The Journal of Sustainable Development Law and Policy

ISSN: 2467-8406 (Print) 2467-8392 (Online) Journal homepage: https://www.ajol.info/index.php/jsdlp

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To cite this article: Tayo Douglas, Adebiyi Anthony Adepoju and Yewande Fadeke Oluwajobi (2024). Impacts of Green Technology on the Promotion of Renewable Energy in Nigeria: The Imperatives of Regulatory Mechanism. The Journal of Sustainable Development, Law and Policy. Vol. 15:3. 287-313. DOI:10.4314/jsdlp.v15i3.11

To link this article: DOI:10.4314/jsdlp.v15i3.11

Published online: September, 2024

IMPACTS OF GREEN TECHNOLOGY ON THE PROMOTION OF RENEWABLE ENERGY IN NIGERIA: THE IMPERATIVES OF REGULATORY MECHANISM

Tayo Douglas*, Adebiyi Anthony Adepoju**, Yewande Fadeke Oluwajobi***

ABSTRACT

In an attempt to address the environmental challenges associated with the extraction and burning of fossil fuels in Nigeria and other nations, special attention must be paid to the issue of renewable energy, which has been neglected in the last few decades. The main objective of this paper is to evaluate the the impact of green technologies on the promotion of renewable energy in Nigeria and the need to have a legal framework for green energy in Nigeria. The paper examined the nexus between renewable energy and green technology; it also reviewed the mechanisms for promotion of green technologies as well as the role of law in the deployment of green technologies for sustainability purposes in Nigeria. This paper adopted the doctrinal approach in analysing the impacts of green energy on Nigeria's push for renewable energy that is sustainable and environmentally friendly. This paper found that green technologies evolved from the need to address environmental concerns over greenhouse gas emissions from 'dirty energy,' in addition to efficiency in the production and use of energy. The study recommended that laws and policies should be implemented to support green energy.

Keywords: Impacts, Green-Technology, Promotion, Renewable-Energy, Green-energy.

1. INTRODUCTION

Intensive demand for energy will continue to rise in Nigeria due to increase population and industrial activity growth. Currently, most of the country's policies and laws regulating the energy sector are mainly in place to address security and availability. Adequate attention has not been given to fundamental issues, including climate change. Policymakers must look beyond energy security, and policies must promote renewable energy transition and address climate change. The transition to green energy will address energy security and affect other sustainable energy components, like energy equity and environmental sustainability.

The concept of green technologies is drawing attention due to the threats posed by greenhouse gas emissions to the environment and the need to efficiently address the use and production of energy.[1] Deployments of technologies based on green energy have brought to the fore procedures or approaches that would ensure that energy production upgrades and advance environmental benefits.[2]

This paper examines the growth of green energy, the promotion of renewable energy and the advancement of technologies that rely on green energy. It traces developments of green technology and renewable energy generation in Nigeria. The paper reveals that as much as the energy and climate change policies support green energy transformation, the extant energy law does not support promoting green energy generation. Therefore, Nigeria's policymakers must ensure the transition to green energy generation. The transition would improve human well-being social equality, and reduce environmental risks associated with energy generation in Nigeria. The essence of this study is to demonstrate that without regulatory mechanisms put in place, it would be difficult for Nigeria as a country to achieve its green energy sustainable goals. This study is premised on the Self Determination theory. This is a theory that argued that renewable energy should be based on creating local solutions to energy problems by utilizing the available indigenous materials. Every local areas have available materials that are in abundance and "by understanding the energy potentials and innovation abilities of each are, national and regional energy policies can be developed to

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1 Paul Edwards, 'Representing the Global Atmosphere; Computer Models, Data and Knowledge About Climate Change', in Clark A. Miltera, Paul N. Edwards (eds.), Changing the Atmospheres Expert Knowledge and Environmental Governance (MIT Press, Cambridge, 2001) 41; Mathew Burns, 'A Sustainable Framework our International Green Technology Transfer' [2012] CJIELP 405, 410

2 Ibrahim Dincer and Mare A. Rosen, 'The Role and Future Benefits of Green Energy' [2007] IJGE 65

support areas with insufficient energy and innovation capacities in their development of local energy sovereignty".[3]

1.1 Renewable Energy and Green Energy Technologies: The Nexus

1.1.1 Green Energy: Meaning and Evolution

Industrialization and economic developments impact the environment. Climate change, air and water pollution, depletion of natural resources, and loss of biodiversity are consequences of economic development and industrialization. Climate change has been a significant environmental challenge for policymakers for decades.[4] Climate change negatively impacts human development, and energy generation is no exception. If not properly addressed, climate change and other environmental challenges such as droughts, will affect energy security. It can cause water levels to fluctuate, leaving the energy generation capacity precariously low.[5]

Energy production has been linked to greenhouse gas emissions, the principal cause of climate change. The multinational oil companies engage in intense energy-related activities contributing significantly to greenhouse gas emissions. This has been a significant reason the sector attracted special attention in the international energy policy and agreements. According to statistics, the energy sector alone accounts for more than 50% of global emissions.[6] The volume of greenhouse gas emissions arising from energy

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3 K.O. Chilakpu, 'Renewable Energy Sources: Its benefits, potentials and challenges in Nigeria' (2015) 5(9) Journal of Energy Technology and Policy. Also see "What is the Theoretical Framework of Renewable Energy, <https://typeset.io/questions/what-is-the-theoretical-framework-of-renewable-energy-29xagm9fgq> accessed 26 August 2024.

4 C. Raleigh and L. Jordan, 'Climate Change and Migration: Emerging Patterns in the Developing World' in R. Mearns and A. Norton (eds), Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World, (The World Bank, Washington DC, 2010) 103; Chidi Odozor and Kola O. Odeku, 'Explaining the Similarities and Differences between Climate Law and Environmental Law' [2014] JHE 127.

5 Monika Manglik and Mangey Ram, 'Behavioural Analysis of a Hydroelectric Production Power Plant under Reworking Scheme' [2015] IJPR 648; Tze-Zhang Ang et al, 'A Comprehensive Study of Renewable Energy Sources: Classifications, Challenges and Suggestion' (2022) Energy Strategy Review 43.

6 J.B. Skjærseth and T. Skodvin, Climate Change and the Oil Industry: Common Problem, Different Strategies, Issues in Environmental Politics (Manchester University Press 2003) 2.

production is a major concern, coupled with the fact that greenhouse gas emissions have been projected to rise by 2030.[7]

In response to the challenges of energy production, scientists are searching for a sustainable energy production approach that will address climate concerns and other sustainable energy objectives. Countries around the world are seeking ways to combat climate change. In the era of climate change occasioned by fast industrialization and economic development, promoting environmental sustainability is as important as other sustainable energy goals[8].

Discussions on the relationship between energy security and climate goals have analysed energy security as a priority policy to which climate change policy should contribute.[9] This explains why energy security has remained the primary focus of major energy systems worldwide. The narrative is changing; mitigating the impact of energy production on climate change is attracting special attention. Efforts are ongoing to ensure that energy policy supports the stabilization of the climate so that there will be a synergy between energy production and climate change mitigation.[10] An important step in this regard has been attempting to reduce fossil fuel dependency in energy generation in favour of green energy sources.

Green energy emerged as a result of the concerns for the environment. Though in existence for many decades, it only begins to attract attention in

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7 Samantha Ölz, Ralph Sims and Nicholai Kirchner, 'Contributions of Renewables to Energy Security: IEA Information Paper' (OECD and IEA, 2007) 1

8 Olujobi, O.J., Irumekhai, O.S., An Analysis of the Abolition of Premium Motor Spirit (PMS) Subsidies in Nigeria: A Breach of Social Contract or Climate Change Action? (2024), Discover Sustainability 5, <https://doi.org/10.1007/s43621-024-00252-z https://link.springer.com/content/pdf/10.1007/s43621-024-00252-z.pdf> (accessed September 10, 2024).

9 Eberhard Jochem and Reinhard Madlener, 'The Forgotten Benefits of Climate Change Mitigation: Innovation, Technological Leapfrogging, Employment, and Sustainable Development' (OECD Workshop on the Benefits of Climate Policy: Improving Information for Policy Makers, 2003) 1

10 F. Krause, W. Bach and J. Koomey, Energy Policy in the Greenhouse: From Warming Fate to Warming Limit, (Earthscan Library Collection, 2009); Rafeal Leal-Arcas, 'Linking Energy and Climate Change' (Presentation at COP 18, UN Climate Change Conference, 2012)

the past two decades.[11] Different authors have described green energy based on different yardsticks, such as the characteristics of the energy source, energy transition and distribution. Meadowcraft identified more than six definitions with multiple variations of what green energy entails and maintained that each definition perspective represents a different mix of energy technologies and orientation for policy interventions.[12] In another stretch, it was defined as clean sources of energy that generate lower environmental impact than conventional energy technology.[13] Another perspective relates to its examination in the context of energy transition. It is described as a transition towards the prioritization of the use of renewable energy for a sustainable society.[14] It can also be defined as a transition towards multiplying the volume of renewable energy mix while at the same time doing away with nuclear energy.[15]

In a similar but from the perspective of a state's economy, it is defined as a transition to a low-emission economy. Some of these descriptions are based on the role that replacing fossil fuels with renewable energy will play in addressing the challenges of climate change. Serrano and Zaveri described definitions of green energy in the context of energy transition as a narrow understanding of what green energy entails.[16] There is a consensus that the need for energy production and use to address environmental concerns is the foundation of green energy[17]. In explaining green energy, several theories

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[11] Anissa Lestari Kadiyono, et al, 'The Introduction of Green Technology in Increasing Green Ethos among Students' (2019) JPCS 1; B.A. Gyamfi, et al, 'An investigation into the Anthropogenic effect of Biomass Energy Utilization and Economic Sustainability on Environmental Degradation in E7 Economies' [2021] Biofuels, Bioproducts and Biorefining 840

[12] J. Meadowcraft, 'What about the Politics? Sustainable Development, Transition Management, and Long-term Energy Transitions' [2009] Policy Science 323.

[13] C. Bhowmik, et al, 'Optimal Green Energy Planning for Sustainable Development: A Review' [2017] 71 RSER 796.

[14] C. Cleveland and C. Morris, Dictionary of Energy (2nd ed. Elsevier Publishers, Amsterdam, 2014) 1

[15] T. Sattich, 'Germany's Energy Transition and the European Electricity Market: Mutually Beneficial?' [2014] JEPE 264-273.

[16] P.V.H. Serrano and A. Zaveri, 'Venturing the Definition of Green Energy Transition: A Systematic Literature Review' (2004) <https://arxiv.org/pdf/2004.10562.pdf> accessed 17 September 2022.

[17] Olujobi O.J., & et al , Sustainable Development and National Integration: A Catalyst for Enhancing Legal Compliance, Environmental Protection, and Sustainability in Nigeria, (2024), Environmental Policy and Law,

emerged that emphasise environmental friendliness while promoting sustainable economic growth.[18]

Green energy is an important component of green growth that seeks to promote the sustainable use of natural resources and new markets for green technologies. Green growth is particularly attractive to developing countries, including Nigeria, because most countries desire economic growth through green technologies and projects.[19] Green energy sources such as wind, solar, bio-energy, hydropower, and geothermal are the ultimate solutions to climate and other related issues.[20] Compared to conventional energy sources, green energy has minimal negative environmental impact.

Green energy rests on the deployment of green technologies. Green technologies are innovations in using renewable energy and carbon dioxide emission technologies.[21] Green technologies combine 'green energy' and 'technologies'. Technology skills and techniques are specifically designed to achieve a set of objectives.[22] Technology is an exhibition of human knowledge about nature and its driving forces.[23]

In the context of green energy, green technologies seek to promote the development of green energy as the foundation of an energy system that relies on renewable energy sources. Green energy technologies are described as overhauling the energy industry in favour of clean energy sources in all sectors of the economy.[24] Technologies describe how the energy system has evolved to use renewable energy and other clean energy sources for enhanced

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<http://environmentalpolicyandlaw.com> (accessed September 6, 2024), 53, 6 Issues, pp.1-15.

18 E.I. Mantaeva, et al, 'Green Technologies as a Factor in the Sustainable Development of the National Economy' (2021) IOP CSEES 1.

19 H.J. Noh, Financial Strategy to Accelerate Green Growth, ADBI Working Paper 866, (Asian Development Bank Institute, Tokyo 2018) 2 <https://www.adb.org/publications/financial-strategy-accelerate-green-growth>

20 B.A. Gyamfi et al, (n 10) 1.

21 Alicia Valero et al, 'Material Bottlenecks in the Future Development of Green Technologies' [2018] RSER 178-79

22 R. Volti, Society and Technological Change (8th Edition, Worth Publishers, New York, 2017) 1

23 Stephen Enyinnaya Eluwa, et al, 'Renewable Energy and Green Technology Adoption: A Viable Option for Efficient Energy Supply in Nigeria' [2022] EAES 1104.

24 Alicia Valero (n 18).

energy delivery.[25] Nikzad and Sedigh defined green energy technologies as improving or enlarging clean energy sources with the aid of technologies.[26] They examined the concept in the context of developing clean energy technologies and other alternative energy technologies. Kadiyono and others defined green technologies as the '… application, equipment or system that has characteristics that prioritize the preservation of the surrounding environment and are environmentally friendly'.[27]

Green technologies encompass zero energy building, sustainability, reusable ability and innovation.[28] Takalo and Tooranloo referred to green technology as eco-innovation by defining it as 'the process that promotes the development of new products and technologies intending to decrease environmental hazards such as pollution and negative impact of resource exploitation'.[29] It is believed that green technologies can help to reintroduce life into the ecosystem.[30]

Green energy has the primary objective of promoting energy and environmental security. In addition to advancing energy security and climate change mitigation, deploying green technologies seeks to advance other environmental benefits. Green energy technologies are deployed for renewable energy generation, given that the technologies can enhance energy security while eliminating or considerably reducing carbon dioxide emissions[31]. It is therefore posited that efficient, clean technologies and

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[25] Ibid, 178; see generally, P. A. Owusu and S. Asumadu-Sarkodie, 'A Review of Renewable Energy Sources, Sustainability Issues and Climate Change Mitigation' (2016) Cogent Engineering 3:1 1167990, DOI:10.1080/23311916.2016.1167990.

[26] R. Nikzad and G. Sedigh, 'Greenhouse Gas Emissions and Green Technologies in Canada' [2017] Environmental Development 99.

[27] Anissa L. Kadiyono Hery Wibowo, 'The Introduction of Green Technology in Increasing Green Ethos Among Students' [2019] JPCS 1175.

[28] Ibid; E.G. Hertwich, et al, 'Material Efficiency Strategies to Reducing Greenhouse Gas Emissions Associated with Buildings, Vehicles, And Electronics: A Review' [2019] ERL 1.

[29] S.K. Takalo and H.S. Tooranloo, 'Green innovation: A Systematic Literature Review' [2021] JCP 122474; H. Sun, et al, 'Assessing the Socio-Economic Viability of Solar Commercialization and Electrification in South Asian Countries' [2020] EDS 1-23.

[30] F. Shair, et al, 'Assessing the Efficiency and Total Factor Productivity Growth of The Banking Industry: Do Environmental Concerns Matters?' [2021] ESPRI 20822–20838.

[31] Olujobi, O.J. et al , Legal Responses to Energy Security and Sustainability in Nigeria's Power Sector Amidst Fossil Fuel Disruptions and Low Carbon Energy

environmentally friendly technologies will enhance the consumption of renewable energy and the efficiency of energy use and consumption.[32]

The primary goals of green energy technologies are reducing environmental challenges, eliminating unsustainable energy use and promoting energy conservation.[33] With the pursuit of industrialization in different countries, green technologies have been explained further, including activities of industries that promote value innovations that benefit the environment. According to Newell and others, green technologies could promote the large-scale adoption of greenhouse gas emission reduction technologies throughout the global energy system.[34] Green energy technologies combine different methods to develop ways of producing sustainable and clean energy.

There are pieces of evidence that green energy has predated recent interests. Green energy played important roles in the early part of human history before fossil energy took over.[35] As early as 1800, there was evidence that wind turbines were being used for farming.[36] Around the 1990s, solar power was being used to power heaters in California.[37] Evidence also showed that electric cars were used in Manhattan, United States, in the 1990s.[38] Developing countries have also been part of the history of green technology.

Transition, (2023), Heliyon, 9(7), e17912 <https://www.cell.com/heliyon/fulltext/S2405-8440(23)05120-4 (accessed September 5, 2023).

32 L.N. Hao et al, 'Green Growth and Low Carbon Emission in G7 Countries: How Critical the Network of Environmental Taxes, Renewable Energy and Human Capital Is?' [2021] STE 752; K. Du, P. Li and Z. Yan, 'Do Green Technology Innovations Contribute to Carbon Dioxide Emission Reduction? Empirical Evidence from Patent Data' (2019) TFSC 297–303.

33 M. Imekova and E. Boltanova, 'Prospects for Sustainable Development of Russia: The Case of Eco-innovations' [2019] IOP CSEES 012103; M. Z. Qamar, et al, 'Green Technology and its Implications Worldwide' [2021] IMMJ 1.

34 P. Newell, I. Scoones and M. Leach, The Politics of Green Transformations (2nd Edition, Routledge, Oxfordshire, 2015) 3

35 Bent Sørensen, 'A History of Renewable Energy Technology' [1991] Energy Policy 8; Zachary A. Smith and Katrina D. Taylor, 'Renewable and Alternative Energy Resources' (ABC-CLIO Inc., 2008) 11

36 Susan Mueller, Green Technology and Its Effect on the Modern World, Thesis submitted in partial fulfillment of the award of Bachelor Degree, Department of Business Information Technology Oulu University of Applied Sciences (Spring, 2017) 11.

37 Ibid.

38 Ibid.

Around 200 BC, Egypt explored wind energy to power ships and boats.[39] However, in terms of contributions, developed countries have benefitted more from green energy than developing countries in energy generation.

Despite the volume of energy consumption, greenhouse gas emissions from developed countries are reducing mainly due to investments in green energy technologies and higher economic development of the international market.[40] In contrast, studies have shown that most energy-related greenhouse gas emanates from developing countries.[41] The unsustainable production of energy, particularly electricity generation, is the major reason greenhouse gas emissions are increasing in developing countries. Studies have shown that the goals of the Paris Agreement may be unrealizable because of the gap between Paris Agreement goals and the current greenhouse gas emission trajectories.[42]

Developing countries will continue to explore fossil energy mainly to ensure the security of their respective energy system. Wen-Cheng argued that about 52 per cent of energy-related greenhouse gas emissions annually emanate from developing nations. Wen-Cheng further argued that there are projections that, in the future, a large volume of energy-related carbon will be released from these countries notwithstanding the two-thirds of total emissions from developed countries that consume energy five times more than the developing countries. Studies further revealed that countries that have deployed green energy can balance energy security and climate objectives by incorporating environmentally friendly technologies into the existing activities to achieve maximum growth at the lowest possible

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[39] S. Amadi, 'Improving Electricity Access through Policy Reform: A Theoretical Statement on Legal Reforms in Nigeria's Power Sector' in Yinka Omorogbe and A. Okoye (eds), Ending Africa's Energy Deficit and the Law: Achieving Sustainable Energy for All in Africa (Oxford University Press, 2018). Also, as pointed by "Sarah Helgeson, Wind Energy in Egypt (Stanford University, December 2016) <http://large.stanford.edu/courses/2016/ph240/helgeson2/>

[40] M. Asikha Aktar et al, 'Green Energy and Sustainable Development', in Tony Wall (ed.), Affordable and Clean Energy (Springer, New York City, 2020) 1-11.

[41] Ibid, 3.

[42] D. Roberts, 'There's A Huge Gap Between the Paris Climate Change Goals and Reality. Current Pledges Are About a Third of What's Needed' (2017) <https://www.vox.com/energy-andenvironment/2017/10/31/16579844/climate-gap-unep-2017>; International Energy Agency, Africa Energy Outlook 2019 (IEA, 2019); International Energy Agency, Global Energy Review: CO2 Emissions in 2021 (IEA, 2022) 3 <https://iea.blob.core.windows.net/assets/c3086240-732b-4f6a-89d7-db01be018f5e/GlobalEnergyReviewCO2Emissionsin2021.pdf>

environmental price.[43] Reducing the use of fossil fuel sources such as oil and coal and increasing reliance on other natural energy sources to meet energy requirements using environmentally green energy technologies will contribute to emissions reduction and sustainable development.[44]

Green technologies play a major role in providing energy access. Globally, there are millions of people without access to energy,[45] with the majority residing in Africa.[46] According to statistics, more than 600 million people in Africa do not have access to energy, and around 530 million people will be without access to energy by 2030.[47] While the developed countries have been exploring green energy technologies for improved energy access, developing countries, Nigeria included, have yet to take advantage of these benefits. The lack of access to clean and modern energy contributed to the state of underdevelopment in Africa.[48] Despite being blessed with renewable or green energy resources, which could have been explored to provide access to clean and affordable energy, Nigeria lacks a legal framework for promoting the same.

The acceleration of green energy generation will promote sustainable energy production. As the world transitions to low-carbon energy sources, policies that rely on green energy to promote energy security, preserve the

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43 Nikzad and Sedigh (n 24)

44 M. Umar, et al, 'Environmental Cost of Natural Resources Utilization and Economic Growth: Can China Shift Some Burden Through Globalization for Sustainable Development?' [2020] Sustainable Development 1678.

45 S. Evans, 'Renewables Will Give More People Access to Electricity Than Coal, Says IEA' (Carbon Brief) <https://www.carbonbrief.org/renewables-will-help-more-people-access-electrcity -than-coal-iea/> accessed 16 September 2022

46 World Bank, 'Report: Universal Access to Sustainable Energy Will Remain Elusive Without Addressing Inequalities' (World Bank Press Release 7 June 2021) <https://www.worldbank.org/en/news/press-release/2021/06/07/report-universal-access-to-sustainable-energy-will-remain-elusive-without-addressing-inequalities> accessed 5 August 2022

47 IEA, (n 39); K. Yusuf, 'About 770 Million Africans have no Access to Energy – Report' (Premium Times (online) 25 July 2021) <https://www.premiumtimesng.com/news/top-news/475589-about-770-million-africans-have-no-access-to-electrici ty-report.html> accessed 2nd September, 2022

48 UN, Harnessing Renewable Energy for Development in the SAHEL <https://www.un.org/ecosoc/sites/www.un.org.ecosoc/files/files/en/2018doc/Energie_Renouvelable_Engl_VF.PDF> accessed 4 September 2020

environment, and bring everyone into social justice should be the focus of policymakers.[49]

1.1.2 Green Energy and Renewable Energy

Although using renewable energy as an alternative to fossil fuels is considered crucial to promoting an environmental sustainability agenda, deploying renewable energy without more is not likely to address environmental concerns in energy generation. Common denominators in the definitions of green energy and renewables include energy, security, and environmental sustainability. Some of the definitions of green energy rest on deploying renewable energy development.[50] For these reasons, some scholars have tried to place green energy as a characteristic of renewable energy.[51] Valero and others described green energy innovations using renewable and carbon dioxide emission technologies.[52]

Green energy is a transition to the use of technologies created to be environmentally friendly from production to usage by ensuring zero production greenhouse gas emissions. This is because not all renewable energy sources generate zero greenhouse gas emissions to qualify as green energy. Large hydro plants, for instance, can release some quantities of greenhouse gas emissions when the original biomass under reservoirs rots due to increased water levels.[53] While hydroenergy generation is fast, the process is not 100% green.[54] It is argued that renewable energy may not be used uniformly across all energy sectors to replace fossil fuels.

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49 Raphael J. Heffron, 'The Just Transition to a Low-Carbon Economy' [2018] RELPR 39.

50 Alicia Valero, (n18); Nikzad and Sedigh, (n 23).

51 Paul Kruger, 'Alternative Energy Resources: The Quest for Sustainable Energy' (John Wiley & Sons, Inc., 2006) 16 and 40; Luis Mundaca and Jessika Luth Richter, 'Assessing 'Green Energy Economy' Stimulus Packages: Evidence from the U.S. Programs Targeting Renewable Energy' [2015] RSER 1174–1186, 1176; Philip Kofi Adom, et al, 'Energy poverty, development outcomes, and transition to green energy' [2021] 178 Renewable Energy 1337-1352.

52 Alicia Valero (n 19).

53 Guardian Development Network Hydroelectric Dams Emit a Billion Tonnes of Greenhouse Gases A Year, Study Finds <https://www.theguardian.com/global-development/2016/nov/14/hydroelectric-dams-emit-billion-tonnes-greenhouse-gas-methane-study-climate-change> accessed 8 September 2022.

54 National Grid, 'What's The Difference Between Green Energy and Renewable Energy?' <https://www.nationalgrid.com/stories/energy-explained/what-is-green-energy>

While renewable energy is a desirable solution for addressing energy security, not all renewable energy sources can address environmental concerns. In this context, one can safely refer to all green energy sources as renewable. However, not all renewable energy sources will qualify as green energy, even though the two phrases are commonly used interchangeably.[55] The major difference lies in the focus of the two energy sources. Renewable energy focuses on energy security, while green energy focuses on ensuring environmental benefits and energy security objectives.[56] The US Environmental Protection Agency explained the difference between renewable and green energy when it declared that green energy 'is a subset of renewable energy. It represents those renewable energy resources and technologies that provide the greatest environmental benefit.'[57]

The Paris Agreement is an important influence on the promotion of green energy. Before the Agreement, the transfer and design of green energy technologies was a central theme of climate negotiation.[58] The reform favouring green energy transition can be traced to the 1997 Kyoto Protocol, the first legally binding document on international climate change regulation. However, some top emitters of greenhouse gas were not parties to the Kyoto Protocol, which affected the compliance procedure.[59] Adopting the outcomes of the 21st session of the Conference of the Parties (COP 21) of the UN

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55 T. Demirbas and A.H. Demirbas, Bioenergy, Green Energy. Biomass and Biofuels' [2010] Energy Sources 1067-1975; Grace Smoot, Green Energy vs Renewable Energy: What's the Difference? <https://impactful.ninja/green-vs-renewable-energy-differences/>; Trespass, What's the Difference Between Green, Renewable, and Clean Energy? <https://terrapass.com/blog/whats-the-difference-between-green-renewable-and-clean-energy> accessed 17 September 2022.

56 Trespass, 'What's the Difference between Green, Renewable, and Clean Energy?' <https://terrapass.com/blog/whats-the-difference-between-green-renewable-and-clean-energy> accessed 17 September 2022.

57 O. J. Olujobi, 'Legal Sustainability of Energy Substitution in Nigeria's Electric Power Sector: Renewable energy as an Alternative' (2020) 5(32) Protection and Control of Modern Power System 7

58 David Popp, Richard G. Newell and Adam B. Jaffe, 'Energy, the Environment, and Technological Change' (NBER Working Paper 14832) 34 <http://www.nber.org/papers/w14832>.

59 Amanda M. Rosen, 'The Wrong Solution at the Right Time: The Failure of the Kyoto Protocol on Climate Change' [2015] Politics & Policy 30; Lindsay Maizland, Global Climate Agreements: Successes and Failures <https://www.cfr.org/backgrounder/paris-global-climate-change-agreements> accessed 4 September, 2022

Framework Convention on Climate Change ('Paris Agreement') is a major milestone in the search for green energy sources.

The Paris Agreement enjoins parties to pursue a low-carbon transition by limiting greenhouse gas emissions to achieve its goals.[60] The signing and ratification of the Paris Agreement resulted in the promotion energy sources with minimal environmental impacts as a major strategy.[61] By the Agreement, countries are required to participate in the global effort to reduce greenhouse gas emissions.[62] Deploying renewable energy sources would replace carbon-intensive energy sources with low-carbon energy sources, thereby considerably reducing pollutant emissions.[63] There are reports supporting the fact that there is a need to do more beyond the adoption of renewable energy in order to actualize the goals of the Paris Agreement.

The reconsideration of adopting renewable energy as a primary strategy of the Paris Agreement becomes necessary in light of the emission trajectories, which show a wide gap between the current state and the terms of the Paris Agreement. To meet the emission target set for the Agreement's second half of the century, countries are pursuing a transition to deployment of energy sources with zero greenhouse gas emissions. The pursuit of green energy is premised on the understanding that its technologies will secure the energy system in response to the increased energy demand and promote environmental objectives.[64]

2. DRIVERS OF GREEN ENERGY

As society embraces the energy transition, corresponding efforts are being made to drive advancements in green energy technologies. The drive involves taking additional policy measures to enhance environmental protection

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60 Joeri Rogelj, et al, 'Energy System Transformations for Limiting End-Of-Century Warming to Below 1.5 °C' [2015] Nature Climate Change 519.

61 Ibid.

62 H.J. Noh (n 17) 2.

63 Fateh Belaid and Maha Harbaoui Zrelli, 'Renewable and Non-Renewable Electricity Consumption, Environmental Degradation and Economic Development: Evidence from Mediterranean Countries' [2019] Energy Policy 1-38.

64 Matthew Burns, (n 1).

measures.[65] Green energy technologies are developed mostly by advanced countries and exported to others.[66] In recent years, primarily because of the obligations in the Paris Agreement, there has been an exponential increase in the development of green energy technologies such as solar PV and wind turbines.[67] Among the factors that have contributed to the development of green technologies are government policies, technological advancement, public education and awareness.

2.1 Government Policies

Government policies are important in the promotion of green energy. Green energy technologies, most times, are subject to heightened uncertainties and externalities. Private investors are usually reluctant to invest in new technologies because of the uncertainties regarding acceptance. In the case of developing countries, promoting mass deployment of green energy technologies can be problematic for some reasons. In some cases, the technologies may not be accepted as a replacement, and introducing green technologies may be expensive. Consequently, the owner of the existing technology will be reluctant to switch to new technologies because of the high costs, which will take time to recoup.

In these situations, active government policies are necessary to ensure that green energy technologies compete favourably in the markets during the transition process. Some scholars argue that activities in the traditional energy industry have a direct negative impact on the transition to green energy. This is because society prefers affordable prices, mostly based on propaganda concentrated on cheaper fossil fuels than renewable energy.[68] Based on the affordability of traditional energy compared to green energy, green technologies will find it difficult to overcome the 'dominant regime' of the existing technologies without a carefully implemented government policy to drive market penetration. In this regard, an important aspect of government policies is the application of fiscal instruments in promoting green technologies.

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65 M.U. Ali et al, 'Fossil Energy Consumption, Economic Development, Inward FDI Impact on CO_2 Emissions in Pakistan: Testing EKC Hypothesis Through ARDL Model' [2021] IJFE 3210.

66 Matthew Burns (n 1).

67 Francesco Lamperti, et al, 'The Green Transition: Public Policy, Finance, and the Role of the State (Duncker & Humblot, Berlin, 2019) 73-88.

68 B. Sung and S.D. Park, 'Who Drives the Transition to a Renewable-Energy Economy? Multi-Actor Perspective on Social Innovation' [2018] Sustainability 448.

Fiscal instruments such as subsidies, waivers, tax relief and tax credits are crucial to promoting green technologies.[69] They operate generally to ensure an increased rate of returns for green energy production. For decades now, the habit of government subsidies for promoting green technologies has been a significant attraction in using fiscal instruments to drive green energy production. Subsidies apply as a means of promoting affordability and accessibility to green technologies. Government subsidies can help developers of green energy technologies cover part of the costs.

In 2016, more than USD140 billion was spent worldwide to subsidise green energy.[70] In the UK, government subsidies have led to an increase in green energy generation, especially the use of wind.[71] Waiver is another fiscal instrument that can drive the adoption of green energy. Waivers offer developers cost savings in green technologies. Also, R&D programmes and technology-driven standards are gaining acceptance as strategies for promoting green technologies. Banks, renewable energy groups, and energy finance firms are relevant stakeholders in effectively implementing government policies on green energy.[72]

2.2 Green Financing

The relationship between finance and the environment is dynamic. Studies show that financial developments have impacts on the environment.[73] Finance has evolved as a major enabler of human progress and development.[74]

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69 J. O. Olujobi, M. O. Olujobi and E. U. Daniel, 'The Legal Regime and Renewable energy as Alternative Sources of energy in Nigeria's Power Sector: The Impacts and The potentials' (2020) 19(3) Academy of Strategic Management Journal 1,19

70 Toshiyuki Shirai and Zakia Adam, Fossil-Fuel Consumption Subsidies Are Down, But Not Out (International Energy Agency, 2017) <https://www.iea.org/commentaries/fossil-fuel-consumption-subsidies-are-down-but-not-out>; Grantham Research Institute on Climate Change, Do Renewable Energy Technologies Need Government Subsidies? (Grantham, December, 2018). K. Ogunleye, Political Economy of Nigeria Power Sector Reform, in Douglas Arent (eds), Renewable Energy and Sustainable Development (Nova Science Publishers Inc. New York, 2015

71 Ibid.

72 B. Sung and S.D. Park, (n 65).

73 A. Haseeb et al, 'Financial Development, Globalization, and CO2 Emission in The Presence Of EKC: Evidence from BRICS Countries' [2018] ESPR 31283–31296; Ayesha Afzal, Ehsan Rasoulinezhad and Zaki Malik, Green Finance and Sustainable Development in Europe' [2022] Economic Research 5150-5163

74 M. Torras and J.K Boyce, 'Income, Inequality, and Pollution: A Reassessment of the Environmental Kuznets Curve' (1998) 25(2) Ecological Economics 147-160; M. Galeotti, et al, 'Reassessing the Environmental Kuznets Curve for CO2 Emissions:

Financial sectors have played and will continue to play important roles in states' economic development, and green energy development is no exception. The financial support for developing green energy technologies lies in the push for investments in low-carbon energy sources.[75] Ensuring a transition to low carbon energy, a financing scheme specifically targets green energy technologies, which are popularly tagged 'green finance'.

Green finance is financial instruments including 'green bonds, green banks, carbon market instruments, fiscal policy, green central banking and community-based green funds'.[76] The aim is to respond to the demand for new technologies to address the energy security crisis and environmental preservation as sustainable development goals. Investing in green energy sources for energy generation is an essential strategy for keeping global warming below 2^0 Celsius.[77] In this context, investment in green energy will ensure the realisation of the 3 elements of sustainable energy rather than a mere tool for satisfying energy security.[78] It will contribute to energy security and environmental sustainability, the bedrock of the Paris Agreement and SDGs.[79]

Private and public finance is crucial to the promotion of green energy.[80] Green banks can finance the promotion of green energy by creating innovative financial products, aggregating small projects, and expanding the market through information dissemination. Green finance ensures reasonably long-term capital for financing green energy development.[81] It is gaining acceptance primarily because of the increase in the depletion of natural

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A Robustness Exercise' (2006) 57(1) Ecological Economics 152-163; J.D. Sachs et al (n 65).

75 Ayesha Afzal et al, (n 70).

76 J.D. Sachs et al (n 66)

77 Ibid.

78 Ibid, 5.

79 Ibid, 5.

80 A. Midilli, I. Dincer and M. Ay, 'Green energy Strategies for Sustainable Development' [2006] Energy Policy 3623.

81 J.D. Sachs, et al, (n 66); Natural Resources Defense Council, 'Clean Energy Finance Outlook: Opportunities for Green Banks and Green Bonds in Chile' (New York, Natural Resources Defense Council, 2016); S. Dikau and U. Volz, 'Central Banking, Climate Change and Green Finance' (ADBI Working Paper 867, Tokyo) Asian Development Bank Institute, 2018.

resources and the need to make financial agencies live up to their corporate social responsibilities.[82]

2.3 International Networking

The international network is another factor driving green technologies. Green technologies are developed globally by industrialized countries and then exported to other parts of the world where the technologies are required. Knowledge is usually transferred via the traditional method of direct acquisition, which includes importation and licensing. It has been shown that the traditional methods of transferring the technologies are effective because the transfer is supported by indigenous research and domestic capacities. Given the limitation, international networking has become a channel through which domestic economies can collaborate in the international markets on research and developments in green energy.

For instance, Kenya's solar PV home system (SHS) has benefited from the exchange of knowledge on green technology development. The SHS, a commercial market for solar, started in the early 1990s. At that time, Kenya was importing solar technologies due to lacking local expertise. There was also no technical knowledge on how to repair and service the new technologies. So, the development of the SHS was greatly hampered due to the lack of local expertise[83], but Kenya has now developed local expertise through international collaboration in green energy.

2.4 Public Education and Awareness

Public education and awareness are often neglected but are important factors in promoting green energy. Governments play an important part in educating the public about the role of green energy in promoting sustainable energy.[84] Concern for the environment has reached a level where constant education and awareness are germane.[85] In Kenya, for instance, SHS gained wider acceptance mainly because of the community's perception of the new

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82 H. J. Noh (n17)

83 UN National Policies for Green Development (World Economic and Social Survey, 2011) 142.

84 A.R. Zahari and E. Esa, 'Motivation to Adopt Renewable Energy among Generation' [2016] PEF 444; E. Sardianou and P. Genoudi, 'Which Factors Affect the Willingness of Consumers to Adopt Renewable Energies?' 57 Renewable Energy 1.

85 K.P. Tsagarakis, et al, 'Clean vs. Green: Redefining Renewable Energy - Evidence from Latvia, Lithuania, and Romania' [2018] Renewable Energy 412.

technology. Public education and awareness influenced Kenya's adoption of SHS, a green energy technology.[86]

3. DEVELOPMENT OF GREEN ENERGY AND TECHNOLOGIES IN NIGERIA

The green energy transition is not alien to Nigeria. In Nigeria, both the energy and climate change policies recognise deploying technologies that enhance energy and environmental security. In recent years, there has been increased awareness of the negative impact of climate change. The signing and ratification of the Paris Agreement imposed additional obligations on the need for Nigeria to promote sustainable environments and energy security. Within the broad framework for environmental sustainability, there is recognition of how technologies can drive access to clean energy while promoting environmental objectives.[87]

The use of renewable energy is at the heart of the national policy on climate change, as seen in the National Climate Change Policy Response and Strategy (NCCPRS) 2012. The NCCPRS seeks to 'foster low-carbon, high growth economic development path and build a climate-resilient society'.[88] The aim is to ensure Nigeria's response to climate change is undertaken within the national framework for sustainable development and consistency with the national development priorities.[89] Like the energy sector, the national climate change policy specifically targets increased use of renewable energy in the energy mix.[90]

In furtherance of the sustainable development objectives, Nigeria targets at least 20% energy production from renewable energy sources by 2030 in order to achieve the country's climate change goals.[91] The goal is reducing greenhouse gas emissions arising from electricity generation from fossil

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86 K.Y Kebede, T. Mitsufuji and E.K. Choi, 'After-Sales Service and Local Presence: Key Factors for Solar Energy Innovations Diffusion in Developing Countries'[2014] PICMET (Proceedings: Infrastructure and Service Integration) 3124–3130; R. E. Katikiro, 'Prospects for the Uptake of Renewable Energy Technologies in Rural Tanzania' [2016] Energy Procedia 229–233.

87 Energy Commission of Nigeria, National Energy Policy (FRN 2013).

88 Federal Ministry of Environment, National Policy on Climate Change 11, 35.

89 Ibid, 10.

90 Ibid, 12.

91 Ibid, 41.

energy sources by maintaining effective 'regulatory control and use of low-cost but efficient technologies'.[92] Regarding strategies, Nigeria embraces a distinct approach to climate change in the NCCPRS by embracing green energy. This means that each sector will adopt a method that will effectively address the peculiarity of the principal source of greenhouse gas emissions to strengthen the national mechanism for the promotion of functional climate change governance in Nigeria.

The recognition of the energy sector objectives in the climate change policy can be seen in Nigeria's nationally determined contribution submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2021.[93] The first and the updated Nationally Determined Contributions (NDC) to the UNFCCC are based primarily on the National Climate Change Policy Response and Strategy provisions. In the NDC, Nigeria's energy sector is identified as the major source of greenhouse gas emissions, emitting around 209 million tons of carbon dioxide equivalent emissions. With this volume of greenhouse gas emissions, the energy sector alone accounts for over 60% of Nigeria's total greenhouse gas emissions.[94] There are projections that the greenhouse gas emissions from the energy sector may reach around 31% by 2030; a level considered a major setback to the country's climate efforts, hence the need for the deployment of technologies to address the situation.[95]

Policymakers are continually making efforts to maintain a balance between Nigeria's energy objectives and climate change objectives. In the National Renewable Energy and Energy Efficiency Policy, Nigeria targets using

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92 Ibid, 40.

93 Federal Ministry of Environment, 'Nigeria's Nationally Determined Contribution' (NNDC) 2015, Being a Requirement by Conference of Parties to the UN Framework Convention on Climate Change (COP-UNFCCC) (FRN 2015) 2; Federal Ministry of Environment (FME), Nigeria's Nationally Determined Contribution – Update: NDC Interim Report (Federal Republic of Nigeria, 27 March 2021) 1; O. Udegbunam, 'Explainer: Facts to Know About Nigeria's Updated Climate Change Commitments', Premium Times 23 August 2021 <https://www.premium timesng.com/news/more-news/480828-explainer-facts-to-know-about-nigerias-updated-climate-change-commitments.html> accessed 12 September 2022. See also, Y. O. Omorogbe, 'Promoting Sustainable Development through the use of Renewable energy: The Role of Law' in D. N. Zillman (ed) Beyond Carbon Economy: Energy Law in Transition (Oxford University Press, 2008)

94 Ibid, Federal Ministry of Environment (FME).

95 Ibid

renewable resources and technologies for a cleaner and greener energy system.[96] Looking at the definitions of green and renewable energy in Nigeria's energy policy documents, green energy is synonymous with renewable energy.[97] In the 2015 National Renewable Energy and Energy Efficiency Policy, renewable energy is defined as the deployment of 'technologies that have minimal environmental impacts, such as less intrusive hydro's and certain biomass combustion. These energy sources normally include solar energy, wind, biomass, small and medium hydro, geothermal, tide and wave energy.[98]

The underlying assumption is that renewable energy (green energy) sources and technologies will promote energy security while addressing environmental concerns.[99] As part of the efforts to promote green energy technologies, the Government must establish incentives to aid the development and storage of clean energy technologies.[100] Nigeria's green energy transition is anchored on three interrelated objectives from the energy and climate change policy documents. Firstly, the increased inclusion of renewable energy in the energy mix to reduce the environmental impact of energy generation from fossil fuels. Secondly, the expansion of energy sources is a way of addressing energy poverty. Thirdly, the transition seeks to reduce the concentration of greenhouse gas emissions arising from energy generation.[101]

Solar PV is the earliest and most commonly used green energy technology in Nigeria. The adoption of solar technology in Nigeria started in the mid-1990s as part of efforts to address energy access challenges in rural areas.[102] As stated in the updated NDC, the adoption and deployment of solar PV will aid decentralised transmission, that is, off-grid energy transmission, for improved energy access. Reliance on decentralised energy transmission will

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96 National Renewable Energy and Energy Efficiency Policy, viii.
97 Ibid, 8.
98 Ibid, 2.
99 Ibid, 6.
100 Ibid, 15.
101 Agaptus Nwofor, et al, 'Transition to Green Energy and Sustainable Development in Nigeria: A Prospective and Evaluative Analysis' [2021] ICESE 9.
102 Stephen E. Eluwa, et al (n 21).

reduce the susceptibility of energy infrastructure, grid-based transmission and the impact of climate change.[103]

In furtherance of the energy security objective anchored on solar PV technology, Nigeria targets 13,000 MW of off-grid renewable generation in the updated NDC.[104] The off-grid renewable energy generation target is a welcome development for two major reasons. Firstly, the off-grid renewable energy generation target through solar PV will go a long way in addressing the challenges of grid energy generation and distribution in Nigeria. The current generation of 10,396 MW combined capacity and the available capacities of 6,056 MW have insufficiently provided energy access to most households and businesses in Nigeria.[105] The low generation capacity is what the country relies on to provide for a population of over 200 million.[106] Energy-generating plants are predominantly thermally based (gas and hydro) and prone to frequent breakdown. As a result of the poor state of energy generation, only about 57% of the population has access to grid energy.[107] The challenge of energy access is compounded by the poor transmission and distribution system, which has been and remained an ongoing challenge of energy access in Nigeria. Green energy technologies will address some factors that have undermined the free flow of access to the grid in Nigeria.[108]

Secondly, green technology (solar PV) will advance the country's fight against climate change. In 1994, Nigeria became a party to the United

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103 Federal Ministry of Environment (n 91).

104 Ibid, 2.

105 E. K. Ogunleye, Political Economy of Nigeria Power Sector Reform, in Douglas Aren't (ed), The Political Economy of Green Energy Transition (Oxford University Press,London 2017) 391-392

106 Y. O. Omorogbe, 'Promoting Sustainable Development through the use of Renewable energy: The Role of Law' in D. N. Zillman (ed) Beyond Carbon Economy: Energy Law in Transition (Oxford University Press, 2008)

107 B. A. Olanipekun and N. O. Adelakun, 'Assessment of of Renewable energy in Nigeria: Challenges and Benefits' (2020) 68(1) International Journal of Engineering Trends, and Technology, 67. As well as "World Bank, Nigeria to Improve Electricity Access and Services to Citizens, (Press Release No.: 2021/088/AFR) 31 July 2022 <https://www.worldbank.org/en/news/press-release/2021/02/05/nigeria-to-improve-electricity-access-and-services-to-citizens> accessed 3 August 2022.

108 A.C. Ohajianya, et al, 'Erratic Power Supply in Nigeria: Causes and Solutions' (2014) IJESI 51, 53; KPMG, 'A Guide to the Nigerian Power Sector' (KPMG Nigeria, 2016) 10.

Nations Framework Convention on Climate Change (UNFCCC).[109] In compliance with its obligation to the UNFCCC, Nigeria submitted its first and second national communication in 2003 and 2014, respectively.[110] Nigeria has also hosted several Clean Development Mechanism (CDM) projects under the Kyoto Protocol as part of the international climate change efforts.[111] Nigeria's involvement in climate change mitigation has been informed by several factors, such as the 2014 report of the World Climate Change Index, which classified Nigeria as one of the ten most vulnerable countries globally.[112]

In a bid to ensure that climate change plans address energy concerns, the deployment of renewable energy has continued to form a critical component of Nigeria's nationally determined contribution. Policymakers and key stakeholders have been relying on the off-grid solar energy generation target in the nationally determined contribution to promote the development of off-grid renewable generation in Nigeria. Since the submission of Nigeria's nationally determined contribution, the use of solar PV has gained widespread acceptance among the states in Nigeria. Nigeria targets an evenly distributed and efficient power generation in the Nigerian energy sector to achieve energy security among the geopolitical, that is, the North, the Central belt, and the South. The reason is that solar, the primary and most abundant renewable resource, increases in intensity as one moves from south to north. There has been more than 60% acceptance and installation of solar PV in major Nigerian cities, e.g. Kano city, between 2015 and 2016, indicating an increase in solar PV adoption by citizens.[113]

Green energy technologies have also enabled private organizations, individuals, and local and state governments to actively participate in the

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109 Federal Ministry of Environment, 'First Biennial Update Report (BUR1) of the FRN under the UN Framework Convention on Climate Change' (UNFCCC) (FRN 2018) i.

110 Ibid.

111 Federal Ministry of Environment, National Policy on Climate Change, Sectoral Action Plans for Nigeria's Nationally Determined Contribution, 8; Christoph Bohringer, "The Kyoto Protocol: A Review and Perspectives", Climate Policy Network Discussion Paper No. 04-01 online: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.203.3804&rep=rep1&type=pdf>.

112 Federal Ministry of Environment (FME) (n 90).

113 A.S. Barau et al, 'Not There Yet: Mapping Inhibitions to Solar Energy Utilisation by Household in African Informal Urban Neighbourhoods' (2020) 12(3) Sustainability 1.

national effort to promote sustainable energy generation. Through the Federal Ministries of Power and Environment, the government introduced several green projects with the primary aim of promoting deployment of green energy technologies in urban and rural areas of the country. In rural electrification, the FGN introduced the Electricity for Rural Productive Uses, which program targets rural communities. The program aims to provide rural communities with solar-based water pumping, lighting and refrigeration solutions.

The FGN also launched the Renewable Energy Micro Utility (REMU) program for the off-grid villages in Nigeria. The REMU is an advanced rural electrification project which seeks to provide universal electricity access in areas where off-grid electricity is considered unsustainable.[114] The program supports green mini-grids and co-generation systems. In green mini-grids, Nigeria has been developing capacities for small-scale renewable energy and smart grid solutions for electricity access in areas where conditions do not allow for large-scale interconnected grids.[115] Nigeria has identified the need to develop and adapt a green mini-grid framework to implement the REMU as mini-grids and stand-alone energy systems in remote areas. REMU relies primarily on commercially viable renewable energy sources available in each location.

At the state level, several state governments introduced different programs to promote the transition to green energy technologies. The country has ongoing collaborations between the FGN, the State Governments and some NGOs on green energy technologies for sustainable energy generation. In Adamawa State, the Renewable Energy Programme Office is collaborating with Green Carbon Afrique to develop a 2,000-hectare sugarcane plantation for bio-fuel plants in Girei and Demsa Local Government Areas of the State. The initiative aims to produce sugar for local use, exports and ethanol for energy.

In Kenya, for instance, green energy, as is the case in Nigeria, is synonymous with renewable energy. Green energy in Kenya has emerged as a major strategy for addressing energy access challenges.[116] Kenya has adopted a

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[114] Ibid, at 44.

[115] Ibid, at 83.

[116] Michael Andres, Kenya Becomes a Pioneer in Green Energy <https://www.kfw.de/stories/environment/renewable-energy/kenia-green-energy/> accessed 26 August 2022.

major strategy for developing green energy technologies by partnering with foreign technical companies. Through international partnerships, Kenya has boosted energy generation from green energy solutions.[117]

Kenya has recorded an increased energy access rate through the large-scale deployment of green energy technologies. The Turkana Wind Farm and Meru County Energy Park are the two major projects in this regard. With Meru Country Energy Park, Kenya is building the first large-scale hybrid green energy source in Africa. The project, when completed, will provide 80 MW of energy from a combination of wind, solar PV and battery storage to more than 200,000 households.[118]

Through international collaboration, Germany has been actively involved in developing green energy for sustainable energy access in Kenya. Specifically, Germany has been instrumental in constructing and financing geothermal plants in Kenya.[119] In addition to the international partnership, the Government of Kenya is partnering with the Non-Governmental Organisations (NGOs) to deploy green energy technologies in the slums.[120] The NGOs primarily serve as vessels for creating awareness about green energy technologies among the dwellers in the slums.[121]

4. CHALLENGES OF GREEN ENERGY IN NIGERIA AND POSSIBLE SOLUTIONS

The importance of the green energy for Nigeria had been highlighted above but its adpotions and implementations had been hindered by many challenges as would be discussed in this section. The huge capital needed for the initial acquisition can lead financial constraints that would hinder Nigeria from investing in green energy especially as most of the components parts of the

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[117] P. K. Oniemola, 'Integrating Renewable energy into Nigeria's Energy Mix through the Law: Lessons from Germany' (2011)2 Renewable energy Law and Policy Review,28,38. See also, Xinhua|, Huawei to support Kenya's green energy transition, Xinhua| June 11, 2022 <http://english.news.cn/africa/20220612/1679b7c77b95481dbf7d660f4c31c164/c.html> accessed 13 August 2022; Gongera Enock George and Esther N. Gicheru, 'Analysis of Green Energy Adoption on Household Development in Kenya: Case of Kibera Slums' [2016] JETP 33.

[118] Lucas Schmidt, The Advancement of Green Energy in Kenya <https://borgenproject.org/green-energy-in-kenya/> accessed on 26 August 2022.

[119] Ibid

[120] George and Gicheru (n 114)

[121] Ibid

technology would have to be imported and subjected to foreign exchange restrictions[122]. The costs implications is the first constraints, the second is the limitations caused by technological expertise. There is no technological infrastructure on ground to enable adoption of green energy in Nigeria, this is a major challenge in spite of the abundance of sources of renewable energy available in the nation including the solar energy, and other essential natural minerals[123].

However, despite the abundance of these resources, solar panels and other essential technology are not produced in Nigeria and when they are imported, the costs implications take them out of the reach of many households, thus limiting the possibility of going green in Nigeria. The lack of infrastructure had also made the adoption of other sources of renewable energy including wind and turbine energy nearly impossible in Nigeria especially as the government had refuse and/or neglected to invest in that area and private investments are also nil.

The solution to the above challenges is the government's commitments to renewable energy in the area of investments supports and regulatory mechanism. In addition, the governments should encourage the private sector's involvements through partnership programs, incentive and waivers. Embracing these solutions would help in stemming the current energy poverty being experienced in Nigeria. It would also provide sustainable and environmentally friendly energy to Nigerians and reduce the financial burdens and increase quality of life. Public awareness and education on the benefits of renewable energy is essential to public acceptance. This is because it is only a motivated population that would drive the energy market.

5. CONCLUSION AND RECOMMENDATIONS

Green energy will enhance Nigeria's capacity by advancing power and environmental objectives. While green energy is essential to promoting sustainable energy development in Nigeria, the country has yet to benefit from the opportunities offered by green energy due primarily to the absence of requisite laws and green financing schemes. Nigeria can address this problem by enacting a law to drive a green transition. The law and policies on using and developing green technologies must be made to align with the

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[122] H.N. Amadi and others, 'Renewable Energy in Nigeriaa: Prospects and Challenges' (2024) EJAET 5i at 55.

[123] Ibid.

country's environmental objectives. The regulatory framework for developing renewable energy resources must accord with sustainable energy generation objectives.

The mix of sustainable energy generation objectives should contain clear and binding targets on how green technologies can drive the targets. The alignment of energy and environmental policies on green energy can be enhanced by introducing performance-oriented policies and periodic reporting. Government investment in research and development is also an important factor that FGN should consider in driving green energy development in Nigeria. The FGN should support the collaboration of sectors in research and development (R&D). It is also important for the FGN to stimulate green energy financing by promoting platforms whereby climate banks and non-bank financial institutions can invest in green projects. Taking these steps to promote mass deployment of green energy technologies is necessary if the country is truly desirous of deploying the country's abundant renewable energy resources for sustainable energy generation. Specifically, this study makes the following recommendations:

1. The regulatory framework and the financing framework have to be improved upon. Nigeria must endeavour to change the energy sector by providing more financing opportunities for its citizens engaged in renewable energy projects. Renewable energy potends lots of potentials as Nigeria is full of natural resources essential in the energy sector such as gas, hydro and solar; but the lack of commitments by the government has limited the potentials from the sector. Therefore, in order to change the energy landscape of Nigeria, the government of the day must show substantial supports by making finances and technical assistance available.
2. As an offshoot of the above, the Nigerian government must also implement workable energy policies and programs. In the past, Nigerian governments have signed many treaties, agreements and MOUs on energy but had failed to demonstrate enough commitments to their implementations. Many of such policies have been forgotten in the graveyards of abandoned projects as it is common in Nigeria. It is time to go beyond just doing lip-service without dogged commitments to see the policies through.
3. Capital investments and technical infrastructure must be made available by the governments in order to encourage green energy in Nigeria. It is important because the capital infrastructure required in the energy sector is huge, local businesses engaged in energy supply should be encouraged

by being giving access to foreign currency at a good rate to other incentives from the government.

4. Public and private initiatives can be stimulated by the government in order to solve the energy crisis in Nigeria. The energy sector can be decentralized in order to foster renewable solutions; this is achievable as more research and developments (R&D) projects are encouraged from both the public and private sectors.
5. Local energy companies can have green energy partnership contracts with foreign investors. The essence of the partnership is that while small and medium scale companies may not have all the resources necessary to tackle the huge renewable energy projects, they can gain supports from foreign expertise through the terms of partnership contracts. Such contracts may lead to further trainings of the Nigerian local experts and also provide the necessary technical assistance.
6. Lastly, it is very essential to have data about energy projects and green banking operations in Nigeria. Foreign investors wanting to invest in the energy sector in Nigeria, most often would demand for these data in order to have a picture of the Nigerian energy landscape. Unfortunately, there is the general lack of data availability in Nigeria. However, all over the world, data and information management has become powerful, therefore, it is imperative for the government to collect data on the energy sector and make it available for foreign direct investments. Availability of data would make planning for renewable energy easy and easier in locating areas requiring urgent energy interventions.