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Solar Energy as an Alternative Source of Electricity Generation in Nigeria: A Review

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ABSTRACT

The access to efficient, affordable and reliable electricity is essential for the economic development of any nation, many countries around the globe have adopted the integration of renewable energy resources into their energy mix with a view to decentralize power generation. This review examined the need to integrate solar energy into Nigeria`s power generation mix. It is found that, the potentials in the solar energy resources in Nigeria, if properly harnessed, could serve as the immediate solution to electricity generation problems in Nigeria.

Keywords: Solar energy, electricity generation, alternative source.

1. NTRODUCTION

The aim of this paper is to emphasize on the importance of deploying solar energy resources into the Nigeria`s power generation mix. The two concepts of solar energy and electricity generation were discussed separately. The potentials of solar energy resources in Nigeria were examined. The global trends in the use of solar energy resource for electricity generation and its impact on the economy; the current status of electricity generation in Nigeria; and the national policy on solar renewable energy were also reviewed. The paper concludes by outlining the benefits of integrating solar energy resources into Nigeria`s power generation mix.

1.2 The Concept of Solar Energy

In order to understand the concept of solar energy the authors provide the following definitions that exist in the literature: The Encarta Dictionary (2008) defines solar energy as the energy radiated from the sun in the form of heat and light, used by green plants for photosynthesis and harnessed as solar power. Foster, Majid, & Alma (2010) conceptualize solar energy as a “renewable and/or sustainable energy” because it will be available as long as the sun continues to shine. Solar energy does not refer to a single energy technology but rather covers a diverse set of renewable energy technologies that are powered by the sun`s heat. Some solar energy technologies, such as heating with solar panels, utilise sunlight directly. Other types of solar energy, such as hydroelectric energy and fuels from biomass (wood, crop residues, and dung), rely on the sun`s ability to evaporate water and grow plant material, respectively.

The common feature of solar energy technologies is that, unlike oil, gas, coal and present form of nuclear power, solar energy is inexhaustible (Yergin, Daniel et al, 2009). For the purpose of this article, it is the view of the authors to conceptualise solar energy as an alternative form of energy which can be tapped and harnessed without depleting the source. It provides a least-cost options for economic and community development in rural communities and around the globe, supplying electricity, creating local jobs, and promoting economic development.

1.2 Concept of Electricity Generation

Electricity generation is the process of generating electric power from sources of primary energy. It is the first stage in the delivery of electricity to end users, the other stages being transmission, distribution, energy storage and recovery. According to (Yergin Daniel et al), electricity can be generated by a variety of technologies that ultimately depend on the effects of solar radiation.

2. THE POTENTIALS OF SOLAR ENERGY RESOURCES IN NIGERIA

Nigeria is endowed with sufficient solar energy resources to meet its present and future development requirements. Recent reports indicate that the country is exposed to a high solar radiation level with an annual average of 3.5 – 7.0 kwh / m^2 /day (Federal Ministry of Power and Steel, 2016, Olayinka, Muyiwa, Olarewaju & Richard, 2014). The total amount of solar energy received by a collector on the surface of the earth during a day or during a year depends on several factors, most important of which are: the geographic latitude of the location of the collector; the average cloudiness or coverage of the location; the day of the year; and the angle of the collector with the horizontal (Efstathios, 2012, p. 202). These conditions are fairly met because, Nigeria with her location on the equator, is within a high sunshine belt where solar radiation is fairly well distributed. In spite of this potential, solar energy is yet to find its foot in the country`s total energy mix. In one article (Hannah, 2015) reports that renewables account for less than one percent of Nigeria`s energy mix, despite the enormous resource potential Nigeria has in solar, wind and non-fossil biomass.

According to her, “renewable energy resources- solar photo-voltaic (solar PV), concentrated solar power (CSP), wind and non-fossil biomass hold promising potentials for Nigeria`s power generation. Nigeria can get 32,456 terawatt hours per year from solar PV, plus 10,045 terawatt hours per year from concentrated solar, and another 12,867 terawatt hours per year from wind energy.” Recent reports also indicate that there is growing interest in the potential for grid connected solar by the Nigerian government (Jan, Paul, James & Famous, 2019). According the report (as cited in Adaju, 2017), Nigeria has signed power purchase agreements with 14 large-scale solar developers with each project having an average capacity of 80 – 100MW (combined about 1.2GW). They are expected to be built mostly in the northern part of the country which is the region with the best solar irradiation.

It must be stated here that, the quick win for Nigeria lies in decentralized power generation because the existing grid lacks the ability to accommodate substantial power generation increase beyond its current capacity. The potentials of solar energy resources in Nigeria must be harnessed as an alternative source for electricity generation to reduce the over - dependence on fossil fuels.

3. THE GLOBAL TRENDS IN THE USE OF SOLAR ENERGY RESOURCES

Nowadays, many countries around the world vigorously pursue the integration of solar energy resources into their energy mix with a view to decentralize power generation. This is because solar energy is expected to become the energy of the future. Commercial activities, industrial activities, communication, health, and education are some of the areas where electricity usage cannot be substituted. The rise of renewables goes hand-in-hand with the trend towards decentralised power generation, Hannah, (2015) concludes that "more than 10% of global electricity is produced from renewable energies, and the trend is rising." For example, South Africa, known for its heavy dependence on coal power has in less than four years added 4,322 megawatts of renewable energy capacity.

Devendra, (2019) described how Solar Water Pump (SWP) is deployed for irrigation in Bangladesh. He opined that:
A comparison between the operating cost of running a diesel-powered pump and a SWP is important because the latter is meant to replace diesel pumps. The cost of irrigating one big hectare of land is around 4,000 takas (a unit of currency) for a diesel pump, and around 2,500 takas for a SWP. The SWP has emerged as a promising technology to expand irrigation and is being deployed across the world.

In Nigeria, the Federal Government under its Energising Education Programme (EEP), recently inaugurated an off-grid solar hybrid power plant at Bayero University, Kano (BUK). According to the Managing Director, Rural Electrification Agency (REA), the project is the largest off-grid solar hybrid power plant in Africa. The EEP is a Federal Government intervention focussed on developing off-grid dedicated independent power plants, rehabilitating existing distribution infrastructure to supply clean, safe and reliable power to 37 Federal Universities and 7 affiliated university teaching hospitals in the country (Femi, 2019).

4. THE CURRENT STATUS OF ELECTRICITY GENERATION IN NIGERIA

Nigeria is endowed with sufficient energy resources to meet its present and future development requirements. For example, the country possesses the world`s sixth largest reserve of crude oil; it is an increasingly important gas province with proven reserves of nearly 5,000 billion cubic meters; coal and lignite reserves estimated at 2.7 billion tonnes, while tar sand reserves represent 31 billion barrels of oil equivalent; identified by hydroelectricity sites estimated at about 14,250mw; Nigeria has significant biomass resources to meet both traditional and modern energy uses, including electricity generation; the country is exposed to high solar radiation level with an annual average of 3.5 – 7.0kw/m^2/day (Federal Ministry of Power & Steel, 2006).

Despite this enormous endowment, access to electricity services is very low in the country. Recent study (Oxford Business Group [OBG], 2019), indicates that the country has the capacity to generate about 12,000MW of electricity on paper; however, the system generally provides 4,000MW. The daily average was 3,985MW and 3,805MW in April and May 2018, respectively and about 85% of that capacity came from natural gas-fired plants, with almost all of the rest from hydropower. The gas-fired plants are rarely able to operate at full capacity because of shortages in supply as a result of attacks and sabotage by militant groups as well as the general reluctance of suppliers to sell the feedstock to the power facilities. This is in part due to past failures of the sector to make payments, along with the government setting tariffs at a rate too low for potential investors to justify capital expenditure. Certainly, Nigeria needs a better electricity services because electrifying the country will serve as a source of economic and social development which will improve the citizen`s quality of life and bring about development. One thing to understand is that repairing the existing grid infrastructure will require huge investments and it will also take a long time. So the quick fix is to deploy solar energy resources into the country`s energy mix to provide solutions for individual households and small businesses with predictable energy consumption.

4.1 The National Policy on Solar Energy Resources

In the policy overview of the National Energy Policy (NEP), of August, 2003, the overall thrust of energy policy is stated as "optimal utilisation of the nation`s energy resources for sustainable development". The following are the relevant provisions of the NEP for solar energy resources in Nigeria:

Policies:

i. The nation shall aggressively pursue the integration of solar energy into the energy mix.
ii. The nation shall keep abreast with the worldwide developments in solar energy technology.

Objectives:

i. To develop the nation`s capability in the utilization of solar energy.
ii. To use solar energy as a complimentary energy resource in the rural and urban areas.
iii. To develop the market for solar energy technologies.
iv. To develop solar energy conversion technologies locally.

Strategies:

i. Intensifying Research and Development (R & D) in solar energy technology
ii. Promoting training and manpower development.
iii. Providing adequate incentives to local manufacturers for the production of solar energy systems.
iv. Providing adequate incentives to suppliers of solar energy products and services.
v. Introducing measures to support the local solar energy industry.
vi. Setting up extension programmes to introduce solar technology into energy mix.
vii. Setting up and maintaining a comprehensive information system on available solar energy resources and technologies (FMPS, 2006).

5. BENEFITS OF DEPLOYING SOLAR ENERGY INTO NIGERIA`S POWER GENERATION MIX.

There is no doubt, integrating solar energy into the country`s power mix will expand our opportunities to generate cleaner electricity while also helping small businesses and households utilise the untapped resources and reduce our dependence on fossil fuels for electricity generation. The benefits of deploying solar energy into Nigeria`s power generation mix are itemised as follows:

i. Reducing energy use
ii. Reducing greenhouse gas emission
iii. Cutting energy cost
iv. Achieving energy independence
v. Create opportunities for job and wealth creation
vi. Boost the economy of the nation.

6. CONCLUSION

This paper reviewed the significance of deploying solar energy resources into the Nigeria`s energy mix. The deployment of solar energy as an alternative to the existing sources of electricity in Nigeria would not just improve our energy independence, improve our ability to use renewable energy sources, and drastically cut greenhouse gas emissions; it can save us billions of naira and become an economic accelerant for creating new jobs, industries, and opportunities for a more prosperous future.

7. RECOMMENDATIONS

What follows are a set recommendations in deriving from the research findings.

i. Government should continue to adopt the Public Private Partnership projects and Direct Private Sector Investment in the power sector in order to boost the generation capacity of electricity in the country.
ii. Government should ensure full implementation of its policies on solar energy resources because enormous gains could be achieved.
iii. Government in collaboration with tertiary institutions in the country should intensify R & D in solar energy technology with a view to produce large manpower in the energy sector.

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