

## **A study solar energy development and implementation in barriers. Tirunelveli and Thoothukudi District**

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### **Abstract:**

The over dependency on fossil fuel in Nigeria could be one big reason for the total failure of the power sector. The country's economic development which depends on productivity output is in peril due to the imminent energy crisis from gas shortage, vandalism, diminishing fossil fuel reserve and energy insecurity. Therefore, a strategic initiative to diversify the power sector into the energy mix to withstand the socioeconomic development has not indicated a positive progress. The insufficient electricity generation at the highest point was only in capacity put at 5000 MW in April 2015 to support a teeming population of about 184 million people. Nigeria is endowed with plentiful natural resources in which solar energy received more attention due to its potential, especially the rural communities. It is estimated that the solar potential deposit raises to 4,849, 782 kWh/m<sup>2</sup> days for the entire country of around 923,768 km<sup>2</sup> areas. The theoretical framework is based on critical literature reviews being part of a PhD research. The research discusses the motivational drivers to the solar energy development and the barriers hindering the implementation. The key drivers were climate change, energy demand, power sector reform Act, energy security, supply versus demand conflicts, job opportunities, technology growth and market potentials. On the other hand, the key barriers are technical, social, economical, institutional and political. Recommendations of measures to surmount the barriers to facilitate implementation are also proffered.

**Keywords:** Solar energy, energy access, solar barriers, solar drivers, implementation

### **Introduction**

There is little or no doubt that access to electricity is crucial to people, not only in the urban developed cities, but also to the development of rural areas. Even though, Nigeria is the biggest producer of Oil and Gas in Africa, 65% of its population lives in rural areas as peasant farmers without access to electricity (Duke, et al. 2016). Surprisingly, the total installed solar power in Germany is seven times more than the highest peak ever generated electricity from all sources in Nigeria, being 5000 MW in April 2015 (Edkins, et al. 2014). Nigeria located on the equator is within a high sunshine belt where solar radiation is potentially well distributed, especially over the Northern part of the country (Okoye and Taylan, 2017). Even though, the solar radiation distribution varies from 3.5kWh/m<sup>2</sup>/day within the coastal area and 7.0 kWh/m<sup>2</sup>/day in the northern part of the country (Ohunakin, et al., 2014). This result to earn the country a total solar radiation of 4,849, 782 kWh/m<sup>2</sup> day covering the area of 923, 768 Km<sup>2</sup> of landmark (Akinyele, et al. 2007). Despite the potential solar radiation in the country, the technology is yet to find a sustainable strategy to be harnessed and put into the energy mix to

solve the alarming energy crisis especially the electricity.

## 2. Status of Solar Energy in Nigeria

The whole of the continent is blessed with a great sunshine radiation, excluding the large areas of tropical rainforests (the Guinean Forests of West Africa and much of the Congo Basin), since desert and savannah regions of Africa stand up as the Earth's largest cloud-free area. The eastern Sahara/northeastern Africa is particularly noted for its world sunshine records: the area experiences not only the greatest mean annual duration of bright sunshine approximately as much as 4,300 hours, which is equal to 97% of the possible total but also the highest mean annual values of solar radiation (the maximum recorded was over 220 kcal/cm<sup>2</sup>) (Edkins, et al. 2014).

The distribution of solar resources across Africa is uniform, with more than 85% of the continent's landscape receiving a global solar horizontal irradiation at or over 2,000 kWh/ (m<sup>2</sup> year). Also, the theoretical reserves of Africa's solar energy are estimated at 60,000,000 TWh/year, which accounts for almost 40% of the global total, thus definitely making Africa the most sun-rich continent in the world (Nevin, 2016). Declining solar equipment

## 3. Solar Energy Projects in Nigeria

There are more than 58 energy mix projects going on in Nigeria, of which 35 are Solar-based from licensed solar energy promoters, including rural electrification projects, with a total capacity of 115 MW of Photovoltaic combining mini-grids and stand-alone installed (ECN, 2014). The Solar-based projects are installed for residential and commercial purpose respectively. Even though, the Ministry of Power launch a project in 2014, known as 'Operation Light Up Rural Nigeria' most of the Solar projects is targeted for rural communities

which are estimated only 10% of the population have access to electricity. Other off-grid projects include the 37 Federal Universities and University teaching hospital projects are underway to complement the electricity supply. Four of the Universities and a teaching hospital has already signed the Engineering, Procurement and Construction (EPC) agreement to develop mini-grid solution to power facilities of up to 9.3MW of solar PV and 5,760 battery cells will be deployed for the projects. Other projects are monitored by the federal ministry of power and the rural electrification agency, energy commission and the regulator (NERC) accordingly (ECN, 2018).

## 5. Key Barriers to Solar Initiatives in Nigeria

Despite the many benefits that can be accrued from the use of solar energy potential and uses, is still very low. The major impediments to the solar energy initiative's adoption are series of barriers identified through critical review of literature which makes it difficult to implement. Even though, Nigeria possesses potential driving factors for solar energy players to promote the initiatives throughout the country, the deployment and implementation of the initiatives still faces major obstacles making the implementation very challenging. It is hoped that the private sector participation will help the government to come out with an achievable solar energy roadmap. The next section will discuss the method by which this research was carried out.

## 6. Methodology

The method adopted for this inquiry was based on desk study, otherwise recognised as literature-based from peer-reviewed. Rather, many of secondary based were searched from published resources 2003 through 2017, with key articles obtained from PsyCho Info, ERIC, ProQuest, Science Direct, SocSci Search, EBSCO and COPAC, which are systematically narrowed to a search of any information related to the driving factors responsible for solar energy initiatives and the barriers which served as an obstacle for the implementation. Relevant literature was themed for critical analysis in order to produce a research outcome. The outcome from the critical literature review is analysed and discussed in the next paragraph.

## 7. Findings

From the literature, it is evident that Nigeria has huge potentials for solar energy almost throughout the year especially the North-East zone of the country. In accordance with literature findings, the factors driving the solar energy technology include a demand for a sustainable environment to achieve the SDGs, increase in energy demand due to increase in population, Power sector reforms Act, which suggested energy mix, challenges of energy security and access, job creation, financing and market potential, the establishment of energy research centers and stakeholders in the public private partnership deals. Even though, the drivers failed the potential for

solar energy initiatives in Nigeria, the industry is encircled by barriers which makes the implementation difficult and almost impossible. Lack of skill personnel, consumer awareness about the product, lack of access to financing, lack of institutional framework, lack of long term policies for sustainable energy and trade barriers are hindering the deployment of solar energy initiatives in Nigeria. The Nigerian socio-economic activities cannot achieve its maximum potential unless the electricity challenges are adequately address by harnessing the available solar energy potential.

## 8. Conclusion and Recommendation

In conclusion, Nigeria, being a country within the belt of high solar radiation, a huge potential for solar energy could be grabbed to help support the epileptic conventional electricity in the country. The country possessed enormous solar energy drivers, making it a big opportunity to harness the potential solar energy to integrate into other renewable available in the country. In spite of the driving forces for the solar radiation in the country, the implementation process is constricted with many barriers, making it implementation chances very narrow. Even though, the power sector reform saw a progress for diversifying strategy to help bailout the power sector, to the energy mix, the progress indicator traced little or no significant to nearly achieving its objectives. The Nigerian government together with integration of public private partnership (PPP) need to aggressively pursue measures to mitigate the barriers for sustainable solar energy initiatives in the country by supporting local solar panels and batteries manufacturers and distributors. The abundant solar energy in Nigeria need to be harnessed effectively and integrated with other renewable energy such as wind, biomass and mini-grid to help solve the electricity challenges tumbling the economic development of the country.

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