promote the use of efficient biomass conversion technology.
- The nation shall commercially develop its wind energy resource and integrate it with other energy resources.
- The nation shall take necessary measures to ensure that wind energy is harnessed to sustain in the rural areas.

David (2009), stated that, in the area of Regulation and Legislations, the Federal Government of Nigeria spelled out the following.

- The major renewable energy applications in Nigeria are in the area of Electricity production, Biofuel for transportation, and other thermal applications such as cooking, drying, heating, etc.
- The co-ordination of the national policies on energy in all ramifications rests on the Energy Commission of Nigeria, established by law in 1979.
- Generally, the Nigeria Electricity Sector was liberalized by the Electric Power Sector Reform Act of 2005, and a strong regulatory institution, the Nigeria Electricity Regulatory Commission (NERC), was thereafter established.
- NERC has the general mandated to regulate the entire electric energy sector in the country with regards to tariff setting and regulation, supervision of market rules, performance monitoring, and overseeing the transformation of the power sector for a more competitive environment. License is required for generation of 1MW aggregate and above at a site, and distribution of power of capacity greater than 100KV in aggregate at a site.

- Generally, automation fuels in Nigeria are regulated by the Department of Petroleum Resources (DPR). Automotive fuels include both mineral fuel and biofuels.
- Other relevant regulatory institutions to Renewable Energy is the Standard Organization of Nigeria (SON) charged with the responsibility of setting and enforcing standards of goods and services in Nigeria. Therefore, the quality standards of solar PV modules, inverters, Batteries Solar Cookers, Improved wood stoves biogas digesters, etc., should be enforced by SON, after the standards have been set in conjunction with relevant bodies like Energy Commission of Nigeria, Manufacturers Association of Nigeria (MAN), Nigeria Society of Engineers (NSC) NERC, etc.,

IV. THE ROLE OF RENEWAL ENERGY IN NIGERIA

Renewal Energy has an important role to play in meeting future energy needs in both rural and urban areas. The development and utilization of renewable energy should be given a high priority, especially in the light of increased awareness of the adverse environmental impacts of fossil-based generation. The need for sustainable energy is rapidly increasing in the world. The Power Nigeria (2019), stated that Nigeria is blessed with a large amount of renewable natural resources, which, when fully developed and utilized, will lead to poverty reduction and sustainable development. NRDC (2018), explained that Renewable energy sources and technologies are key components of sustainable development for the following primary reasons:

- They cannot be depleted, if used carefully inappropriate applications; renewable energy sources can provide a reliable and sustainable supply of energy almost indefinitely. In contrast, fossil fuel resources are diminished by extraction and consumption.
- They generally cause less environmental impact than other energy sources. The implementation of renewable energy technology will help to address the environmental concerns that emerged due to greenhouse gas emissions such as Carbon Dioxide (CO₂), oxide nitrogen (NO_x), oxide of sulfur (SO_x), and particulate

matters as a result of power generation from oil, natural gas, and coal.

- Renewable Energy Technology has security of supply, unlike fossil fuels, which are negotiated on the international market and subject to international competition, sometimes even resulting in wars and shortages.
- The rate of use does not affect their availability in the future, thus they are inexhaustible.
- Renewal Energy Sources are generally well distributed all over the world, even though temporary variations occur.
- All regions of the world have reasonable access to one or more forms of renewable energy supply.
- Renewal Energy can be cheaply and continuously harvested and therefore a sustainable source of energy. Unlike the nuclear and fossil fuel plants which belong to big companies, governments or state enterprises, renewal energy can be set up in small units and is therefore sustainable for community management and ownership. In this way, the returns of renewable energy can be kept in the community.

The sustainable development in Nigeria energy sector involves the provision of energy services in a sustainable manner, which in turn necessitate that energy services we provide for all people in ways that now and in the future, are sufficient to provide the basic necessities affordable, not detrimental to the environment, and acceptable to communities and people.

V. USE OF RENEWABLE ENERGY

Collectively, developing countries, such as Nigeria are rapidly expanding the market for renewable energy. In isolated areas, electricity grid extensions are often not economical. Off-grid renewal technologies provide a sustainable cost-effective alternative, it can also help to displace other unsustainable energy sources such as kerosene lamps and traditional biomass. According to NRDC (2018), renewal energy is used or applied in the following areas in developing countries.

- I. **Poverty Alleviation:** Renewal Energy Projects in many developing countries have demonstrated that renewable energy can directly contribute to poverty alleviation by providing the energy needed for creating

businesses and employment. Renewable energy can also make indirect contributions to alleviating poverty by providing the energy for cooking, space heating, and lighting.

- II. **Education:** Renewal energy can also contribute to education, by providing electricity to schools. Renewal energy for cooking and heating can reduce the time that children spend out of school collecting fuel.

- III. **Health:** So many people living in remote areas in Nigeria use traditional biomass, such as wood, residues, and dung, for cooking and heating. The constant use of these types of energy sources exposes them to indoor particulate and carbon monoxide concentrates. Traditional stoves using dung and charcoal emit a large amount of carbon monoxide and other noxious gasses. Women and children suffer most because they are exposed for the longest periods of time. Acute respiration illnesses affect as much as women and young children in developing countries, they die prematurely each year from breathing the fumes from indoor biomass stove (World Health Organization (WHO), 2019). Renewal Energy can improve this situation by reducing exposure to indoor pollutants.

IV. CHALLENGES OF USING RENEWAL ENERGY TECHNOLOGY IN NIGERIA

The following are observed as some of the bottleneck in using renewal energy in Nigeria.

- There is no detailed study or knowledge of biomass and Geothermal.
- Inadequate incentives for renewable energy development.
- The National energy policy and master plan needs a review and pass into energy law.
- Inadequate human capacity in renewable energy.
- Absence of local manufacturing capacity for renewal energy components and systems.

V. CONCLUSION AND RECOMMENDATION

Nigeria is endowed with appreciable renewal energy

sources of solar, wind, biomass and hydro. Nigeria needs to move fast in the area of cleaner energy in order not to be left behind by the rest of the world. The use of renewable energy lessens the effect of climate change and environmental degradation on the nation. The National Energy Policy exists that encourages the exploration of renewable energy resources and integration into the nation's energy supply for sustainable national development through private partner participation. Regulatory bodies such as ECN, NERC, DPR, and SON exist. The Energy Policy and master plan should be passed to law. More human resources should be employed and trained in renewable energy technology. Renewable energy should have a reasonable annual budgetary allocation.

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