

**ENTREPRENEURIAL OPPORTUNITIES IN THE RENEWABLE ENERGY SUB-
SECTOR IN NIGERIA**

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Abstract

The negative environmental effects of burning fossil fuels as well as world population explosion along with political instability in many regions of the world combined with the rising cost of energy have set many nations on a quest for alternative sources of energy as well as some degree of energy independence and security. With these factors driving the shift towards renewable energy, the time has come to start looking for opportunities to help solve the world's energy problems and perhaps, make money. This study, utilizing the library research approach, has examined the above issue with a particular focus on Nigeria. The study found that, despite her great and diverse natural endowments, Nigeria is yet to diversify from fossil fuels and tangibly embrace the renewable energy revolution. It was also found that there are a great many entrepreneurial opportunities in the renewable energy industry in Nigeria but that many Nigerians are not aware of these opportunities much less taking advantage of them. It was recommended (among others) that for Nigeria to make any significant progress in developing her renewable energy potentials, major policy initiatives must be developed and leveraged upon to drive interest and encourage investment in renewable energy and that Government should embark on intensive enlightenment campaign to acquaint the citizens of the benefits and impact of renewable energy on their living standards.

Key Words: Fossil fuels, Renewable energy, Policy initiatives, enlightenment campaign, living standards.

INTRODUCTION

In view of the obvious fact that the earth is growing old with many of its resources fast depleting, we owe it to ourselves and the coming generations the responsibility to ensure that available resources are conserved and managed more prudently. At the top of the list of resources we need to keep a close watch on, is the issue of energy. Apart from the fact that most energy resources are fast depleting, energy costs have become so high and this has had direct consequences on the costs of goods and services.

The solution to this problem has led to the development of cost effective alternative energy sources which cause less pollution and protect the environment. These alternative energy sources gotten from direct and indirect sources can be regenerated or replaced hence are known as renewable energy. According to Ajaero (2015), investment in the renewable energy industry is not only an investment in a business that would make a lot of money but one is also investing in a business that would help to better the lives of generations to come by protecting the environment and much more, one is also investing in a business that has the backing of the government in terms of taxes and funding.

With the surge in global investment in renewable energy gaining ground and as other developing countries in Africa such as South Africa (SA) and Ghana, jostle to take leadership in the sector, Nigeria apparently has yet to fully key into the sector despite the abundance of the mix of rich solar, wind, biomass and hydro energy resources in the country.

In the year 2012, of the \$268.7 billion invested worldwide in renewable energy according to data from Bloomberg New Energy Finance, Africa had about \$4.3 billion but South Africa accounted for most of it. It had the biggest annual clean energy investment growth rate in the world in the year 2012, outstripping China, Japan, South Korea and a host of other economies, and entered into the global green power league. The continent had about 36 projects, 28 were in South Africa, with Kenya, Nigeria, Ethiopia and Zimbabwe accounting for the rest (Asu, 2013).

For Nigeria to rise to occupy her rightful place as the giant of Africa, entrepreneurs in Nigeria must rise up and key into the great opportunities offered by the renewable energy industry in view of the fact that we have a rich mix of the renewable energy resources in the country to exploit. In this paper, we shall examine Conceptual framework, Factors necessitating the quest for renewable energy, The Energy Situation in Nigeria, Entrepreneurial opportunities in renewable energy investment, Conclusion and Recommendations

CONCEPTUAL FRAMEWORK

This section attempts some definitions of the two major concepts discussed in this paper; namely Renewable Energy and Entrepreneurship.

Renewable Energy

According to the Penn State College of Agricultural Science (2015), renewable energy is energy generated from natural resources-such as sunlight, wind, rain, tides and geothermal heat-which are renewable (naturally replenished). Renewable energy technologies range from solar power, wind power, hydroelectricity/micro hydro, biomass and biofuels for transportation. Put another way, Renewable Energy is energy that is generated from natural processes that are continuously replenished. This includes sunlight, geothermal heat, wind, tides, water, and various forms of biomass. This energy cannot be exhausted and is constantly renewed.

The **Texas Renewable Energy Industries Alliance (TREIA)**, has explained that there is much debate about how to define and distinguish renewable energy from non-renewable, and the terms and definitions chosen can have huge impacts on policy and regulatory efforts aiming to promote clean energy resources. TREIA's definition of renewable energy has been adopted by the Texas legislature, and is as follows:

"Renewable energy: Any energy resource that is naturally regenerated over a short time scale and derived directly from the sun (such as thermal, photochemical, and photoelectric), indirectly from the sun (such as wind, hydropower, and photosynthetic energy stored in biomass), or from other natural movements and mechanisms of the environment (such as geothermal and tidal energy). Renewable energy does not include energy resources derived from fossil fuels, waste products from fossil sources, or waste products from inorganic sources."

The **Australian Renewable Energy Agency (ARENA)** has defined renewable energy as energy which can be obtained from natural resources that can be constantly replenished. Renewable energy technologies include technologies that use or enable the use of one or more renewable energy sources.

Entrepreneurship

Till date, the debate on the appropriate definition of entrepreneurship has remained an unsettled issue. It continues as business concepts, and ownership structures change and depending upon the subject and methodology employed in the investigation of the entrepreneurial phenomenon (Igbe, Aaver and Zever, 2008). Be that as it may, we find the definition by the Lowell Stahl Center for Entrepreneurship & Real Estate, Lewis University (2016) as sufficiently meeting our needs for this paper. According to these authors, entrepreneurship refers to:

“capacity and willingness to develop, organize and manage a business venture along with any of its risks in order to make a profit. The most obvious example of entrepreneurship is the starting of new businesses. In economics, entrepreneurship combined with land, labor, natural resources and capital can produce profit. Entrepreneurial spirit is characterized by innovation and risk-taking, and is an essential part of a nation's ability to succeed in an ever changing and increasingly competitive global market place”.

FACTORS NECESSITATING THE QUEST FOR RENEWABLE ENERGY

As the global population rises, the reality of finite resources is intensifying. Our energy requirements cannot depend on fossil fuels forever, and although advances in technology allow us to tap into reserves that were inaccessible in the past, at some point we will run out of these as well (Johnston, 2015).

These concerns, along with the negative impacts of burning fossil fuels, have created an environmentally and socially conscious mindset amongst different sets of economic factors, including consumers, investors, firms and governments. Firms and investors looking for profits have taken advantage of consumer interest in cleaner energy alternatives and government-incentivized greener business initiatives (Nayak, 2015)

Furthermore, political instability in regions like the Middle East have set many nations on a quest for energy independence and security. Solar, wind and geothermal energy sources can be tapped into from essentially anywhere in the world - at least in varying degrees - thus offering the hope

of energy independence and security. With these factors driving the shift towards renewable energy, now is the time to start looking for opportunities to help solve the world's energy problems and, perhaps, make money (Nayak, 2015).

Another impetus for the quest for renewable energy lay in the fact that, renewable energy wind, solar, geothermal, hydroelectric, and biomass provides substantial benefits for our climate, our health, and our economy. Each source of renewable energy has unique benefits and costs. We shall in this section, explore the many benefits associated with these energy technologies as enumerated by the Union of Concerned Scientists (2009).

Little to No Global Warming Emissions.

Human activity is overloading our atmosphere with carbon dioxide and other global warming emissions, which trap heat, steadily drive up the planet's temperature, and create significant and harmful impacts on our health, our environment, and our climate. Electricity production accounts for more than one-third of U.S. global warming emissions, with the majority generated by coal-fired power plants, which produce approximately 25 percent of total U.S. global warming emissions; natural gas-fired power plants produce 6 percent of total emissions (Environmental Protection Agency, (2012) and Energy Information Agency, 2012).

In contrast, most renewable energy sources produce little to no global warming emissions. According to data aggregated by the International Panel on Climate Change, life-cycle global warming emissions associated with renewable energy including manufacturing, installation, operation and maintenance, and dismantling and decommissioning are minimal (Intergovernmental Panel on Climate Change, 2011). Compared with natural gas, which emits between 0.6 and 2 pounds of carbon dioxide equivalent per kilowatt-hour (CO₂E/kWh), and coal, which emits between 1.4 and 3.6 pounds of CO₂E/kWh, wind emits only 0.02 to 0.04 pounds of CO₂E/kWh, solar 0.07 to 0.2, geothermal 0.1 to 0.2, and hydroelectric between 0.1 and 0.5. Renewable electricity generation from biomass can have a wide range of global warming emissions depending on the resource and how it is harvested. Sustainably sourced biomass has a low emissions footprint, while unsustainable sources of biomass can generate significant global warming emissions. Increasing the supply of renewable energy would allow us to replace carbon-intensive energy sources and significantly reduce U.S. global warming emissions. For example, a 2009 UCS analysis found that a 25 percent by 2025 national renewable electricity standard would lower power plant CO₂ emissions 277 million metric tons annually by 2025—the equivalent of the annual output from 70 typical (600 MW) new coal plants (Union of Concerned Scientists, 2009). In addition, a ground-breaking study by the U.S. Department of Energy's National Renewable Energy Laboratory explored the feasibility and environmental impacts associated with generating 80 percent of the country's electricity from renewable sources by 2050 and found that global warming emissions from electricity production could be reduced by approximately 81 percent (National Renewable Energy Laboratory, 2012).

II. Improved Public Health and Environmental Quality

Generating electricity from renewable energy rather than fossil fuels offers significant public health benefits. The air and water pollution emitted by coal and natural gas plants is linked to breathing problems, neurological damage, heart attacks, and cancer. Replacing fossil fuels with renewable energy has been found to reduce premature mortality and lost workdays, and it reduces overall healthcare costs (Machol, 2013)

III. A Vast and Inexhaustible Energy Supply

Throughout the United States, strong winds, sunny skies, plant residues, heat from the earth, and fast-moving water can each provide a vast and constantly replenished energy resource supply. These diverse sources of renewable energy have the technical potential to provide all the electricity the nation needs many times over. Estimates of the technical potential of each renewable energy source are based on their overall availability given certain technological and environmental constraints (NREL, 2013). In 2012, NREL found that together, renewable energy sources have the technical potential to supply 482,247 billion kilowatt-hours of electricity annually. This amount is 118 times the amount of electricity the nation currently consumes. However, it is important to note that not all of this technical potential can be tapped due to conflicting land use needs, the higher short-term costs of those resources, constraints on ramping up their use such as limits on transmission capacity, barriers to public acceptance, and other hurdles.

IV. Jobs and Other Economic Benefits

Compared with fossil fuel technologies, which are typically mechanized and capital intensive, the renewable energy industry is more labor-intensive. This means that, on average, more jobs are created for each unit of electricity generated from renewable sources than from fossil fuels. Renewable energy already supports thousands of jobs in the United States. For example, in 2011, the wind energy industry directly employed 75,000 full-time-equivalent employees in a variety of capacities, including manufacturing, project development, construction and turbine installation, operations and maintenance, transportation and logistics, and financial, legal, and consulting services (American Wind Energy Association (AWEA). 2012a and 2012b.). More than 500 factories in the United States manufacture parts for wind turbines, and the amount of domestically manufactured equipment used in wind turbines has grown dramatically in recent years: from 35 percent in 2006 to 70 percent in 2011 (Wiser, Ryan & Mark, 2012).

V. Stable Energy Prices

Renewable energy is providing affordable electricity across the country right now, and can help stabilize energy prices in the future.

The costs of renewable energy technologies have declined steadily, and are projected to drop even more. For example, the average price of a solar panel has dropped almost 60 percent since 2011 (SEIA, 2012). The cost of generating electricity from wind dropped more than 20 percent between 2010 and 2012 and more than 80 percent since 1980 (AWEA, 2012b). While renewable facilities require up front investments to build, once built they operate at very low cost and, for most technologies, the fuel is free. As a result, renewable energy prices are relatively stable over time. UCS's analysis of the economic benefits of a 25 percent renewable electricity standard found that such a policy would lead to 4.1 percent lower natural gas prices and 7.6 percent lower electricity prices by 2030 (UCS, 2009).

In contrast, fossil fuel prices can vary dramatically and are prone to substantial price swings. Using more renewable energy can lower the prices of and demand for natural gas and coal by increasing competition and diversifying our energy supplies. An increased reliance on renewable energy can help protect consumers when fossil fuel prices go up,

VI. A More Reliable and Resilient Energy System

Wind and solar plants are less prone to large-scale failure because they are distributed and modular. Distributed systems are spread out over a large geographical area, so a severe weather event in one location will not cut off power to an entire region. Modular systems are composed of numerous individual wind turbines or solar arrays. Even if some of the equipment in the system is damaged, the rest can typically continue to operate. For example, in 2012 Hurricane Sandy damaged fossil fuel-dominated electric generation and distribution systems in New York and New Jersey and left millions of people without power. In contrast, renewable energy projects in the Northeast weathered Hurricane Sandy with minimal damage or disruption (Unger, 2012). The risk of disruptive events will also increase in the future as droughts, heat waves, more intense storms, and increasingly severe wildfires become more frequent due to global warming. Renewable energy sources are more resilient than coal, natural gas, and nuclear power plants in the face of these sorts of extreme weather events.

THE ENERGY SITUATION OF NIGERIA

Energy is the mainstay of any nation's economic growth and development and Nigeria is not an exception. In the area of renewable energy, Nigeria has enormous potential resources but government and the private sector have not seriously paid attention to them. Presently, Nigeria is embroiled in serious energy crisis. Despite her great and diverse natural endowments, Nigeria is yet to diversify from fossil fuels and tangibly embrace the renewable energy revolution. It is shameful that even Ghana is leading Nigeria in this area (Osu, 2013).

It is a great irony that Nigeria being the most populous black nation in the world and endowed with rich and diverse natural resources is still one of the poorest countries in the world. The energy crisis in Nigeria is a major factor that has kept the country where it is economically. As a result of the extreme electricity deficiency in Nigeria, the people have been forced to resort to generators for household and industrial use with the attendant high costs.

Energy demand in Nigeria is dominated by wood fuel and women and children are the most affected in this crisis. The energy sector in Nigeria totally relies on government subsidized fuel and funding of major energy plants and energy capital projects by the Federal Government, states and government agencies.

The Nigerian government has not been able to find permanent solutions that will resolve the problems. The irony of the situation is that, as the abundance of the vast oil and gas reserves are in Nigeria, so also are abundance of renewable energy potentials, but the country still depends on alternatives that are still within the limits of fossil fuels, which are the main sources that currently power the nation's economy.

Majority of Nigerians are not aware of the environmental impacts and economic benefits of adopting renewable energy. The public awareness of the renewable energy technologies is generally low. Consequently, the Nigerian public does not have much influence that will compel the government to formulate decisive policies and initiatives that will enhance and promote the application, development, dissemination and diffusion of renewable energy technologies and resources in the Nigerian energy market (Amaefula, 2015).

The environment will surely benefit from the elimination of fossil fuels, which will also boost most sectors of the economy. This is where it becomes the business of the general public in Nigeria to prod the government to divert to renewable energy by at least creating the enabling

environment that will help entrepreneurs to invest in this lucrative industry to better the socio-economic lives of the citizens and enhance the economy of the nation.

Entrepreneurial Opportunities in the Renewable Energy Industry

There are innumerable opportunities for implementing an innovative renewable energy solution. However, the best place to start looking is in one's own area of expertise. One needs to think about those industries one has worked in and consider how renewable energy could benefit them. Also, it should be remembered that becoming a renewable energy entrepreneur doesn't mean one would have to build and own a wind farm or hydroelectric dam. Renewable energy is about more than just electricity generation; it is also about storage, conservation and distribution. One does not need to invent a new product or technology, but can choose instead to get involved in installation, repair/maintenance or consulting. One needs to think broadly, and remember his/her areas of expertise (Johnston, 2015).

Ajaero (2015) has listed what he calls Top 20 Business Opportunities in the Renewable Energy Industry that entrepreneurs can readily take advantage of in Nigeria. These business opportunities are as listed below;

1. Solar Panel Sales and Distribution-: Solar energy is really gaining prominence and a lot of people have started using solar energy not only in their homes but also in their factories and offices. Solar energy is cheaper once it is installed, which makes it the favorite renewable energy source for many people. You can start importing solar panels in wholesale quantities from countries like China and Hong-Kong; where it is majorly produced and sell to solar panel installers and retailers.

2. Solar Panel Installation-: Before you can start this business, you would need to undergo some form of formal training in school or informal training from professionals already in the field. Training may cost you some money but once you have the skills, there's no limit to how much you can make from this business; which involves helping people install solar panels in their houses, offices or factories so that they can tap energy directly from the sun.¹

3. Bio-fuel Production-: Ajaero (2015) tells of someone brought a stove to his office some months ago. Very small and cute looking stove. He was about to dismiss her saying "I have got a gas cooker at home, why would I need a smoky stove? But she said this was different and I should allow her demonstrate. She said it was a bio-fuel stove. The stove runs on a fuel made from waste. He was really impressed and had to buy one. The fuel is so cheap and to think that it's actually made from waste! And to crown it all, the cute little stove doesn't emit smoke like the conventional stove we have around here. You can start to produce your own bio-fuel too and create your own invention that would run on bio-fuel. It could be a generator, a tricycle or even a motor vehicle.

4. Wind Energy Installation-: A lot of people are also embracing wind energy. It's not uncommon to see an entire community that runs on wind energy. You could set up a wind farm in your area and have people pay you to supply their houses with wind energy. Like solar energy, wind energy is cost-effective.

5. Solar water pumping system-: Water is very essential and everyone knows that water pumping machines sap a lot of energy. You could start a business that helps people install water pumping machines that run on solar power and makes it cheaper and easier to pump water.

6.Solar refrigeration system-: You could also start selling refrigerators that run-on solar power. This would be received with open arms by hotels, bars and fast food outlets.

7.Power Storage (Inverters &UPS)-: Uninterrupted power supply systems also known as UPS or inverters are gadgets used to store energy, so that when there is absence of power, the UPS can be used as a back-up source of power. UPS are used in hospitals, schools, information technology companies, individual homes and almost every company out there. You would definitely make good money from selling this hot item,

8.Photovoltaic system/modules-: Another renewable energy source is photovoltaic system which converts solar radiation into electricity through semi-conductors,^

9.Consultancy Services-:Well, you may not be interested in all the buying and selling or installation business but what about selling your knowledge and ideas to people who are interested in the industry? This could be people who need advice on the best renewable energy source to install in their homes and business premises or people who are just interested in learning about the industry.

10. Repair & Maintenance services-: These systems though durable, have the tendency to breakdown; so they would need regular maintenance and repair. There's no doubt that starting a repair and maintenance business which would focus on the renewable energy industry is a smart business idea.

11. Solar water heating system-: This one is especially needed in hotels and homes. Instead of using the conventional electric water heaters, solar water heaters would help conserve energy and save money,

12. Electric Vehicles-: One major expense that people undergo daily is motor vehicle fueling. Imagine a world where you didn't have to fuel your vehicle. You can develop your own electric vehicle or employ people to develop one and sell the idea to you for reproduction. I am certain that a lot of people would receive this innovation with open arms. However, you need to be deep-pocketed to do this kind of business. And in case you are asking if it's possible for cars to run on electric, I say yes it is. A little bit of research would clear your doubt.

13.Bio-fertilizer-: The agricultural industry could also enjoy the benefits of renewable energy through the use of bio-fertilizers.

14. Energy Auditor-: An energy auditor inspects homes or business premises and advises on the best way to optimize energy resources usually through renewable energy sources.

15. Research & Products developer-: There are so many equipment that can make use of renewable energy sources and hopefully, there are other renewable energy sources that people are yet to discover. You could start an R&D company with focus on the renewable energy industry. You could even sell your ideas to others, so that they can develop it or you could start developing your own products.

16.Geothermal Power-: Geothermal power makes use of heat from the earth as a source of energy.

17.Financial Consultant-: Investing in the renewable energy industry is on small financial undertaking, which is why investors need financial support most of the time. You could use your

knowledge of the financial industry to seek for financial assistance in form of loans and grants for people looking to invest in the renewable energy industry.

18.Cell phone technologies-: You could also develop cellphones that run on solar energy.

19.Trainer/Teacher-; Another business idea is to set up a training institute that teaches people how to install these renewable energy systems and make money for themselves.

20.Author/Promoter-: Author and promoter are put together but they are two different business ideas but you can merge the two together. As an author, you would write educational and informational materials about the renewable energy industry. It could be books, magazines or even start a blog while a promoter would be involved with increasing awareness for the renewable energy industry as well as the products available.

The above list of investment opportunities in the renewable energy industry in Nigeria is by no means exhaustive. There are so many other opportunities that are not mentioned in that list. Anyone with some level of interest in this area can easily discover the other opportunities. For instance, one can produce informational services for the renewable energy industry as there is a strong demand for good quality information in this area. Thus a person that is good at research can consider producing research reports, how to e-books, instructional videos, solar training classes, and so on. In fact the list of things one can be involved in is limited only by his or her imagination.

Barriers energy entrepreneurship in Nigeria:

Despite the benefits associated with energy entrepreneurship, the programme is surrounded with a good number of barriers including the following:

- i) Economic/financial barriers;
- ii) Policy/regulatory barriers;
- iii) Technology barriers;
- iv) Information/capacity building barriers;
- v) Social barriers.

Some other barriers include:

- ✓ Relatively high cost of equipment;
- ✓ There is need for financial support;
- ✓ Weak development of the national industry for production of solar techniques;
- ✓ Weak public awareness on solar energy advantages;
- ✓ Dependent on weather conditions;

CONCLUSION

The importance of clean energy development is being increasingly well appreciated now, but like most African countries, Nigeria has been slow to expand her energy resources and implement policies to attract investments. As was stated earlier, Nigeria is presently embroiled in serious energy crisis. The energy crisis in Nigeria is a major factor that has kept the country where it is economically. As a result of the extreme electricity deficiency in Nigeria, the people have been forced to resort to generators for household and industrial use with the attendant high costs.

Nigeria is not only blessed with abundance of renewable energy potentials, but equally has a huge market that can easily absorb products from the vast investment opportunities in the

renewable energy industry.

RECOMMENDATIONS

In view of all that has been said, we make the following recommendations. Note that some of the recommendations have been adopted from the work of Amaefula (2015).

1. On a competitive scale, renewable energy technology in Nigeria is way below that of other widely known energy sources due to technological and economic drawbacks, in addition to deep rooted policy inertia. Accordingly, for Nigeria to make any significant progress in developing its renewable energy potentials, major policy initiatives must be developed and leveraged upon to drive interest and encourage investment.
2. The Nigerian government through a policy position must encourage the deployment of Solar Home & Commercial Systems (SHCS). This is a key demand side intervention mechanism as this will rebalance the demand side pressure on the national grid emanating from various residential and commercial power consumers; The financial services industry must also play its role through provision of credit facilities to individuals and businesses enabling them to deploy SHCS. This has been a very successful model in Bangladesh and India where (in India) it is estimated that around 5 million residential solar systems will be sold between 2014 and 2018.
3. Deployment of solar farms. Solar farms are quicker to deploy than conventional power stations. Development policy in this regard must take into account land use policy and it must be streamlined to ensure that developers face minimal challenges when building and installing solar farms.
4. The national and state energy policy must include provision that places an obligation on regional distribution companies to purchase power from developers on preferential fixed term basis, incorporating a favourable feed-in tariff that will reflect the cost of energy units produced, financing costs etc,
5. Government should formulate policies that will take care of the barriers involved in energy entrepreneurship in the country
6. Government should embark on intensive enlightenment campaign to acquaint the citizens of the benefits and impact of renewable energy on their living standards.

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