



## Prospects and Challenges of Investment in Renewable Energy Potentials of Nigeria

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### Abstract

*Researches have shown that Nigeria has abundant renewable and non-renewable energy to meet its energy demands and even supply its neighboring countries. Fossil fuel and hydro resources substantially dominated her energy supplies for many decades. Yet, the country is suffering from epileptic power supply owing to some teething problems thereby crippling its drive for industrialization and economic prosperity. In her attempt to redress her energy sector crises and energy deficiency needs in particular, the country is positioning herself to explore and exploit her alternative cleaner sources of energy popularly known as 'renewable energy' that are in abundance but not tapped to the fullest, while grappling to see how it will fix the problems embedded in its conventional 'fossil fuel' energy sector. The prospect of Nigeria's renewable energy potentials and how it can be harnessed by the state and private investors to meet the country's energy as well as how available sources of finance can be accessed by investors to develop her renewable energy sector are hereby examined. The research methodology employed secondary data and qualitative means of data analysis situated within the context of critical theory. The paper found out that the renewable energy potential of Nigeria is massive, with continued growth expected to trickle-in to complement the country's problematic fossil fuels sector that is being reformed for optimal performance. The paper recommends, among others, creating the right enabling environment to attract investment in cleaner renewable sources, strengthening her comatose fossil fuel sector and grid infrastructure. This is the way to go to enhance the countries energy deregulation drive for energy supply and efficiency devoid of low carbon emission.*

### Keywords:

Non-renewable energy  
Renewable energy  
Green energy  
Biomass energy  
Biofuel

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## 1. Introduction

Energy is a major sector of the global economy and accounts for trillions of dollars each year. The world economy needs power, creating sustained, long-term demand for the energy sector. The sector is a potential gold mine for high dividends or companies' growth, if the right enabling environment is provided. Nigeria is also one of Africa's largest fossil fuels/crude oil producers, crude oil being a vital component needed for energy production. Yahoo Finance ranks Nigeria at peak of its crude oil production, the world's 15th top producer. Nigeria's crude oil production currently hovers between 600, 000 barrels per day and 1.5 million bpd. It has an OPEC quota of 1.78mbpd and capacity for much higher than it rarely meets. Nigeria has the largest oil and gas reserves in sub-Saharan Africa with an estimated 37 billion barrels of oil and 188 trillion cubic feet of gas.' Nigeria is rated as one of the world's most resource-dependent countries with oil and gas contributing the majority of government revenues and 90 percent of her exports in 2015 (PwC, 2021). Hydropower has the utmost Renewable Energy (RE) potential, which amounts to 10,000 MW for large hydropower and 734 MW for small hydropower (SHP) (Shaaban and Petinrin, 2014).

The abysmal performance of Nigeria's power/energy sector has continued to shake the nation's economy to its foundation with many organized private sector operators having to expend a substantial portion of their revenues on generating sets. The fate of these organizations is also sealed by the prohibitive cost of diesel and petroleum/PMS over the years, thereby forcing many companies to shut down or relocate to neighboring countries. The small-scale industry is not spared as the fear of incurring heavy losses arising from lack of sufficient access to power has forced many ambitious business owners to abandon their plans. The attendant loss of jobs by various businesses in their attempt to reduce operating cost brought about by scarcity and

rising cost of energy as well as the threat to government plummeting revenue in form of taxes is another dimension of the fallout of the power sector crisis.

This article is carefully designed to x-ray the realities facing the country's energy sector by sharpening its focus on key challenges and opportunities. Specifically, by examining the issues that falls within the realm of physical environment, policy, regulatory and financial sector, to the roles being played by the government and private organizations in the development of renewable and green energy sources in Nigeria, it believes that problem bedeviling her energy sector will not only be easily identified and fixed, but will woo investors to come in and build her renewable energy sector.

## 2. Literature review

Nigeria has a significant percentage of the world's oil production as well as large quantities of coal and gas (Akinwale, Ogundari, Ilevbare and Adepoju, 2014). It also has abundant sunlight, wind as well as abundant land. Nigeria's land includes the tropical rain forest which has carbon sequestration implications. The country also has arable and affable land with a potential for biofuels. In terms of utilization, fossil fuels, biomass and hydro makeup Nigeria's cum Africa's most predominant energy sources. Almost all the hydro and geothermal resources in Nigeria are in Central, South West and South East of Nigeria. A big percentage of the wind and solar resources can be located in the North and West.

The solid mineral industry is a very peculiar industry. It is a sector that requires a high capital formation for any person that wants to venture into it. These kinds of large capital formation are most of the time not within the reach of local entrepreneurs in Nigeria, hence the need for foreign investors. The industry is one that requires a high level of technical know-how. High quality machines and other work

accessories are required for the proper functioning of this industry. These machines and equipment are most of the times, only found in developed countries. Nigeria, as such, needs these foreigners for the development of this sector. The long gestation period of this industry is a source of discouragement to local entrepreneurs in Nigeria, who cannot afford to tie their capital down for a very long period of time. Minerals resources are naturally occurring inorganic solid elements or compound with a definite composition or range in composition usually having a regular internal crystal structure (Filani, 2014). They are generally classified as metallic and non-metallic minerals, and some are discovered to be major component of energy production in the world. The National Policy on Solid minerals in Nigeria (1999) defined minerals as encompassing a wide variety of endowments going from iron ore to coal, to sand, gravel, some of them found on the surface, while others can only be won from the earth through underground mining. Mineralogists world-wide, have identified about 1,500 separate mineral species and about 200 of these were said to be common minerals (Peter, 2004). They classified them based on their constituents and they include; Native element, Sulfides, Sulfosalts, Oxides and hydroxides, Halides and Borates, Carbonates, Nitrates and Codates, Phosphates, Vanadates and arsenates, sulfates, Tungstates and Molybdates, Silicates etc. In Nigeria (National Policy on Solid Minerals, 1999), minerals are classified according to their uses and these are mineral fuels, metallic minerals, industrial minerals and Gemstones.

Metallic Minerals such as Iron ores of diverse quality and origin are found in Nigeria. The energy needs of a blast furnace depend on the quality of the ore. As the metal content increases, the energy required for the production of iron decreases. A lower metal content results in more slag, as well as greater limestone additions and higher energy use (Palacios, 2011). The purest ores occur in a series of basement

ridges. Proven iron ore reserves are at least 200 million tons with a life-span of over 100 years are found in Nigeria. The commercial ore grades range in ferrous (Fe) content from rich ores with over 50% Fe, medium-grades ores (30-50%Fe) to poor ores (25 – 30% Fe). Mining is undertaken by the National Iron Ore. Mining Company for the Ajaokuta Steel Plant and the production of super concentrates for the Delta Steel Plant at Aladja near Warri (Victor, 2004).

The occurrence of bitumen deposits in Nigeria is indicated at about 42 billion tonnes; almost twice the amount of existing reserves of crude petroleum. Analytical results suggest that this potential resource can be used directly as an asphalt binder. Most bitumen used for road construction in Nigeria is currently imported. Nigerian coal is one of the most bituminous in the world owing to its low sulphur and ash content and therefore the most environment-friendly. There are nearly 3 billion tonnes of indicated reserves in 17 identified coal fields and over 600 million tonnes of proven reserves (Ministry of Foreign Affairs, Nigeria, 2023). The most well-known bitumen-based fuel has been developed by **Intevep**, the Research and Development Affiliate of Petroleos de Venezuela SA (PDVSA), in a collaboration with British Petroleum (BP), and is branded "Orimulsion." It is an emulsion of natural bitumen mined from the Orinoco Belt and fresh water. Bitumen-based fuel is currently used as a commercial boiler fuel in power plants in Canada, Japan, Lithuania, and China (Wikipedia, 2022).

As battery metals take on a strategic significance in many ways similar to the central role long played by oil, it will be very hard for developing countries with significant resources to keep their development trajectories from being hijacked by geopolitics. No country illustrates that problem better than the Democratic Republic of the Congo (DRC), which controls the world's largest known reserves of cobalt - a metal that has emerged as key to the green transition, not least because electric vehicle (EV) batteries produced

with cobalt tend to allow longer driving distances between charges (Standen, 2022).

Fuel minerals are carbonaceous fuels stripped from the earth. There are three main types of fuel minerals, viz: coal, petroleum, and natural gas. These are also known as fossil fuels and available in commercial quantity in Nigeria. Mineral fuels are part of non-Metallic Minerals. Geochemically they represent the concentration of carbon and hydrogen by processes that were initially biological in nature. Coal is essentially the product of accumulation of land plants in large amounts, and petroleum and natural gas are the products of marine organisms, although the origin of some petroleum and natural gas under nonmarine conditions cannot be entirely excluded. The origin of petroleum and natural gas presents a more difficult problem than coal because they are fluids and thus are free to migrate from their place of origin (Mason, 2023). Other types of energy sources available to be tapped in Nigeria are Magnetic, Electric, Nuclear, Radiant, Elastic, Ionisation, Thermal, Gravitational, and Heat & Mechanical work. Chemical energy can also be used in food and wood and stored in Biomass, Coal, Chemical batteries, and vehicle's airbags. Energy is the scalar quantity whose International System of Units, universally abbreviated SI (from the French *Le Système International d'Unités*), the modern metric system of measurement, SI unit is given in "Joule." Energy is found in various things, and therefore there are different types of energy. All energy forms are either potential - energy that is stored, or kinetic - the energy of moving objects. It can be changed from one to another type, but it can be neither destroyed nor created (Vedantu, 2023).

Nigeria's energy environment is at a critical crossroads of a global energy change as the globe moves toward greener pastures, amid a symphony of progress and prosperity. Given their abundance, fossil fuels have long held the reins of electricity generation, intertwining the nation's development with a complex web of

environmental degradation and periodic resistant being made by inhabitants of the oil-bearing communities. Presently, the dependence of Nigeria on fossil fuels has negatively affected the environment. This accounts for more than 65% of the country's greenhouse gas emissions.

### 3. Methodology

The methodology provides a stepwise approach in carrying out the research work. The study derived its data from secondary sources collected from relevant text books, journals, internet, new papers, and periodic reports. The data collated are thereafter analyzed using qualitative analysis method i.e. content analysis of documents, using methods that are narratives, descriptive and holistic. The frame work of analysis used falls within the ambit of political economy using critical theory which enable us to recognize, understand and dissect the tendencies that arose from specific patterns of interaction between nature and some social forces in both the society and state institutions.

#### 3.1 Discussion on Legal, Regulatory and the Domestication of the National Energy Transition Plan

The Electricity Act ("the Act") enshrines the liberalization of the electricity market to allow private sector participation. Nigeria is not oblivious to the global trend and many opportunities and so is progressively evolving policy and regulatory frameworks to incentivize renewable energy such as the National Electric Power Policy 2001, Renewable Electricity Policy Guidelines 2006, and Electricity Power Sector Reform (EPSRA) Act 2005. The EPSRA is the principal law that governs the Nigerian power sector. It also establishes the Nigerian Electricity Regulatory Commission (NERC), the principal regulator of the power sector in Nigeria. The NERC in performing its functions has established several policies and regulations like the NERC Mini-Grid Regulation 2016, NERC Renewable Energy Feed-In Tariff Regulations

2015, and recently the Independent Electricity Distribution Network (IEDN) license.

The most recent constitutional amendment, specifically the 1999 Constitution of the Federal Republic of Nigeria (Fifth Alteration) Bill No. 33, 2022 (on the National Grid System – Part I & II, Second Schedule), received unanimous approval from both Chambers of the National Assembly on March 1, 2022. This amendment grants individual states the authority to generate, transmit, and distribute electricity within areas already integrated into the national grid. President Buhari formalized this amendment by affixing his signature on March 17, 2023. This constitutional amendment presents a significant opportunity to enhance the implementation of the national energy transition plan. It provides a means to enhance energy accessibility and leverage the diverse resources available across the states to optimize Nigeria's energy mix composition.

While Nigeria has an established national energy transition plan, it is imperative for individual states to seamlessly integrate and domesticate this plan within their medium and long-term policy frameworks. Each state boasts a distinctive energy landscape with varying renewable energy resources, infrastructural capabilities, and energy consumption patterns. Through a judicious alignment of the national plan with their specific circumstances, states can strategically optimize their transition endeavors and leverage their available resources through several avenues, such as: Harnessing Abundant Renewable Resources; Strengthening Grid Infrastructure; Promoting Energy Efficiency Measures; Encouraging Private Sector Participation; Fostering Research and Innovation; and Prioritizing Education and Awareness.

Section 1 of the Act provides a framework to guide the market's transition to a purely contract-based competitive electricity market from the previous non-contract-based structure. This liberalization was done to revolutionize the

market's monopolistic characteristic and disentangle the roadblocks that hinder the influx of private capital into the Nigerian Electricity Supply Chain (NESI). Deregulating the market has been heralded by industry experts as the key to revamping the NESI. Private participation in the power industry has recorded numerous benefits in the Global South, including competition, innovation in electricity services and overall sector growth. An illustrative example is China. In China, its state-owned energy producer, the State Power Corporation (SPC) – before it was unbundled into several companies, controlled over seventy (70) per cent of the total generation capacity. However, after deregulating the country's electricity sector and allowing private sector participation, SPC's control was reduced to forty (40) per cent. This change led to increased independent power producers (IPPs), which enhanced affordable connectivity and power generation. De-monopolizing electricity markets increases competition, which may drive down electricity prices. On the other hand, this begs the question of the challenges that may accompany liberalizing the market and how prepared the Nigerian Electricity Supply Industry (NESI) is to handle them. These potential challenges are discussed below.

### **3.2 Constraints of Renewable Energy in Nigeria**

The Nigerian power sector experiences many broad challenges related to electricity policy enforcement, regulatory uncertainty, gas supply, transmission system constraints, and major power sector planning shortfalls that have kept the sector from reaching commercial viability. Despite the good prospects for the development of renewable energy resources in Nigeria, there are still some challenges militating or that are potentially capable of militating against the development of renewable energy resources in the country. The key challenges and risks associated with renewable investment include

regulatory and policy risks, technological risks, market and price volatility, environmental and social risks, and infrastructure and integration challenges.

On environmental and social risks, climate change is likely to increase the uncertainties facing capital markets because the economic effects of climate change are difficult to predict. For example, increased risks of heatwaves, windstorm, wildfires, floods, and droughts will increase the potential losses for insurers and investors. These uncertainties are likely to result in higher long-term costs for the financial sector. On political Instability, it is a fact that a stable and peaceful atmosphere in a country will attract investment. The solid mineral industry and fossil fuel sector are also affected by this. Since investment in the solid mineral and fossil fuel industry are capital intensive, and has a long gestation period, it is necessary that the political atmosphere in the host country should be stable enough for the investors to reap the fruit of their investment without undue fear, harassment and bottleneck. This factor is responsible for the withdrawal of foreign investors from the oil and gas sector as well as the solid mineral industry in Nigeria during the civil war (Filani, 2014:693; Bello, 2017).

High costs of executing renewable energy projects relative to other sources of energy significantly affects the economics of renewable energy projects such that it is difficult for them to break even on a commercial basis. This is a major disincentive to developing renewable energy projects on a commercial basis in Nigeria. Electricity generation cost is volatile in liberalized markets. This volatility is because the market forces of demand and supply determine the cost of electricity and not regulators, which is alarming for a few reasons. One, unlike the consensus that a competitive market reduces electricity prices, the United States electric industry evidenced otherwise. In 2007,

In spite of the formulation of the National Energy Policy, 2003 which addresses several

energy subsectors including different renewable energy sources, there is currently no law that addresses issues of renewable energy. The reality is that specific legal and regulatory intervention is required in order to alleviate some of the impediments to developing renewable energy projects. One area in which this intervention is needed is in the taxation of renewable energy projects. Currently, renewable energy projects are subject to the same tax regime as any other energy development projects except the oil and gas upstream energy industry. The implication is that given the financing constraints associated with renewable energy projects, significant tax incentives need to be given in order to enhance the economics of such projects.

Inadequate solar initiative's research, lack of technological know-how, short-term policies, lack of awareness and political instability are the major barriers that made the implementation of solar initiatives almost impossible in Nigeria. Nigeria's potentially has abundant sunshine throughout the year, making it full thirst for solar energy generation. Even though, the country's solar energy projects have not realized a fair result over the years, due to many barriers associated with initiatives implementation. Therefore, the entire power sector remains incapacitated to generate, transmit and distribute a clean, affordable and sustainable energy to assist economic growth. The shock of the barriers therefore, constitutes a major negative contribution to the crippling of the power sector in the state. Future research will concentrate on initiatives for mitigating solar and other renewable energy barriers.

Finally, the biggest problem with renewable energy sources is that they generate most of their energy at certain times of the day. They electricity generation does not match with the peak demand hours. The intermittency of sunshine and wind cannot provide an on-demand power source 24 hours a day. Solar energy and wind are unpredictable. Like wind and solar, most renewable systems have low energy

content, siting problems as well as capacity factors thus needing significant inputs of conventional fuels to maintain stability of supply. China for example used its cheap energy resources such as coal to alleviate poverty and achieve close to 100% electrification rate. They are now making progress towards renewable energy but this is after eradicating poverty and reaching a certain economic growth level (Wesseh and Lin, 2016).

### 3.3 The Financing options for renewable energy development in Nigeria

International financial institutions (IFIs) play a significant role in climate finance. They provide funding, technical assistance, and policy support to help countries implement climate projects. IFIs like the World Bank, regional development banks, and the Green Climate Fund channel finance to developing countries, enhance access to capital, and facilitate the integration of climate considerations into national development strategies.

Investments in renewable energy projects contribute to global efforts to reduce greenhouse gas (GHG) emissions and mitigate the impacts of climate change. Investors may prioritize these projects as part of their environmental, social, and governance (ESG) strategies. Like many other countries, Nigeria has committed to increasing its use of renewable energy to contribute to global climate action. However, one constraint in fulfilling this commitment is the availability of funds to promote renewable energy. Hence, this section will explore various financing options for renewable energy development in Nigeria.

The development of renewable energy projects largely depends on access to funding. As a result, some of these projects never kick off in Nigeria. However, access to information on financing options can encourage renewable energy developers in the country. The United Nations' seventh Sustainable Development Goal (SDG 7) speaks to achieving clean energy for all.

To implement this goal, educating intending developers on financial instruments that support the scaling up of renewable energy technologies (RETs) is pertinent. The financing options for renewable energy development in Nigeria are divided into two categories (Nextier, 2023), viz:

- a) Public finance instruments, and
- b) Private finance instruments.

### 3.4 Public Finance Instruments - Grants, Concessional Loans, and Subsidies:

**i.** **Grants** are funds provided by the government or international development organizations to support renewable energy projects. For example, the African Development Bank (AfDB), through Sustainable Energy for All (SEFA), has developed several initiatives to support developers of RETs by offering grants and technical support to developers. The African Development Bank is boosting the promotion of resilient, green and sustainable growth, with the launch of the African Green Bank Initiative, a model for deploying green financing across the continent. The initiative, which was presented at the just-concluded UN Climate Change Conference (COP27) in Egypt, will support the implementation of African countries' Nationally Determined Contributions (NDCs). Part of the African Financial Alliance on Climate Change (AFAC), the Green Bank Initiative will be supported by the African Green Finance Facility Fund (AG3F).

Launching the initiative, African Development Bank vice president for Energy, Power, Climate and Green Growth, Kevin Kariuki, said the African Green Bank model would help increase the continent's access to global climate finance. The Green Bank Initiative is a powerful tool for reducing financing costs and mobilizing private sector investments in climate action in Africa," Kariuki said.

**ii.** Another example of a public finance instrument for renewable energy development is concessional loans, offered at lower interest rates than market rates. An example of a concessional

loan program is the Nigerian Electrification Project (NEP). The project aims to increase access to electricity in rural areas. The project's goal is to subsidize the large-scale development of mini-grids by shrinking initial costs and creating room for scaling operations and recovery of investments by developers during the project cycle.

iii. Subsidies are another financing option for renewable energy development in Nigeria. The government provides subsidies on renewable energy equipment for developers to reduce the cost of renewable energy projects. For example, the Nigerian government offers import duty exemptions on renewable energy equipment such as solar panels, inverters, and batteries.

The Federal Government of Nigeria (FGN) has put incentives such as the Value Added Tax (VAT) Modification Order, 2020. This exempt specified renewable energy equipment from the application of VAT with respect to the importation or in-country sale of the equipment. The FGN also launched the Solar Power Naija Project. The project focuses on providing five million households with solar home systems for off-grid communities, under the Nigeria Economic Sustainability Plan (NESP). The implementation of the project is facilitated by the Central Bank of Nigeria, which will make available NGN140bn (approximately US\$340m) in direct and indirect loans to qualifying projects.

In addition to the large number of mini-grids and small scale solar Independent Power Projects (IPPs) springing up across the country, the FGN is also taking steps to boost the existing hydroelectric generation capacity, with the concession of Gurara Hydropower Project, the proposed concession of the Zungeru Hydropower Project and the planned development of the 3,050 MW Mambilla Hydropower Project.

### 3.5 Private Finance Instruments - Equity, Debt, and Mezzanine Financing:

- i. **Equity financing** involves raising capital from investors in exchange for project ownership. In Nigeria, several venture capital firms such as All-On, Sahel-Capital, and Off-Grid Electric have invested in renewable energy projects.
- ii. **Debt financing** for renewable energy development involves borrowing money from financial institutions, such as banks or pension funds, to finance projects. Debt financing is a common instrument used for Nigeria's renewable energy sector. For example, Access Bank, one of Nigeria's leading banks, provides debt financing for renewable energy projects.
- iii. **Mezzanine financing** is a hybrid of equity and debt financing. It involves providing capital to the project in exchange for a share of ownership and a high return on investment. Mezzanine is a sort of blended finance or a funding strategy that seeks to attract investments from both public and private actors. It is often used to attract commercial capital to support development projects, thereby increasing funding for these projects and providing investors with a profitable return. Blended finance can also be used to combat climate change, according to the World Economic Forum. This model can attract money from private investors to support mitigation projects when public funds alone are not sufficient.

In addition to the aforementioned, there are several other financing options for renewable energy development in Nigeria. These include crowdfunding, green bonds, and carbon credits.

- i. Crowdfunding involves raising small amounts of capital from many people, usually through online platforms.
- ii. Green bonds are debt securities issued by organizations to finance environmentally sustainable projects.
- iii. Carbon credits are a financial instrument representing a reduction in greenhouse gas



emissions. These credits can be bought and sold, and the revenue generated can be used to finance renewable energy projects.

#### 4. Conclusion

Nigeria is endowed with abundant energy resources, both conventional and renewable, which can potentially provide the country with a sufficient capacity to meet the ambitions of both urban and rural Nigerians of a full, nationwide electrification level. Yet, Nigeria has one of the lowest consumption rates of electricity per capita in Africa. With the demand superseding the generation, there is inequitable access of rural communities to the electricity service in the country. There are inherent obstacles militating against the effective implementation of an orderly energy policy in Nigeria. The inefficiencies overshadowing the allocation of energy resources coupled with the near depletion of fossil fuels, make it imperative for the country to exploit its huge natural renewable resources to avoid a worsening energy supply scenario and provide feasible electricity to rural dwellers.

Renewable energy will continue to rise in the upcoming decade, edging out fossil fuels and reducing greenhouse gas emissions. The future of renewable investment is promising, with continued growth expected in the renewable energy sector. As technological advancements continue to drive down costs and improve efficiency, renewable energy sources are becoming increasingly competitive with traditional energy sources. This trend, combined with growing global commitments to combat climate change, is expected to drive further investment in renewable energy projects. Increased investment in renewable energy sources has the potential to significantly transform the global energy landscape.

As more countries and businesses shift towards clean energy solutions, the world can move closer to achieving global climate goals and transitioning to a more sustainable, low-carbon economy. Renewable investments offer

opportunities for sustainable growth and development, both economically and environmentally. By supporting the transition to clean energy, investors can contribute to a more sustainable future, create jobs, promote innovation, and foster economic development in communities around the world.

#### 5. Recommendations

- 1) Nigerian government should clean up the mess happening with her four refineries by selling all the refineries in a transparent, corruption-free, and cronyism-free auctions to reputable investors to attract foreign investment and foster competition in the downstream oil sector.
- 2) States must invest in upgrading and expanding their transmission and distribution networks to accommodate the increased integration of renewable energy sources. Smart grid technologies, energy storage solutions, and microgrid systems can enhance grid resilience, ensuring a stable and consistent energy supply.
- 3) States should actively engage with the private sector to attract investments and expertise in renewable energy projects.
- 4) States can establish research centers, collaborate with academic institutions, and incentivize innovation hubs to drive technological advancements in energy generation and renewable energy technologies.
- 5) States should implement awareness campaigns, workshops, and educational programs to empower communities with the knowledge and skills to embrace sustainable energy practices.

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