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From Compliance to Collaboration- Enhancing Sustainable Energy Transition Through Community Engagement

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Abstract

Since fossil fuels coal, oil, and natural gas make up the majority of the world's energy resources, they will eventually run out and have a negative impact on the environment, as they are one of the primary sources of greenhouse gas emissions. For this reason, every country has an economic and environmental interest in developing and implementing clean, renewable energy. However, regulatory frameworks and policies are unable to lead the necessary energy transition to a more modern, cleaner, and reasonably priced energy source for a variety of reasons, including insufficient community involvement. The research is based on a comprehensive and multidisciplinary review of the literature. The purpose of this study is to close the gap in the literature about the contribution of community engagement to the acceleration of the shift to sustainable energy. By ensuring equitable access to energy, promoting energy literacy, accelerating the adoption of renewable energy, and stimulating local economies, community participation becomes the catalyst for an inclusive energy transformation. By incorporating community engagement into the energy transition, we can create a sustainable future that benefits all.

Keywords: Energy, Renewable Energy, Sustainable Development, Community Engagement, Nigeria

Introduction

The 21st century saw a more than ten-fold rise in global energy consumption (Kaufman et. al., 2021). Low energy sources harm a nation's various socioeconomic progress because energy is one of the major forces behind economic development (Si-dai et. al., 2021). Societies rely heavily on energy sources. Energy is actually a necessary component of existence and a compulsory input for the majority of economic activities and manufacturing processes (Harjanne and Korhonen, 2019). For social and economic growth, there must be more access to contemporary energy services (Oyedepo, 2014a). The "energy issue" has become more and more significant in the last several years in relation to all other decisions, plans, and policies pertaining to the survival and advancement of humanity.

The majority of the world's energy resources currently come from fossil fuels, which include coal, oil, and natural gas (Weder et. al., 2020). This means that energy supplies will eventually run out and have a negative influence on the environment. It is one of the main contributors to greenhouse gas emissions, accounting for 1.01 percent of world emissions, due to its high reliance on fossil fuels like crude oil for energy production (Okonko et. al., 2021; Elum and Momodu, 2017). Even with all of the environmental problems that come with exploring for crude oil, Nigeria still relies heavily on it for energy (Abam et. al., 2014). A more varied and environmentally friendly energy supply results from switching from conventional energy systems (coal, petroleum products) to non-traditional home renewable energy sources (solar, bioenergy, wind power, hydropower) (Kok et al., 2008). Renewable energy is defined by the International Energy Agency (IEA) as energy derived from natural processes that regenerate more quickly than they is consumed (Emodi and Ebele 2016). Hydropower, solar energy, biogas, biomass, geothermal energy, wind, and water waves are examples of renewable energy sources (Adaramola et. al., 2012). These energy sources have a wide range of uses in the production of fuel, electricity, thermal energy, and mechanical force (Okonko et. al., 2021).

Energy security and environmental friendliness are the two main benefits of renewable energy. The environment is either not affected at all by renewable energy sources. It ensures that byproducts such as carbon dioxide, sulfur dioxide, and other compounds will be kept to a minimum and generates very little waste (Okonko et. al., 2021). In order to achieve sustainability and fulfill future energy needs, renewable energy is crucial (Oyedepo et al., 2018). Nowadays, most people agree that the best way to maximize the potential of renewable energy is to increase its capacity

(Lorenzini et al., 2010). Therefore, every nation has an economic and environmental interest in developing and implementing clean, renewable energy (Emodi and Yusuf, 2015). To provide everyone with inexpensive, sustainable, and environmentally friendly energy, researchers and policymakers are concentrating on the energy transition. The need to reduce environmental effect through the use of cleaner energy resources and systems, along with the fact that millions of people lack access to electricity, especially in Africa, is driving this (Gebreslassie and Cuvilas, 2023). For both urban and rural residents of Nigeria, obtaining a consistent and dependable supply of power is a significant difficulty (Oyedepo et al., 2018). Nigeria, the largest economy in Africa in terms of GDP and population, has a low rate of electricity availability (Emodi and Yusuf, 2015). The nation's supply and demand for energy are out of balance (Oyedepo et al., 2018). Nigeria has an abundance of energy resources, but the country's burgeoning population's energy needs cannot be satisfied by the electric energy infrastructure that is currently in place. Nigeria has a vast amount of untapped renewable energy potential. Growing populations and economies are driving up demand for sustainable energy sources (Emodi and Yusuf, 2015). According to Shaaban and Petinrin's (2014) forecasts, Nigeria's fossil fuel reserves are expected to run out by 2050, making it more important than ever to focus on decentralized renewable energy generation. Without a doubt, Nigeria's current power crisis will continue unless the government adopts new technologies and diversifies energy sources in the domestic, commercial, and industrial sectors in order to combat global warming and achieve sustainable development through energy security (Emodi and Ebele, 2016).

Thorough approaches are required to boost the contribution of renewable energy to the current energy supply mixes and to expedite the production and exploitation of renewable energy (Nnaji et al., 2010). Regulatory frameworks and policies are unable to spearhead the required energy transition to a more contemporary, cleaner, and reasonably priced energy source for a number of reasons. Various factors contribute to this, including inadequate community involvement, weak pledges from stakeholders, ignorance of business models, incentive packages lacking, and unfavourable legislative frameworks (Koirala et al., 2018). Nigeria is also confronted with these numerous obstacles in the renewed energy transition. Numerous studies are conducted on the obstacles that developing countries, like Nigeria, face in their transition to renewable energy. Despite the substantial research, a thorough examination of the academic literature reporting the significance of community engagement in advancing the renewable energy transition has not yet been conducted. Thus, the purpose of this article is to perform a thorough, multidisciplinary literature analysis on the impact of community engagement on Nigeria's transition to sustainable energy.

Literature Review

The best option for diversifying sustainable energy sources is to effectively use renewable energy (RE) in a decentralized way. The use of renewable energy in the

production of contemporary energy (electricity) has been trending upward globally (Monyei et. al., 2018). To prevent an impending energy crisis, Nigeria must pay close attention to how its RE resources are being used. It is long overdue for Nigeria to switch from the search and use of conventional energy-rich resources to renewable resources with the right technologies. Intriguingly, the nation may possess sustainable energy resources to address the issues posed by the demand for power.

Energy Potentials in Nigeria

Nigeria's attempt to encourage the diversification of its energy mix resulted in the creation of the Renewable Energy Master Plan (REMP), which was revised in 2011 after being approved by the government in November 2005. The United Nations Development Program (UNDP) and the Energy Commission of Nigeria (ECN) collaborated on this plan to create a broad vision, objectives, and action plan for resolving the nation's major energy-related problems through the rapid development and utilization of renewable energy sources. The main objectives are to advance the growth of renewable energy and increase access to electricity, particularly in rural regions. Through the National Biomass Energy Programme, National Solar Energy Programme, National Hydropower Programme, National Wind Energy Programme, Emerging Energy Programme, and Framework Programme for Renewable Energy Promotion, the strategy identified solar, wind, hydro, and biomass (Obideyi, 2017).

Hydro Energy

Using the gravitational pull of falling or flowing water to create power is known as hydro energy. It is the most prevalent renewable energy source that can be found almost anywhere on Earth. It depends on the gravitational potential of high water, which is raised by sunlight from the seas (Okonko et al., 2021). Most hydropower facilities are located in large dams with strong gravitational pull. Nigeria, with technical hydroelectric energy of 32,450 GWh/yr, rated seventh in Africa for hydropower potential (Okedu et. al., 2020). Only 21.5% (6986 GWh/yr) of the hydro potential had been used as of 2001. Only around half of the 1.9 GW hydroelectric capacity now installed in three sizable power plants Kainji, 760 MW; Jebba, 570 MW; and Shiroro, 600 MW—is in use (NERC, 2012). Despite its enormous potential, Nigeria's hydropower capacity is still underutilized; current hydropower generation accounts for 14% of the country's hydropower potential and roughly 30% of all installed grid-connected electricity generation capacity (Oyedepo, 2014).

Solar

Solar energy is defined as the process of using sunlight to generate electricity; it is based on the nuclear fusion power found in the Sun's core. There are two ways in which we can obtain solar energy: direct solar photovoltaic (PV) and indirect solar

energy (CSP). The latter method uses sunlight to boil and heat water in order to generate power (Nkoana et al., 2018). Nigeria has a landmass of roughly 924 km2, with an average annual incident solar energy of 1831.06 kWh and an average irradiance per unit area of 5.535 KWh/m2 (Agbo et. al., 2021). The amount of sunshine in the nation varies, with 9 hours in the far north and 3.5 hours in the south (Okonko et al., 2021). These figures demonstrate that a sizable quantity of energy may be produced and used to counteract the epileptic energy supply from the vast solar radiation that is accessible.

Wind power

Wind energy refers to the utilization of wind as a valuable source of energy for power generation. Typical wind power equipment includes windmills and turbines that produce energy, as well as drainage pumps that are used to remove water from the wind (Audu et. al., 2019). The average wind strength of a wind turbine at a given area is not sufficient to achieve overall energy efficiency because wind strength varies with location (Okonko et al., 2021). Wind energy has one of the fastest growth rates in the global renewable energy market since it is clean, abundant, inexpensive, renewable, and ecologically beneficial by nature. Nigeria's wind energy resource is accessible at an average yearly speed of 2.0 m/s close to the shore and 5.0 m/s at a height of 10 m in the country's northern regions. The Jos Plateau, Gembu, Kano/Funtua, and the Sokoto region are predicted to have the fastest wind speeds. Fair wind speeds, adequate for energy generation by wind farms, were also reported by the stations in Maiduguri, Lagos, and Enugu (Shaaban and Petinrin, 2014).

Biofuels

The production of electricity from biological materials, substances, or organisms, such as garbage, wood, and alcohol fuels, is known as biomass energy (Okonko et al., 2021). Wood chips and dead trees are examples of biomass that can be utilized to produce heat and power (Nyika et. al., 2020). During combustion, this waste frequently turns into fuel. Fossil fuels that are organic are not included in biomass as energy sources. Nigeria, being an agrarian nation, has a lot of potential to close the gap between supply and demand for energy by exploiting its plentiful biomass resources, including agricultural leftovers (Garba and Zangina, 2015). Wood biomass, forage grasses and shrubs, residues and wastes (forestry, agricultural, municipal, and industrial), as well as aquatic biomass, are Nigeria's biomass resources (Olurinde, 2015). According to Agba et al. (2010), Nigeria has a great potential for the development of bioenergy because 74 million hectares (or 98 million ha) of its total land area is arable, and 60 percent of that arable land is currently idle (Olanrewaju et. al., 2019).

Challenges for Sustainable Energy Technology Development in Nigeria

1. **Lack of related technical skill**

   New technology implementers frequently fail to recognize the importance of user education and awareness campaigns, maintenance service expertise development, and local technical training. Any renewable energy project that wants to succeed will need to train its technicians on renewable energy. In order for the public to change their mind set and adjust their lives to a changing energy system, builders will need to receive training in renewable energy construction techniques. Universities, technical institutions, and trade schools will also need to be ready and equipped to help with the switch to the new energy system.

2. **Uncertainty of finance sources:**

   Even for governments, renewable energy technology is still costly at this point in its development. The expense of owning a self-sponsored renewable energy system is simply too high for rural towns and individuals. In the absence of a donor-developed project, a creative finance strategy will be required to establish an infrastructure based on renewable energy in the rural areas where the greatest demand exists.

3. **Standards and Quality Control**

   One of the main obstacles to Nigeria's renewable energy market's growth is the lack of standards and quality control for both imported and domestically produced technologies. Establishing quality assurance is a prerequisite to increasing consumer trust and expanding the renewable energy sector. The impression of potential users, a shoddy system for standards setting, testing, and certification, and operator professionalism are two significant aspects of quality difficulties. Governments and researchers have overlooked the importance of community involvement in promoting the shift to sustainable energy. An essential instrument for advancing this strategy is community involvement. That was embraced by various nations as a crucial element of their energy transition plans. countries such as

4. **Policy and Regulatory Barriers**

   Centralized conventional electric power sources have always been the main focus of national strategy. To encourage investments in conventional power generating, a number of incentives were introduced. Up until now, investments in alternative energy solutions have been penalized by grid electricity subsidies. The development of alternative power services has been severely hampered by the absence of level playing fields for all energy sources and technologies. Up until recently, the only organization with the legal right to generate and distribute power was the now-defunct Power Holding Company

of Nigeria (PHCN). Independent power producers are allowed to operate under the 2005 Act, although the legal framework needed to properly implement PPA is still developing. Potential investors in renewable electricity face additional obstacles due to the perception of high regulatory risks held by financial institutions and potential investors. Moreover, deciding to invest in grid-connected power projects requires taking into account the certainty of grid connection. Renewable energy sources are currently not guaranteed non-discriminatory unrestricted access to the national electrical grid.

Beyond Regulatory frameworks, community engagement as a tool for driving sustainable development

Numerous scholars concur that legislation and incentives supporting renewable energy are major factors driving the growth of sustainable energy projects in industrialized economies like the European Union (Chukwuka et. al., 2018). As part of off-grid energy solutions, community energy systems are widely employed in the Global North, especially in Europe, to allow communities more control over their energy generation and utilization. The ambition to achieve renewable energy targets and improve energy efficiency is also driving the initiation of community energy projects in Canada and some European nations (Mazaher et. al., 2023). The European Union has positioned community energy at the core of its strategy and policy in light of these understandings. According to a study conducted in Sub-Saharan Africa, sustainable energy systems usually fall short of fully including the community in their development and are ineffective at easing the continent's transition to sustainable energy (Ambole et al., 2021). The project's implementation, management, and upkeep fall within the purview of the government, which will establish complicated relationship between the government and the beneficiary, which will be the community or consumer.

Design for behaviour change, community's engagement, design for accessibility, and participatory approaches are some of the solutions to some of these problems. A significant level of community involvement is required (Deutschmann et. al., 2021). It is said that civic engagement is becoming more prevalent worldwide in matters that are either directly or indirectly related to environmental quality (Gebreslassie and Cuvilas, 2023). In order to provide green, clean energy where it is needed, government and private industry are investing in renewable energy projects and modernizing transmission lines as our conventional energy assets deteriorate. Landowners and communities whose lives are impacted by the installation of energy infrastructure must support this initiative in order for it to succeed (Pillan et. al., 2023). Due to a lack of broad community support from local communities during their energy transition, Australia faced an uphill battle (Sadik-Zada and Gatto, 2023). Reducing community involvement in the transition could lead to a decline in public acceptance and

participation, which could threaten or impede the transformation of the energy system (Monyei et. al., 2018). Businesses and governments must collaborate to involve the community early on in projects that will impact their lives and livelihoods in order to improve outcomes for regional and rural communities and strengthen support for the energy transition (Walker et. al., 2010). Reducing greenhouse gas emissions and increasing energy savings are the primary goals of the energy transition. The significance of behavioral change solutions has long been recognized, in addition to the advancement of technical opportunities (Nkoana et al., 2018). Behaviour change can refer to a wide range of behaviours, attitudes, and roles, from engaging with a touchpoint to drastically altering one's way of life. For sustainability, it is crucial to take into account the stages at which behavioural change is addressed (Sadik-Zada and Gatto, 2023). The energy sources and equipment that consumers choose have a big impact on the environment. Attitude and personal capabilities are among the variables that can affect an individual's behaviour.

Personal capacities include things like financial accessibility, technical proficiency, and self-worth (Pillan et. al., 2023). People's attitudes and behaviours regarding the adoption of sustainable practices and technology are greatly influenced by these factors. Regarding attitude components, bottlenecks typically allude to potential resistance to change, the challenge of forming and sustaining new habits, etc, (Koirala et. al., 2018). A feeling of distrust or disinterest as well as a unique or modified perspective on sustainability-related concerns. It is crucial to connect electrification to activities at the individual, local, and economic levels in order to accommodate the various sensitivities and objectives of people. This shift can be achieved by (i) increasing participation and understanding, (ii) altering energy-consumption patterns, (iii) changing work and everyday routines, and (iv) making decisions about energy suppliers and electric appliances. Encouraging citizens to adopt new behaviours and habits, such cutting back on energy use or switching to renewable energy sources, is a common step in the sustainable energy transition process (Ambole et. al., 2021). Here, there is a trade-off between creating solutions that are user-friendly and convenient and those that necessitate substantial behavioural adjustments. It's critical to strike a balance between encouraging sustainable behaviours and causing the least amount of disruption to citizens' daily life (Mey and Hicks, 2019).

Ways to Improve Interest in Sustainable Energy Transition

Participatory Decision-Making

Community members' commitment and trust can be increased by including them in decision-making processes related to sustainable energy initiatives. Public consultations, neighbourhood gatherings, or even online forums where suggestions and opinions are exchanged might be used for this.

Technical and Financial Assistance

A deficiency of monetary and technological means may provide formidable obstacles to community-driven energy initiatives. Giving communities access to capital, incentives, and technical know-how can enable them to take charge of their energy

destiny. It can be difficult to guarantee that these solutions are both reasonably priced and available to a large number of citizens. Additionally, implementing new sustainable energy technologies and systems may have many advantages, but there may be difficulties with their widespread acceptance. Making technology user-friendly is the trade-off in order to make sure that the general public can comprehend and utilize it with ease.

Providing Incentives

Providing rewards to the community, such tax credits, rebates, or subsidies, can encourage them to embrace sustainable energy methods. Installing energy-efficient appliances or renewable energy systems may be a requirement for these incentives.

Initiatives for Collaborative Renewable Energy

In certain regions, towns have partnered with producers of renewable energy to set up massive solar or wind farms. By working together, we can make sure that the community is involved in decision-making, benefits from the clean energy produced, and is able to create jobs locally and boost the economy.

Conclusion

Through the inclusion of community engagement in the energy transition, we can build a sustainable future that benefits all. Community participation becomes the engine driving an inclusive energy transformation by providing fair access to energy, fostering energy literacy, speeding the adoption of renewable energy, and boosting local economies. Participating in the community is a continuous activity rather than a one-time event. It necessitates constant communication, attentive listening, and adaptability to changing conditions. Beyond the confines of the law, interventions that encourage participation, awareness, and sensitization can be created to influence behavior toward electrification.

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