# SUSTAINABLE RENEWABLE ENERGY POTENTIALS IN NIGERIA AND INDIA: COMPARATIVE LEGAL AND INSTITUTIONAL FRAMEWORK ANALYSIS

**Livinus I. Nwokike***

## Abstract

*It is no longer news that the supply of electricity in Nigeria is epileptic and this underscores the fact we normally hear people say at the neighbourhood that it is not our turn today. It surprises us people when light comes and people still shout "UP NEPA" despite the fact that Power/Electricity has been privatized in Nigeria. In India, it is not so. This epilepsy as regards power supply is not unconnected with the failure of the conventional energy sources which Nigeria unlike India adopted as their main energy supply despite measures taken nationally, regionally and at international levels to have alternative to this conventional source of energy for countries' economic development. The question is whether the legal and institutional frameworks available in Nigeria and India as energy source regulators are sustainable enough to provide good alternative sources of energy supply. Are the conventional energy sources for economic development in this competitive world lacking or abundant? This is the aim of this research. The work looked at renewable energy options in both countries, comparative legal and institutional framework regimes on renewable energy in both countries and of course, made recommendation where necessary as a way forward.*

**Keywords**: Sustainable, Renewable Energy, Potentials, Nigeria, India, Comparative, Legal and Institutional Framework and Analysis.

## 1. Introduction

Nigeria and India were both colonized by the same asters –Britain. The British colony came to transfer their culture, religion and technology. India colonial copied their technology completely but did not copy their culture and religion as such. Nigeria on the other hand did not copy their technology but copied and swallowed their culture and religion hook, line and sinker. Nigeria unlike India is yet to tap the benefit of abundant renewable energy for its socio-economic development despite the facts of the recently concluded bid round for the privatization of state power companies bidding either directly or in collaboration with local companies as technical partners.[1]

Renewable Energy otherwise described as 'Renewables' are types of energy that can be replaced naturally such as energy produced from wind or water; renewable such as hydro-

*__L. I. Nwokike__, OND, HND, PGD, MBA, FNIM. LLB (Hons), BL, LLM, Ph.D (candidate), Justice of Peace, Member, Nigerian Society of International Law, Notary Public & Lecturer, Department of International Law and Jurisprudence, Faculty of Law, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria, Email: li.nwokike@unizik.edu.ng, tolerancefocus@gmail.com, website: http://www.geci.org.ng. Phone Number: 08033521034, 09073018015

[1] Y. Oke, *Nigerian Energy Resources: Law and Practical* (Lagos: Princeton & Associates Publishing Co. Ltd, 2019) p. 628. See also the Public Enterprises (Privatization and Commercialization) Act, Cap P.38, Laws of the Federation of Nigeria, 2004 (Revised 2010) Pursuant to this Act, the NCP recently privatized some electricity generation and distribution successor companies (GENCO's and DISCO's) respectively

electricity and solar energy.[2] The availability of renewable energy or alternatives is vital to the provision of low cost, affordable and regular electricity for industrial development, employment generation and poverty alleviation in Nigeria. Energy is a catalyst for national development[3] and explains the reason why the current regime leaves no doubtful impression as to the need for the restructuring of the Nigerian electricity sector through privatization of state power companies.[4]It is conservatively estimated that the nation may have lost about 800 million US dollars due to unreliable power supply by NEPA and another 440 million US dollars through inadequate and inefficient fuel distribution. And figures like this do not even tell the whole story. They cannot, for example, capture the scope of human suffering and even loss of lives caused by shortage of petroleum sector where business centres, repair workshops, hair dressing salons, etc depend on steady supply of electricity to function.[5]As you all are away, we are not starting privatization from the scratch. Some work has been done by previous administration. This is also a pool of knowledge and experience we can draw from other countries that have successfully privatized their state-owned enterprises. Where such previous exercises will promote the integrity and transparency of our privatization exercise, they will be adopted and built upon.[6]

Beyond privatization, the reformed power sector of Nigerian requires some operational and regulatory restructuring to bring about a socially sustainable and community-friendly electricity regime in the country. The electricity industry is very complex.[7]Rigorous competition as a result of privatization could discourage investment in renewable energy in developing countries like Nigeria where the government desires to attract private investors, particularly for the purpose of production of renewable energy. To maximize the benefit of renewable energy requires proper planning, as unsuccessful outcome could result in great and unnecessary loss that tends to discourage investment.[8] Based on the foregoing, we shall look at the overview of Nigeria Energy regime, overview of Renewable energy governance in Nigeria, overview of the policy and framework and related Legislative and Regulatory

---

[2]A S Hornby Oxford Advanced Learner's Dictionary of Current English 9th ed., (Oxford: Oxford University Press, 2015) p. 1308

[3]F T Sparrow et al "Electricity Trade and Capacity Expansion Options in West Africa" Purdue Institute for Interdisciplinary Engineering, on-line at http://www.enc.purdue.edu/IIES/SUFGS, at page 5, accessed April 15, 2015.

[4]Y. Oke "Beyond Power Sector Reforms: The need for Decentralized Energy Options (DEOPs) for Electricity Governance in Nigeria, The Nigerian Journal of Contemporary Law; 18(1) 67-92

[5]Olusegun Obasanjo "The Imperative of Privatization", on the occasion of the inauguration of the National Council on privatization, presidential villa Abuja, Tuesday, 20th July, 1999, p.4

[6]*Ibid* at p. 5

[7]Y. Oke *op.cit* at 629

[8]D. Nikomborirak and W. Manachorphong, "Electricity Reform in Practice: The case of Thailand, Malayia, Indonesia and the Philippines, Intergovernmental Group of Experts on Competition Law and Policy", Geneva, 7-19 2007, pp. 1-3

intervention or measures that have been adopted in India as basis for those that need to be put in place to promote energy efficiency through renewable energy in Nigeria, Renewable energy options for Nigeria, Renewable energy for sustainable development in India: current status, future prospects, challenges, investment opportunities and way forward for both countries.

### 1.1 Clarification of Terms

The adjective 'sustainable' is defined as involving the use of natural products and energy in a way that does not harm the environment: sustainable forest management.[9]Sustainable development is seen as constituting development that meets the needs of the present without compromising the ability of the future generation.[10] Sustainable development is possible by use of sustainable energy and by ensuring access to affordable reliable sustainable and modern energy for citizens.[11] Renewable Energy (of energy and natural resources) is defined as that is replaced naturally or controlled carefully and can therefore be used without the risk of finishing it all. Renewables on the other hand are type of energy that can be replaced naturally such as energy produced from wind or water.[12]Potential is defined as that can develop into something or be developed in the future. Comparative Legal and Institutional Framework analysis describes how laws and institution between Nigeria and India are compared and analyzed on sustainable renewable energy to seeing the prospects and potential in each country above the other.

Privatisation is a noun word from the verb word Privatize. Privatize means to sell a business or an industry so that it is no longer owned by the government. It is the same thing as denationalize – the opposite of nationalize. Full privatization depicts divestment by the Federal government of all its ordinary shareholdings in the designated enterprise. Partial privatization on the other hand means divestment by the Federal Government of part of its ordinary shareholdings in the designated enterprise.[13]Commercialization is a noun word from the verb word commercialize. Commercialize means to use something, to try to make a profit, especially in a way that other people do not approve of. Full commercialization means that enterprise so designated will be expected to operate profitability on a commercial basis and be able to raise funds from the capital market without government guarantee. Such enterprises are expected to use private sector procedures in the running of their business partial commercialization on the other hand means that such enterprises so designated will be

---

[9]A.S. Hornby Oxford Advanced Learner's Dictionary, *Op.Cit*

[10] L.I. Nwokike, Sustainable Strategies for Waste Management in Nigeria: A Legal Appraisal, being Dissertation for the Award of Doctor of Laws, Faculty of Law, Nnamdi Azikiwe University, Awka, 2019

[11]C.R. Kumar et al, Renewable energy for sustainable development in India: Currency status, future prospects, challenges employment and investment opportunities, https://dol.org/10.1186/s13705-019-0232-11 . Accessed 18th July, 2020

[12]A S Hornby, *op.cit*

[13]See Federal Republic of Nigeria National Council on Privatization, Privatization Handbook 2nd ed., May 2010, p. 51

expected to generate enough revenue to cover their operating expenditures. The government may consider giving them capital grants to finance their capital projects.[14]

## 2. An Overview of Renewable Energy Governance in Nigeria

Although the power sector of Nigeria has now been privatized, it is yet to be liberalized in practical terms due to lack of definitive regime for renewable energy. This is because "privatization without liberalization" policy does not necessarily result in efficiency and higher social surplus. Frankly, privatization could lead to higher electricity price and reduction in social surplus[15] unless viable alternatives are created through the provision of renewable energy alternatives by re-working the pattern or model of energy resources governance and management in Nigeria towards a decentralized structure.[16] The concept of "Decentralized Energy Options [DEOPs]" centers on holistic approach to sustainable energy utilization and management for developing countries. It advocates decentralization of the governance structure, multiplication of the means of production, availability of affordance options and devolution of governance, control and management responsibilities.[17]The Nigerian Electricity Regulatory Commission (NERC) is saddled with power sector governance including facilitating electricity generation in Nigeria through conventional and renewable sources. The Commission is also charged with duties to create, promote, and preserve efficient industry and market structures, and to ensure the optimal utilization of resources for the provision of electricity by promoting and facilitating consumer connections to distribution systems in both rural and urban areas; among others.[18]

Conventional energy sources are not sustainable in the long run, being perishable and un-renewable.[19] Renewable energy constitutes one of the means of attaining the objective of decentralized energy options argued elsewhere by the author.[20]The trends of renewable energy have already taken deep roots in some countries in Africa. In Kenya for example, the widespread introduction and adoption of renewable energy technologies is made national priority on virtually every national development policy agenda.[21]No similar policy exists in

[14]*Ibid* at p. 52
[15]D. Nikomborirak and W. Manachorphong, *supra*
[16]Y. Oke, *Supra*
[17]*Ibid*
[18]See section 32(1) of the *Electric Power Sector Reform Act*, 2005, Cap E7, Laws of the Federation of Nigeria (LFN), 2004 (updated to the 31st Day of December, 2010).
[19]J. Kennedy-Darling, N. Hoyt, K. Murao and A. Rose, "The Energy Crisis of Nigeria" – An Overview and Implications for the Future, (LLM Thesis, The University of Chicago, 6.3. 2008), pp. 2-5
[20]See Y. Oke, "Beyond Power Sector Reforms: The need for Decentralized Energy Options (DEOPs) for Electricity Governance in Nigeria", *supra* note 2 at pages 67-92
[21]R H Acker, "The Quiet (Energy) Revolution: Analysing the Dissemination of Photovoltaic Power Systems in Kenya" (1996) 24:1 *Energy Policy*, pp. 81-111 at 81

Nigeria although the National Energy Policy[22] advocates and encourages renewable energy sources which are yet to translate to a matter of 'national priority.' The availability of renewable energy or alternatives is vital to the provision of low-cost, affordable and regular electricity for industrial development, employment generation and poverty alleviation in Nigeria. This paper underscores the importance of renewable energy to Nigeria from the standpoint of sustainable electricity including climate change adaptation in the country.[23] Renewable energy[24] came to the lime light in Nigeria due to energy challenges in the country occasioned largely by epileptic supply of electricity to consumers and partly as a result of the global trend of reducing the emission of carbon dioxide to curtail devastating effects of the use of fossil energy resources which led to climate change.

Renewable energies are derived from sources that are essentially inexhaustible, unlimited and naturally renewable and replenish-able such as wind, water, sun, wave, refuse, bio-fuel, among others. Captured in the Policy Guidelines on Renewable Electricity in Nigeria are Solar, Biomass, and wind which formed the focus of this article.[25] For a country like Nigeria, the challenge of maximizing the potential of renewable energy is one of lack of technological ability and innovation required to tap, utilize and manage renewable energy sources.[26] Although attaining the goal of national energy security through an efficient energy delivery system is one of the cardinal principles of the National Energy Policy;[27] realizing this lofty objective has proved very difficult, though not impossible in Nigeria.[28] The National Energy Policy aims at guaranteeing adequate, sustainable and reliable supply of energy at appropriate costs and in an environmentally friendly manner to various sectors of the economy for

---

[22]See the *Federal Republic of Nigeria,* "National Energy Policy", the Presidency- Energy Commission of Nigeria, April 2003, at p. 1

[23]See Y. Oke, "Adapting to Climate Change: Sustainable Mitigation Options for Developing Countries in Sub-Saharan Africa" (2011) 1 *NAIJS Journal of Environmental Law* (Nigerian Institute of Advanced Legal Studies), at pages 59-101.

[24]"Renewable electricity" refers to electric power obtained from energy sources whose utilization does not result in the depletion of the earth's resources. Renewable electricity also includes energy sources and technologies that have minimal environmental impacts, such as less intrusive hydro and certain biomass combustion. See *Policy Guidelines on Renewable Electricity in Nigeria,* December 2006, paragraph 2.0.

[25]*Ibid.* The Policy defines "biomass electricity", "solar energy" and "wind energy" thus:
Biomass electricity – Green plants converting sunlight into plant material through photosynthesis produce biomass energy
Solar energy – Electricity is generated from solar energy predominantly through photovoltaic materials (cells or modules) that converts sunlight directly into electricity.
Wind energy – The energy contained in the movement of air in form of wind is used to turn the blades of windmills or wind turbines which in turn could be used to drive electrical generators to produce electricity.

[26]J F K Akinbami, *Renewable Energy Resources and Technologies in Nigeria: Present Situation, Future Prospects, and Policy Framework, Mitigation, and Adaptation Strategies for Global Changes* (Kluwer Academic Publishers, Netherlands, 2001) at pp. 155-181 and pp. 162-164

[27]See "National Energy Policy", supra note 14

[28]*Ibid*

national development. It also emphasizes the need for promoting the use of alternative energy sources by conserving and using the environment and national resources for the benefit of present and future generations. The overall objective of this Policy Guidelines is to expand the role of renewable electricity in sustainable development through effective promotional and regulatory instruments.[29]

The above policy instrument also captures the need for effective implementation through coordination of rural electrification expansions with economic development objectives that encourage states, local communities as well as the private sectors to partner in the development of renewable energy sources. The Policy Guidelines is the Federal Government of Nigeria's integrated renewable energy policy. The Policy Guidelines sets out the Federal Government's vision, policies and objectives for promoting renewable energy in the power sector.[30]It acknowledges that access to electricity services is critical to achieving economic and social development targets of the Federal Government of Nigeria.[31]However, beyond the

[29]The policy guideline seeks to achieve the following specific objectives:

i. Expand electricity generating capacity to meet national economic and social development goals;
ii. Encourage the diversification of sources of electricity supply through renewable energy, and as such improve the energy security of the country;
iii. Increase access to electricity services nationwide, especially in rural areas;
iv. Stimulate growth in employment generation through an expanded renewable electricity industry;
v. Enhance technological development through increased domestic manufacturing of renewable electricity components;
vi. Stimulate competition in the delivery of renewable electricity;
vii. Promote rapid expansion of renewable-based electricity market through cost-reducing supply side and demand side incentives
viii. Develop regulatory procedures that are sensitive to the peculiarities of renewable energy based power supply;
ix. Create stable and predictable investment climate in renewable electricity market;
x. Provide effective promotion of electricity consumers through effective regulation; and
xi. Reduce household and outdoor air pollution as well as contribute to the abatement of greenhouse gas emissions, and thus contribute to improved health and overall social development.

*Ibid*. See also Adegoroye Adegoke, "The Challenges of Environmental Enforcement in Africa: The Nigerian Experience" – *The Third International Conference on Environmental Enforcement,* at pp. 43-45

[30]See *Policy Guidelines on Renewable Electricity in Nigeria,* December 2006. The Policy Guidelines is drawn primarily from the Constitution of the Federal Republic of Nigeria (1999), the National Energy Policy (2003), the Master Plan (2005), the draft Rural Electrification Policy and the National Economic Empowerment and Development Strategy (NEEDS).

[31]The Federal Government of Nigeria seeks the implementation of the policy on renewable electricity for the following specific reasons: First, renewable energy represents an important tool in the Government's overall effort to expand access to electricity services nationwide. Second, rural electricity access in Nigeria is less than 20%. By their nature, renewable electricity technologies are generally ideal for improving rural electricity access situations in the country, as grid power extensions over long distance to serve low load densities are usually technical and financially involving compared with a decentralized renewable electricity option. Renewable electricity provides more diversity and improves the reliability of electricity supply through the grid, especially in times of localized disruption of sources of power supply. It is environmentally friendly being mostly carbon

seemingly vague and general powers given to the NERC on renewable energy, the country lacks enforceable legal and/or regulatory framework to govern and manage renewable energy utilization for national growth and socio-economic development.

## 3. Renewable Energy Options for Nigeria

A number of renewable energy options are presently available in Nigeria, though largely unexplored including: wind, solar and biomass. This segment aims at amplifying the three renewable energy sources, being the sources captured by the Policy Guidelines on Renewable Electricity, as highlighted above.

### 3.1 Wind Energy

Renewable energy literature indicates that wind energy is the oldest source of power applied by mankind, used together with other sources of energy.[32] The use of wind as a source of power is said to have its origin in the Asian Civilization of China, Tibet, Indian, Afghanistan and Persia, with the first written evidence of its use as wind turbines.[33] Introduction of the steam engine in the Eighteenth ($18^{th}$) century led to gradual increase in the demand for energy to power machine.[34] With electrification of the industrialized world, the roles of wind power decreased, as fossil fuel became more economically competitive in providing electrical power on large scale. The trend of wind energy development and popularity of harnessing power from the wind depends primarily on the economic alternative sources of energy from fossil fuels.[35]

Nigeria's energy resources potentials still suffer from over dependence on hydro power which is largely susceptible to seasonal variations in the amount of water levels at dams. This is one of the rationales offered for the nation's commitment to establishing wind energy projects as power generation alternatives.[36] Nigeria's wind and other renewable energy initiatives are

---

neutral and reduces indoor and urban pollution as well as emission of greenhouse gases that cause global warming, *Ibid*, paragraph 1.0 – background

[32] See The Early History of Wind Energy, Global Sources, on-line at: http://www.brighthub.com/environment/renewable-energy/articles/71440.aspx, accessed June 17, 2019

[33] "History of Wind Energy" – United States Department of Energy, on-line at: http://www1eere.energy.gov/wind/printable_versions/wind_history.html.Windoprogram accessed June 17, 2019

[34] Bourton Hill, "Wind Electricity Generation" Practical Action: The Schumacher Centre For Technology and Development, Bourton-on-Dunsmore, Rugby, Warwickshire, CV239QZ, UK, on-line art: www.practicalaction.org accessed September 20, 2019

[35] See Dannem and Anderson, "Review of Historical and Modern Utilization of Wind Power": RISO Department Publications-Wind-Energy Department http://www.risoe.dtu.dk.rispubl/VEA/Review_Historical_Modern_Utilization_Wind_Power.pdf, accessed September 20, 2019

[36] Ibid

inspired by various international processes.[37] By placing reliance on renewable energy that are naturally inexhaustible in nature, the country is able to develop renewable energy resources for its economic development while also contributing in improvement of the global world through pursuit of greener energy devoid of greenhouse gases that deplete the ozone layers.[38]

Wind energy is a global phenomenon. For instance, in its submission to the United Kingdom National Grid on the future operation of the Electricity Transmission Network, wind energy is seen as a crucial back-up to the nation's electricity needs.[39] Similarly, China's total exploitable capacity for both land based and off-shore wind energy is higher when compared to other leading global wind power markets that are closer to that of United States and greatly above the resource of India, Germany or Spain. This further amplifies the importance of wind energy to countries and underscores the need for Nigeria to fully exploit her wind energy resource in the quest for stable, private-sector driven electricity in the country.[40] For Nigeria, renewable sources of energy for power generation portend enormous, untapped and sustained opportunities for meeting the electricity demands in the country.

### 3.2 Solar Energy

Solar radiation, being abundantly present in Nigeria, is one area of focus among the renewable energy resources, though technologies for solar energy applications are yet to be fully accepted as household commodities in the country.[41]Solar energy portends hope for majority of the people in Nigeria who live in rural communities where there are difficult terrains, no good roads, electricity grids or lack of access to fossil fuel energy resources.[42] Solar energy is one of the veritable sources of renewable electricity in Nigeria.[43] The Renewable Energy Policy of Nigeria 2006,[44] merely acknowledge the fact that "renewable electricity offer cost-effective, options for extending electricity and stimulating sustainable development in the rural areas." The Guidelines also sets out the Federal Government's vision, policies and

[37] See for example the United Nations Conventions and Programmes, the G8 process and the high level Ministerial Conference Series and International Renewable Energy Conference dedicated to renewable energy which forms platforms for positioning and promoting renewable energy as a potential win-win option in both the environmental and development arenas.

[38] Renewable Energy and Electricity: "World Nuclear Association". Online http://www.world-nuclear.org/info10.html accessed April 13, 2019, at p.3

[39]Rajveer Mittal, K S Sandu and D K Jain, "Battery Energy Storage System of Variable Speed Driven PMSG for Wind Energy Conversion System" (2010) 1:3 International Journal of Innovation, Management and Technology, at pp. 9-11

[40]*Ibid*

[41] See P A Ilenikhena, "Solar Energy Applications in Nigeria" WEC, Montreal, Paper No. 135 (Revised), 2010 on-line at http://www.worldenergy.org/documents/congresspapers/135.pdf, accessed October 15, 2019.

[42]*Ibid*

[43] Other sources of electricity include; solar energy, wind power, geothermal; bio energy or bio fuel or biomass cogeneration; hydrothermal, tide; wave and hydrogen energy, among others

[44] See the Policy Guidelines on Renewable Electricity in Nigeria, 2006, *supra* note 22

objectives for promoting renewable energy in the power sector, including electricity from solar energy sources.[45]

Nigeria is squarely located in the tropics, with its land mass stretching between latitudes 5-degrees south and 15-degrees north of the equator. As a consequence, the country enjoys abundant amounts of sunshine.[46] The opportunities offered by decentralized rural community solar powered electrification programs have been well documented.[47] For Nigeria, these benefits include but not limited to community water pumping; enhanced healthcare delivery to rural areas and remote villages, exposure to modern education technology and lighting. Solar energy sources could therefore enable the development of social infrastructures in Nigeria to enhance the health and wellbeing of rural communities; catalyze the development of small-scale enterprises and cottage businesses; and stem the trends of rural-urban migration. However, despite efforts to create awareness on the effective use of solar energy, the technologies for solar energy applications are yet to gain acceptance in most Nigerian households.[48]

The use of solar electricity is particularly suitable for rural electrification due to inability to connect to the national electricity power grid.[49] Nigerian researchers have made attempts to justify the need for rural, community electrification through solar, by applying photovoltaic to convert solar energy radiation to electricity.[50] The development of renewable energy for rural communities through solar cannot be overemphasized though, regrettably, there is no specific legal framework for solar energy in Nigeria. One may concede that the policy framework for solar energy is enshrined in the National Energy Policy and the Policy Guidelines on Renewable Electricity in Nigeria which lists 'solar' as one of the focal points of Government's renewable electricity policy and guidelines respectively.[51]

### 3.3 Biomass Energy

As a renewable energy source, biomass is biological in nature and derived from living, or

---

[45] *Ibid*

[46] The average solar insulation in Nigeria is estimated to vary between 4.0KWh/m2/day at the southern coasts to 7.0KWh/m2/day at the northern coasts of the country. The daily average is estimated at 5.5 KWh/m2/day. The availability of abundant sunshine is a positive indicator that Nigeria is an ideal candidate for investment in solar energy resource development

[47] R Freling, J Lahl, *Renewable Energy Technology: Optimizing Energy Sources for the Development of Millennium Project Villages;* Solar Electric Light Fund (SELF): Washington, DC, USA, 8 July 2005

[48] See P A Illenikhena, "Solar Energy Applications in Nigeria", supra note 45

[49] See Adenike Boyo, "Development of Solar Energy in Lagos State, Nigeria" on-line at: http://www.wcpsd.org/posters/environment/Boyo_Adenike_2pdf accessed October, 15 2015

[50] *Ibid*

[51] See for example paragraph 2.0 of the Policy Guidelines on Renewable Electricity in Nigeria, supra note 22

recently living organisms.[52] Biomass can either be used directly such as bio-power, or converted into other energy products such as bio-fuel.[53] Examples of sources of biomass include forest residues, (such as dead trees, branches and stumps), yard clippings, wood chips, etc. The other category of biomass includes plant or animal matter that can be converted into bio-fuels and those derived from other types of plants such as switch-grass, corn, sugarcane, oil palm, etc.[54]Biomass is one of the oldest sources of renewable energy in Nigeria used since our ancestors learned the secret of fire.[55] Biomass is a renewable low carbon fuel that is already widely available in all the parts of the world. Its production and use also brings additional environmental and social benefits. If properly managed, biomass is a sustainable fuel that can deliver a significant reduction in net carbon emissions when compared with fossil fuels.[56] The vital difference between biomass and fossil fuel is one of time scale. Unlike biomass, the burning of fossil fuel dirties the air, consumes and pollutes water, hurts plant and animal, creates toxic wastes and causes global warming.[57] This makes biomass a preferable option in the quest for greener energy sources. Biomass can be used for fuels, power production and products that would otherwise be made from fossils fuels. Biomass energy has the potential to greatly reduce greenhouse gas emission.

Traditionally, biomass is the most commonly used source of rural energy in Nigeria because fuel-wood is the cheapest and most accessible source of fuel even in urban households. Despite the availability of conventional domestic fuels, fuel-wood as traditional fuel source remains in very high demand at the expense of Nigerian forests. Generally, biomass energy is derived from five distinct energy sources: garbage, wood, waste, landfill gases and alcohol fuel. But despite its relative benefits and abundance, there is no enabling legislation on Biomass as a source of renewable energy. In the quest for rural electrification, the pursuit of biomass will ensure uninterrupted electricity to rural areas; enhance rural energy efficiency; promote technological innovations and transfer of renewable energy technologies to rural communities and generally improve lives and livelihoods of the Nigerian masses, particularly in the rural areas and local communities. This makes it crucial for definitive legal and policy framework on biomass in Nigeria.

---

[52] See D Arnosti, and D Abbas, "Harvesting Fuel: Cutting Cost and Reducing Forest Fire Hazards through Biomass", (2008) *Institute for Agriculture and Trade Policy,* at p 1

[53] T A Volk, *Developing a Willow Biomass Crop Enterprise for Bioenergy and Bio-products in United States,* (Buffalo Press, New York, 2000) at 15

[54]*Ibid*

[55] Miller Alan and Serchuk Adam, "The Environmental Imperative: A Driving Force in the Development and Deployment of Renewable" (1996) NO. 1 REPP issue Brief, p.5

[56] L R Brown, "Plan B: Mobilizing to Save Civilization." (2008) Earth Policy Institute, W W Norton and Company, New York, p 398

[57] J Holmberg and V Dornburg, "Using Biomass for Climate Change Mitigation and Oil Use Reduction" (2007) 35 Energy Policy, p. 671

## 4. The Nigerian Energy Challenge

Nigeria's energy need is on the increase, and its increasing population is not adequately considered in the energy development program. The present urban-centered energy policy is deplorable, as cases of rural and sub-rural energy demand and supply do not reach the center stage of the country's energy development policy. People in rural areas depend on burning wood and traditional biomass for their energy needs, causing great deforestation, emitting greenhouse gases, and polluting the environment; thus creating global warming and environmental concerns. The main task has been to supply energy to the cities and various places of industrialization, thereby creating an energy imbalance within the country's socioeconomic and political landscapes. Comparing the present and ever-increasing population with the total capacity of the available power stations reveals that Nigeria is not able to meet the energy needs of the people. The rural dwellers still lack electric power. Infact, the following are the challenges facing Nigeria in her development of renewable energy:

- Prevalence of a regime of price control.
- Weak concern for cost recovery and lack of adequate economic incentives to induce the state-owned companies (NNPC and PHCN) to engage in efficient production and investment behaviour. This seems apparent in the existence of large input and output subsidies.
- Multiplicity of economic and noneconomic objectives without proper identification of the trade-offs among these different objectives. This is implicit in its pricing policies in both electricity and petroleum products markets.
- Institutional and governance failures which induced gross distortions and inefficiency in production, investment choices and high costs of operation, low return on investment, and expensive delays along with cost overruns in the state energy enterprises.

### 4.1 Comparative Legal Regimes of Renewable Energy

The sources of electricity production such as coal, oil, and natural gas have contributed to one-third of global greenhouse gas emissions Conventional energy sources are not sustainable.[58] Nigeria is vulnerable to the threat of energy crisis despite the country's great energy potentials. This creates the ineluctable need for renewable energy sources,[59]and this requires deploying suitable, modern technologies.[60] Several countries have put in place policy and legal framework for simulating the development and growth of renewable energy.

India has an increasing energy demand to fulfill the economic development plans that are being implemented. The provision of increasing quanta of energy is a vital pre-requisite for

[58] Julia Kennedy-Darling, Nick Hoyt, Kyle Murao and Allison Rose, *Supra* note 11

[59]*Ibid*

[60]Rajveer Mittal, K S, Sandu and Jain D K, "Battery Energy Storage System of Variable Speed Driven PMSG for Wind Energy Conversion System", *supra* note 43

the economic growth of a country.[61] It is essential to raise the standard of living by providing cleaner and more reliable electricity.[62]

According to the World Resource Institute Report 2017,[63] India is responsible for nearly 6.65% of total global carbon emissions, ranked fourth next to China (26.83%), the USA (14.36%), and the EU (9.66%). Climate change might also change the ecological balance in the world. Intended Nationally Determined Contributions (INDCs) have been submitted to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. The latter has hoped to achieve the goal of limiting the rise in global temperature to well below 2ºC.[64] According to a World Energy Council[65] prediction, global electricity demand will peak in 2030. India is one of the largest coal consumers in the world and imports costly fossil fuel.[66] Close to 74% of the energy demand is supplied by coal and oil. According to a report from the Center for Monitoring India Economy, the country imported 171 million tons of coal in 2013- 2014, 215 million tons in 2014 – 2015, 207 million tons in 2015-2016, 195 million tons in 2016 – 2017, and 213 million tons in 2017 – 2018.[67] Therefore, there is an urgent need to find alternate sources for generating electricity.

## 5. India's Experience in Renewable Energy Development

In India, in the year 2009, the Ministry for New and Renewable Energy (MNRE) approved a generation based incentive (GBI) scheme for wind power projects which stipulated that an incentive tariff would be given to eligible projects for a period of ten years. By year 2010, the Indian government clearly recognized the role that renewable energy can play in reducing dependence on fossil fuel, and combating climate change. The country introduced a tax on every metric ton of coal produced or imported into India, which was used to contribute to a new clean energy fund, through a Green Bank working in tandem with the Indian Renewable

---

[61] C R Kumar, J V Kumar, M A Majid, Wind energy programme in India: emerging energy alternatives for sustainable growth, Energy & Environment, 30(7) (2019), pp. 1135-1189

[62] C V Zabeltitz, Effective use of renewable energies for greenhouse heating. Renewable Energy, 5 (1994), pp. 479-485

[63] Canadian environmental sustainability indicators, Global greenhouse gas emissions (2017). Available at http://www.ec.gc.ca/indicateurs-indicators/54C061B5-44F7-A3EC-5F8B253A7235/Global GHG Emissions_EN.pdf. Accessed 27 June, 2017. See also D Pappas, Energy and industrial Growth in India: The Next Emissions Superpower? 105 (2017) Energy procedia, pp. 3656-3662

[64] P Agreement (2015) Available at https://unfccc.int/sites/default/files/english_paris_agreement.pdf. Accessed 20 August, 2017. See also P Aggarwal 2ºC target, India's climate action plan and urban transport sector, 6 (2017). Travel Behaviour and Society, pp. 110-116

[65] World Energy Scenarios Composing energy futures to 2050, (2013), World energy Council. https//www.worldenergy.org/wp-content/uploads/2013/09/World-Energy-Scenarios_Composing-energy-futures-to-2050_Full-report. Pdf. Accessed 01 Jan 2017

[66] *Ibid*

[67] M Blondeel, V T de Graaf . Toward a global coal mining moratorium? A comparative analysis of coal mining policies in the USA, China, India and Australia, Climatic Change, 150(1-2) (2018), pp. 89-101

Energy Development Agency which is a government owned non-banking financial company.[68]

The National Electricity Plan [NEP][69] framed by the Ministry of Power (MoP) has developed a 10-year detailed action plan with the objective to provide electricity across the country, and has prepared a further plan to ensure that power is supplied to the citizens efficiently and at a reasonable cost.[70] In this way, the country will have a rapid and global transition to renewable energy technologies to achieve sustainable growth and avoid catastrophic climate change. Renewable energy sources play a vital role in securing sustainable energy with lower emissions.[71] It is already accepted that renewable energy technologies might significantly cover the electricity demand and reduce emissions. In recent years, the country has developed a sustainable path for its energy supply. Awareness of saving energy has been promoted among citizens to increase the use of solar, wind, biomass, waste, and hydropower energies. It is evident that clean energy is less harmful and often cheaper.

India is aiming to attain 175 GW of renewable energy which would consist of 100GW from solar energy, 10 GW from bio-power, 60 GW from wind power, and 5GW from small hydropower plants by the year 2022.[72] Investors have promised to achieve more than 270GW, which is significantly above the ambitious targets. The promises are as follows: 58GW by foreign companies, 191GW by private companies, 18GW by private sectors, and 5GW by the Indian Railways.[73] Recent estimates show that in 2047, solar potential will be more than 750GW and wind potential will be 410GW.[74] To reach the ambitious targets of generating 175GW of renewable energy by 2022, it is essential that the government creates 330,000 new

---

[68] The Green Bank contribute to a new clean energy fund, working in tandem with the India Renewable Energy Development Agency which is a government owned non-banking financial company. The funds from the fund are generated through annual returns from the Clean Energy Fund

[69] National Electricity plan, Generation, Central Electricity Authority (CEA), Ministry of Power, GOI. Volume 1, (2016) Available at http://www.cea.nic.in/reports/committee/nep/nep_dec.pdf Accessed 31 Jan, 2018

[70] C R Kumar & M A Majid, Renewable energy for sustainable development in India: Current, status, future prospects, challenges, employment and investment opportunities. Online at https://dol.org/10.1186/s13705-019-0232-1 accessed on 18th June, 2020

[71] S Kumar, CO2 emission reduction potential assessment using renewable energy in India, Energy, 97(2016), pp. 309-342

[72] C R Kumar, J M Arunsi, B Jenova, R M A Majid, Sustainable waste management through waste to energy technologies in India-opportunities and environmental impacts. International journal of renewable energy research, (2019), 9(1): 309-342

[73] National Institution for Transforming India, Government of India, Report of the Expert group on 175 GW RE by 2022. (2015) Available at http://nitigov.in/writereaddata/files/writerreaddata/files/document_publication/report.175-GW-RE.pdf.Accessed 31 Dec 2016

[74] R B Sholapurkar, Y S Mahajan, Review of wind energy development and policy in India. Energy Technology & Policy, 2 (2015) pp. 122-132. See also India Energy scenario 2047, ISGF for planning commission (2015). Available at http://www.indiaenvironmentportal.org.in/files/file/ISGF_IES%2020447%20Documentation. Pdf Accessed 01 Jan, 2017

jobs and livelihood opportunities.[75]

A mixture of push policies and pull mechanisms, accompanied by particular strategies should promote the development of renewable energy technologies. Advancement in technology, proper regulatory policies,[76] tax deduction, and attempts in efficiency enhancement due to research and development (R&D)[77] are some of the pathways to conservation of energy and environment that should guarantee that renewable resource bases are used in a cost-effective and quick manner. Hence, strategies to promote investment opportunities in the renewable energy sector along with jobs for the unskilled workers, technicians, and contractors are discussed. This article also manifests technological and financial initiatives,[78] policy and regulatory framework, as well as training and educational initiatives[79] launched by the government for the growth and development of renewable energy sources. The development of renewable technology has encountered explicit obstacles, and thus, there is a need to discuss these barriers. Additionally, it is also vital to discover possible solutions to overcome these barriers, and hence, proper recommendations have been suggested for the steady growth of renewable power[80]. Given the enormous potential of renewable in the country, coherent policy measures and an investor-friendly administration might be the key drivers for India to become a global leader in clean and green energy.

### 5.1 How renewable energy sources contribute to the energy demand in India

Even though India has achieved a fast and remarkable economic growth, energy is still scarce. Strong economic growth in India is escalating the demand for energy, and more energy sources are required to cover this demand. At the same time, due to the increasing population and environmental deterioration, the country faces the challenge of sustainable development. The gap between demand and supply of power is expected to rise in the future.[81]

---

[75] T Harrison, G Kostka, Balancing priorities, aligning interests: developing mitigation capacity in China and India. Comparative Political Studies, 47(2014) pp. 450-480. See also K S Akash, Renewable energy resources in South Asian Countries: challenges, policy and recommendations. Resource-Efficient Technologies, 3 (2017) pp 342-346

[76] G Schmid, The development of renewable energy power in India: which policies have been effective? Energy Policy, 45 (2012) pp. 317-326

[77] K Vikas, N Savita, B Prashant, Status of solar wind renewable energy in India, Renewable and Sustainable Energy Reviews, 27(2013) pp. 1-10

[78] R Singh, India's renewable energy targets: How to overcome a $200 billion funding gap. Renewable Energy Focus. 16(4) (2015) pp. 60-61

[79] T Blenkinsopp, S R Coles, K Kirwan, Renewable energy for rural communities in Maharashra, India, Energy Policy. 60 (2013) pp. 192-199. See also T C Kandp, H P Garg, Renewable energy education for technicians/mechanics, Renewable Energy, 14(1-4) (1998) pp.393-400

[80] C S Bhattacharyya, Shaping a sustainable energy future for India: management challenges, Energy Policy 38(8), pp. 4173-4185. See also S Singh, K C Boparai, India and renewable energy: a future challenge, Renewable Energy, 15(1-4) pp.16-21

[81] A Inaki, The energy requirements of a developed world, Energy for Sustainable Development, 33 (2016) pp.1-13

According to the Load generation and Balance Report (2016-2017) of the Central Electricity Authority of India (CEA), the electrical energy demand for 2021-2022 is anticipated to be at least 1915 terawatt hours (TWh), with a peak electric demand of 298 GW.[82] Increasing urbanization and rising income levels are responsible for an increased demand for electrical appliances, i.e., an increased demand for electricity in the residential sector. The increased demand in materials for buildings, transportation, capital goods, and infrastructure is driving the industrial demand for electricity. An increased mechanization and the shift to groundwater irrigation across the country is pushing the pumping and tractor demand in the agriculture sector, and hence the large diesel and electricity demand. The penetration of electric vehicles and the fuel switch to electric and induction cook stoves will drive the electricity demand in the other sectors.

According to the International Renewable Energy Agency (IRENA), a quarter of India's energy demand can be met with renewable energy. The country could potentially increase its share of renewable power generation to over one-third by 2030.[83]

### 5.2 Estimated renewable energy potential in India

The estimated potential of wind power in the country during 1995[84] was found to be 20,000 MW (20 GW), solar energy was 5 x $10^{15}$kWh/pa, bioenergy was 17,000MW, bagasse cogeneration was 8000 MW, and small hydropower was 10,000MW. For 2006, the renewable potential was estimated as 85,000MW with wind 4500 MW, solar 35MW, biomass/bioenergy 25,000MW, and small hydropower of 15,000 MW.[85] According to the annual report of the Ministry of New and Renewable Energy (MNRE) for 2017-2018, the estimated potential of wind power was 302.251 GW (at 100-m mast height), of small hydropower 19.749 GW, biomass power 17.536 GW, bagasse cogeneration 5GW, waste to energy (WTE) 2.554 GW, and solar 748.990GW. The estimated total renewable potential amounted to 1096.080 GW[86] assuming 3% waste land.

---

[82] V Khare, Status of solar wind renewable energy in India Renewable and Sustainable Energy Reviews, 27 (2013) pp. 1-10

[83] REMAP, renewable energy prospects for India, The International renewable energy agency (IRENA). (2017) Available at https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/May/IRENA_REmap_India_paper_2017. Pdf. Accessed 23 August, 2017

[84] B S K Naidu, Indian scenario of renewable energy for sustainable development, Energy policy Vol 24, (1996) pp 575-581,

[85] A Kumar, K Kumar, N Kaushik, S Sharma, S Mishra, Renewable energy in India: Current status and future potentials , Journal of renewable and sustainable energy reviews, 14(2010), pp 2434-2442

[86] S Bandyopadhyay, Renewable targets for India. Clean Technologies and Environmental Policy 19(2)(2017) pp 293-294

### 5.2.1 Solar Energy

Under the National Solar Mission, the MNRE has updated the objective of grid-connected solar power projects from 20 GW by the year 2021-2022 to 100GW by the year 2021-2022. In 2008-2009, it reached just 6MW. The "Made in India" initiative to promote domestic manufacturing supported this great height in solar installation capacity. Currently, India has the fifth highest solar installed capacity worldwide. By the 31st of December 2018, solar energy had achieved 25,212.26MW against the target of 2022, and a further 22.8GW of capacity has been tendered out or is under current implementation. MNRE is preparing to bid out the remaining solar energy capacity every year for the periods 2018 – 2019 and 2019 – 2020 so that bidding may contribute with 100GW capacity additions by March 2020. In this way, 2 years for the completion of projects would remain. Tariffs will be determined through the competitive bidding process (reverse e-auction) to bring down tariffs significantly. The lowest solar tariff was identified to be INR 2.44 per kWh in July 2018. In 2010, solar tariffs amounted to INR 18 per kWh. Over 100,000lakh (10,000 million) acres of land had been classified for several planned solar parks, out of which over 75,000 acres had been obtained. As of November 2018, 47 solar parks of a total capacity of 26,694 MW were established. The aggregate capacity of 4195MW of solar projects has been commissioned inside various solar parks (floating solar power).

### 5.2.2 Wind Energy

As of the 31st of December 2018, the total installed capacity of India amounted to 35,138.15MW compared to a target of 60GW by 2022. India is currently in fourth position in the world for installed capacity of wind power. Moreover, around 9.4 GW capacity has been tendered out or is under current implementation. The MNRE is preparing to bid out for A 10 GW wind energy capacity every year for 2018-2019 and 2019-2020, so that bidding will allow for 60GW capacity additions by March 2020, giving the remaining two years for the accomplishment of the projects. The gross wind energy potential of the country now reaches 302 GW at a 100m above-ground level. The tariff administration has been changed from feed-in-tariff (FiT) to the bidding method for capacity addition. On the 8th December 2017, the ministry published guidelines for a tariff-based competitive bidding rule for the acquisition of energy from grid-connected wind energy projects.

## 6. Conclusion and Recommendations

Compared to advanced countries like United States of America and China, Nigeria and India should double their efforts in promoting renewable sources of electricity. It is beyond doubt that Nigeria still remains in abysmal situation in terms of renewable energy initiatives, as efforts aimed at diversifying the country's energy sources from economically perilous fossil

fuels to renewable energy are yet to yield desired results.[87]India on the other hand, has developed technologies for renewable energy potentials and utilization than Nigeria, but their government needs to relax some of their policies and regulatory framework which is not available in the renewable sector so as to help them develop their renewable energy potentials like United States of America and China; technology and financial initiatives in India notwithstanding.

Looking at the above conclusion, this paper advocates putting appropriate policy, legal and institutional frameworks in place to promote and develop potential renewable energy sources towards meeting the much-desired electricity needs of the country and to stimulate socio-economic development. Nigeria should emulate a range of legal and policy measures available in India for developing sustaining renewable energy to boost the nation's electricity. Thus, where there is a requirement to promote the growth of particular renewable energy technologies, policies might be declared that match with the plans for the development of renewable energy.

[87] See for example the argument of Abubukar S. Sambo, 'Strategic Developments in Renewable energy in Nigeria' International Association Energy Economics, at p. 1