Harnessing Renewable Energy towards Entrepreneurial Growth in Nigeria

K. E. Ojaomo, O. V. Akerele & Igbasanmi O. E.

Abstract: Solar, hydro-power, wind and biomass which are the major renewable energy sources in Nigeria can be better utilized to suit the purpose of promoting energy stability in Nigeria towards encouraging entrepreneurship growth for enhancement of social and economic development. This is against the backdrop of the present state of energy supply which is inadequate, unreliable, epileptic and promises to be much more expensive as withdrawal of fuel subsidy is strongly being contemplated by government. The worst hit by the menace of the energy crisis are the small and medium scale enterprises. This paper examined entrepreneurship development, renewable energy sources, their development and observed that the deliberate policy of government to develop entrepreneurial skills amongst the citizenry, will only succeed when the problem of energy availability is properly addressed. Suggestions made included: Investment in research and development in renewable energy technologies and energy efficiency projects to be supported by establishment of a special trust fund; involvement of private sector participation in the development of renewable energy, workable government policies and collaboration with relevant international agencies to fully tap the gains of renewable energy.

Index Terms: Entrepreneurship evolution, Fuel subsidy, Investment, Policy formulation, Renewable energy, Research, Rural growth, Small Scale Enterprises (SME).

Introduction

The ever increasing demand coupled with the meager supply of energy in Nigeria has been a great challenge to her entrepreneurship development. The economic development of modern societies is crucially dependent on energy. Energy is vital for sustainable development. It is used to generate electricity for a variety of needs, among which are domestic, transport and industrial needs. The methods of production, supply and consumption of energy are key issues in sustainable development because they strongly affect the local and global environment. However, the current methods of energy production are primarily sourced from fossil fuels. These fossil fuels are largely responsible for global warming as they are accompanied by huge emissions of carbon dioxide and other greenhouse gases into the atmosphere. These methods of production are not sustainable in the long run and therefore do not contribute to sustainable development.

Coal, Oil and Natural gases are all fossil fuels. When fossil fuels are burned, they release huge amounts of carbon dioxide into the atmosphere, thus adding to global warming and climate change. Given that energy usage will continue to increase with the demands of growing population and, with the gap between the demand and supply of energy growing wider by the day, there is the great need to harness other sources of energy as alternative to fossil fuels. People in rural areas depend on burning wood and traditional biomass for their energy needs, causing great deforestation, emitting greenhouse gases and polluting the environment, thus creating global warming and environmental concerns. This paper discusses renewable energy and ways they could be harnessed for the benefit of entrepreneurship development in Nigeria. Nigeria is blessed with huge amount of

solar irradiation, abundant wind energy resources, heavy deposits of fossil fuel and enormous hydro-power resources from Niger and Benue Rivers. However, of these resources, about 80% of hydro-power is untapped, the total radiation of 5.5kWh/m^2/day solar radiation is unutilized and wind energy resources spanning the six geopolitical zones across the country is virtually unexploited (Awogbemi and Asaolu, 2008). Renewable energy is energy generated from natural resources. They can be replenished in a short period of time. The five renewable energy sources used most often include; hydro power, solar, wind, geothermal and biomass. Of the five sources only hydropower has been fairly developed for electricity generation as in Kanji, Jebba and Shiroro (Ajueyitsi, et al., 2007)

A wide range of renewable energy technologies are established commercially and recognized as growth industries by most governments. UN and other international agencies have large programmes to encourage such technologies. Wind power is growing at an annual rate of 30% and is widely used in European countries and the USA. The annual manufacturing output of the photovoltaic industry reached 6,900MW in 2008, and photovoltaic power stations are popular in Germany and Spain (Awogbemi and Asaolu, 2008). Brazil has one of the largest renewable energy programmes in the world, involving production of ethanol fuel from sugar cane, and ethanol now provides 18% of the country's automotive ethanol fuel. Climate change concerns, coupled with high oil prices and increasing government support are driving the increasing renewable energy legislation, incentives and commercialization in the developed countries.

Energy is the mainstay of Nigeria's economic growth and development. It plays a significant role in the nation's international diplomacy and it serves as a tradable commodity for earning the national income, which is used to support government development programmes. It also serves as an input into the production of goods and services in the nation's industry, transport, agriculture, health and education sectors, as well as an instrument for politics, security and diplomacy. The energy sub-sector, especially petroleum, continues to maintain its prominence as the single most important source of government revenue and foreign exchange earner. Despite the fortunes of the oil sector, other sectors of the economy are declining. For instance, according to Ikuponisi (2004), consumption of electricity actually declined by 13.4% between 2002 and 2006 even though the total electricity consumption showed a marginal increase of 1.8% from 5.63GWh in 2002 to 7.47GWh in 2006. Only about 40% of households in Nigeria are connected to the national grid. There is high-energy loss due to the physical deterioration of the transmission and distribution facilities, inadequate metering system and increased incidence of power theft through illegal connections. Other problems of the power sector include manpower constraints, inadequate support facilities, high cost of electricity production, inadequate basic industries to service the power sector, poor billing systems and poor settlements of bills by consumers. These have resulted in the low available capacity which is about 40% of the installed capacity of about 6,000MW. Consequently, power supply became

epileptic and unreliable thereby creating huge market for manufacturers of petrol and diesel generators as most people now resort to them as expensive alternative.

Renewable Energy Sources

Solar Energy: Nigeria lies within a high sunshine belt and thus has enormous solar energy potentials. The mean annual average of total solar radiation varies from about 3.5 $kWhm^{-2}day^{-1}$ in the coastal latitudes to about 7 $kWhm^{-2}day^{-1}$ along the semi-arid areas in the far North. On the average, the country receives solar radiation at the level of about 19.8 MJm^{-2} day^{-1}. Average sunshine hours are estimated at 6 hrs per day. Solar radiation is fairly well distributed. The minimum average is about 3.55 $kWhm^{-2}day^{-1}$ in Katsina in January and 3.4 $kWhm^{-2}day^{-1}$ in Calabar in August and the maximum average is 8.0 $kWhm^{-2}day^{-1}$ in Nguru in May (Chendo, 2002). Given an average solar radiation level of about 5.5 $kWhm^{-2}day^{-1}$, and the prevailing efficiencies of commercial solar-electric generators, then if solar collectors or modules were used to cover 1% of Nigeria's land area of 923,773 km^2, it is possible to generate $1850x10^3$ GWh of solar electricity per year. This is over one hundred times the current grid electricity consumption level in the country (Bugaje, 1999).

Solar thermal applications, for which technologies are already developed in Nigeria, include: solar cooking, solar water heating for industries, hospitals and households, solar evaporative cooling, solar crop drying, solar incubators and solar chick brooding. Solar electricity may be used for power supply to remote villages and locations not connected to the national grid. It may also be used to generate power for feeding into the national grid. Other areas of application of solar electricity include low and medium power application such as; water pumping, village electrification, rural clinic and schools power supply, vaccine refrigeration, traffic lighting and lighting of road signs.

Wind Energy: Wind, which is an effect from the uneven heating of the earth's surface by the sun and its resultant pressure inequalities, is available at annual average speeds of about 2.0 m/s at the coastal region and 4.0 m/s at the far northern region of the country. Assuming an air density of 1.1 kg/m^3, wind energy intensity, perpendicular to the wind direction, ranges between 4.4 W/ m^2 at the coastal areas and 35.2 W/ m^2 at the far northern region. According to Bugaje (1999), wind energy conversion systems that is; wind turbines, wind generators, wind plants, wind machines and wind dynamos are devices which convert the kinetic energy of the moving air to rotary motion of a shaft, that is, mechanical energy. The technologies for harnessing this energy have, over the years been tried in the northern parts of the country, mainly for water pumping from open wells in many secondary schools of old Sokoto and Kano States as well as in Katsina, Bauchi and Plateau States. It has been reported that an average annual wind speed of about 4.7 m/s at a height of 10 m above ground level is the feasible speed for the exploitation of wind energy at today's cost (Fadare, 2010). Tractors and Equipment (T & E), a Division of the United African Company (UAC), at one time, produced windmills in Nigeria. Promising attempts are being made in Sokoto Energy Research Centre (SERC) and Abubakar Tafawa Balewa University, Bauchi to develop

capability for the production of wind energy technologies.

Even though there is a fairly reasonable level of use of the renewable energy in the country, a significantly higher level could be attained. More efforts should be geared towards producing renewable energies from wind especially for the medium scale entrepreneurs. This category of the people requires lesser amount of energy to operate their equipment and machinery and engage in their day to day activities without being connected to the national grid.

Hydro Energy: Essentially, hydropower systems rely on the potential energy difference between the levels of water in reservoirs, dams or lakes and their discharge tail water levels downstream. The water turbines which convert the potential energy of water to shaft rotation are coupled to suitable generators. The hydropower potential of Nigeria is very high and hydropower currently accounts for about 29% of the total electrical power supply. The first hydropower supply station in Nigeria is at Kainji on the river Niger where the installed capacity is 836MW with provisions for expansion to 1156 MW. A second hydropower station on the Niger is at Jebba with an installed capacity of 540 MW. Kaduna, Benue and Cross River at Shiroro, Makurdi and Ikom, respectively indicate their total capacity to stand at about 4,650 MW. Estimates for the rivers on the Mambila Plateau are put at 2,330MW. The overall hydropower resources potentially exploitable in Nigeria are in excess of 11,000MW (Aliyu and Elegba, 1990).

The foregoing assessment is for large hydro schemes which have predominantly been the class of schemes in use prior to the oil crisis of 1973. Since that time, however, many developed and developing countries have opted for small-scale hydropower with appreciable savings made over the otherwise alternative crude oil. It should be noted that hydropower plants that supply electrical energy between the ranges of 15kW to 15MW are mini-hydro while those supplying below 15KW are normally referred to as micro-hydro plants (Sambo and Taylor, 1990). Indeed small-scale (both micro and mini) hydropower systems possess the advantage over large hydro systems in that problems of topography are not excessive. In effect, small hydropower systems can be set up in all parts of the country so that the potential energy in the large network of rivers and run offs can be tapped and converted to electrical energy. Thus the energy so generated can be used to support small and medium scale enterprises (SME) which will translate to the provision of employment opportunities for the teaming Nigerian youths. Small scale businesses will go a long way to improving the economy of the country, especially in the rural areas where energy demand is minimal. Urban-rural migration will certainly drop and the social life of the citizenry will be enhanced. Self-empowerment jobs like shoe carving, embroidery, barbing, weaving, welding, blacksmithing, sawing, vulcanizing, video games, restaurant and the likes do not require large amount of energy.

Biomass Energy: Biomass energy refers to the energy of biological systems such as wood and wastes. The biomass resources of Nigeria can be identified as wood biomass, forage grasses and shrubs, residues and wastes (forestry, agricultural, municipal and industrial) as well as

aquatic biomass. Wood, apart from being a major source of energy in the form of fuel-wood is also used for commercial purposes in various forms as plywood, paper products and electric poles.

For crop residues and wastes, estimates of the 6.1 million tonnes of dry biomass that are produced annually leave residues whose energy content approximate to 5.3 x 10^{11} MJ. Estimates made in 1985 give the number of cattle, sheep, goats, horses and pigs as well as poultry birds as 166 million. These produce 227,500 tonnes of animal wastes daily which come to 2.2 x 10^9 MJ taking the calorific value of animal dung to be 9,800 MJ/tonne. Animal residue can be converted to biogas and estimates show that this is of the order of 5.36 x 10^9 m^3 which has an energy content amounting to 2.93 x 10^9 kWh (Ogbonnaya, et. al., 2007).

Biogas can easily be produced from current waste streams, such as paper production, sugar production, sewage, animal waste (e.g. cow dung), etc. These are slurred together and allowed to naturally ferment, producing methane gas. Sewage plants can also be converted into biogas plants. After extraction of methane the residues can be used as fertilizer. Biogas can also be produced via advanced waste processing systems such as mechanical biological treatment which recover the recyclable elements of household waste and process the biodegradable fraction in anaerobic digesters. Renewable natural gas is a biogas which has been upgraded to a quality similar to natural gas, making it possible to distribute it to the mass market via existing gas grids.

Geothermal Energy: Energy obtained by tapping the heat of the earth itself form kilometers deep in some places or from just a few meters via a geothermal heat pump (a central heating and/or cooling system that pumps heat to or from the ground – using the earth as a heat source in winter or a heat sink in summer). Geothermal power stations are expensive to build, but operating costs are low. Three types of power plants are used to generate power form geothermal energy;

Dry steam plants take steam out of fractures in the ground and use it to directly drive a turbine. Flash plants take hot water, usually at temperatures over 200^{o}C, out of the ground, allow it to boil as it rises to the surface, and then separate the steam to run through a turbine.

Binary plants allow the hot water to flow through heat exchanger, boiling an organic fluid that spins the turbine. The condensed steam and remaining geothermal fluid from all three types of plants are injected back into the hot rock to pick up more heat.

New technology is being explored to generate geothermal energy from underground granites rocks; Holes at least 3km deep are drilled into the earth. Some of these holes pump water into the earth, while other holes pump hot water out.

Entrepreneurship Development

The goal of education is entrepreneurship (Iyekepolor, 2007), which is the production of an individual who is self-reliant and an employer of labour. Hornby (2010) defines entrepreneurship as the act of making money by starting or running businesses, especially when this involves taking financial risks. Entrepreneurship plays a significant part in employment generation in any country because it enhances self-employment.

There is no gainsaying that entrepreneurship plays prominent role in the development of a nation. According to Ugiagbe (2007), entrepreneurship serves as key to modernizing or developing a society. The developed nations in the world today have achieved greatness due to the special attention given to small scale enterprises known as entrepreneurship. One of the strategies for enhancing economic growth of a nation is the fulfilment of the conditions that would guarantee entrepreneurial trade amongst the citizens. Vital areas of relevance of this trade are the rural areas that are separated from the national energy supply or that are not being served enough energy from the national grid.

Entrepreneurship occurs when an individual develops a new venture, a new approach to an old business or an old idea or a unique way of giving the market a product or service by using resources in a new way under conditions of risk (Umar, 2006). It helps to create wealth, self-direction, satisfying career and also adds value to societal well-being. On the other hand, it is the utilization of natural resources and the creation of artificial ones. It is an artistic enterprise which offers a lot of occupational opportunities in areas like; manufacturing of pharmaceuticals goods, foodstuff, packaging, detergent, soap, flavours, fragrances, pulp and paper, paints, candles, metals, welding, carpentry, textiles, weaving looms, agricultural products, chemicals, sales of goods, consultancy services, researching, laboratory services, etc. Sustainable development of entrepreneurship is hinged largely on adequate, reliable and regular supply of energy at affordable cost.

Nigeria is endowed with abundant energy resources both renewable and non-renewable, unfortunately however, energy availability to consumers is inadequate, inefficient and unreliable (Ajueyitsi, et.al., 2007). The rural areas, which are generally inaccessible due to absence of good road networks, have little access to conventional energy such as electricity and petroleum products. Petroleum products such as kerosene and gasoline are purchased in the rural areas at exorbitant prices. Other needs that require electricity to run are virtually not met at all as a result of poor supply or no supply of modern energy to the rural populace. The teaming populace in the rural economy who engage in subsistence life style could be more enterprising if adequate energy supply were provided for them.

With the ongoing restructuring of the power sector and the imminent privatization of the electricity industry it is obvious that for logistic and economic reasons especially under the privatized power sector, rural areas which are remote from the grid and/or have low consumption or low power purchase potential will not be attractive to private power investors. Such areas may remain un-served for a very long time. Meanwhile, electricity is required for such basic developmental services as pipe borne water, health care, telecommunications and quality education. The poverty eradication and Universal Basic Education (UBE) programmes require energy for success. The absence of reliable energy supply has not only left the rural populace socially backward but has left their economic potentials untapped. The logical solution is increased penetration of renewables into the energy supply mix technologies in Nigeria towards

entrepreneurial development of the nation, especially in the rural areas. The challenge here is to give rural electrification high priority in government's efforts to increase the standard of living in rural areas, reduce rural-urban migration trends, and realize other development objectives

In Nigeria, where rivers, waterfalls and streams with high potentials for small hydropower development is abundant, harnessing of these hydro-resources leads to decentralized use and local implementation and management, thereby making sustainable rural development possible through self-reliance and the use of local natural resources. This can be the most affordable and accessible option to provide off-grid electricity services. Based on Nigeria's level of hydropower development, small hydropower means installed capacity of between 2MW and 10MW; Mini hydropower is less than 2MW while Micro hydropower is less than 100kW. In recent studies carried out in twelve states and four (4) river basins, over 278 unexploited small hydropower sites with total potentials of 734.3MW were identified. However, small hydropower potential sites exist in virtually all parts of Nigeria with an estimated capacity of over 3500MW. These could be harnessed for entrepreneurship development.

Conclusion and Recommendation

Recommendation

National Energy Policy exists that encourages the exploitation of renewable energy resources and its integration into the nation's energy supply mix for sustainable national development through private sector participation.

In order to fully harness renewable energy in Nigeria, the following recommendations will be useful:

(1) Government at various levels should pay more attention to renewable energy resources by allocating more resources to it in their budget.

(2) Government should establish renewable energy trust fund to support renewable energy development and energy efficiency projects.

(3) Private sector should be given the right environment and encouragement by Government to engage in the development of renewable energy and energy efficiency.

(4) Tertiary and other research institutions should be adequately funded in order to carry out more researches on suitable conversion technologies. More personnel should also be trained to provide workforce for renewable energy projects.

(5) Renewable energy should be harnessed towards entrepreneurial growth and development to forestall the menace of unemployment and its associated vices. Productivity will be enhanced through this laudable step both at the rural and the urban centres.

Conclusion

Renewable energy is considered a viable solution to the energy challenges of Nigeria especially in the rural areas of the country and to the restrictions posed by the rising cost of conventional or traditional energy. This paper examines the factors affecting developments of the small scale enterprises and observes that erratic energy supply is a major impediment towards economic liberalization of the Nigerian entrepreneur. The possibility of providing the energy needed off the national grid is the recourse for renewable energy development as an alternative. However,

the renewable energy sector, and efforts made to ensure capacity building for renewable energy, stimulation of the private sector, developing the markets for renewable energy, obtaining the necessary finance for renewable energy projects and the assistance of multilateral institutions in advancing renewable energy technologies in the country are so fundamental towards achieving this laudable goal.

Nigeria is blessed with much renewable energy potentials. Renewable energy is the right way to go for Nigeria in order to meet the energy needs of her citizens. If the available renewable energy potentials in Nigeria are fully tapped and utilized to encourage entrepreneurship development, youth restiveness, unemployment and other social vices would drastically be reduced. The economy would also receive a boost as the effects of the emerging entrepreneurs will positively ginger the positive contributions of all and sundry.

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Correspondence Author's Address:
Engr. Koleola Ebenezer Ojaomo
Department of Mechanical Engineering,
The Federal Polytechnic, Ado-Ekiti
P.M.B. 5351, Ado-Ekiti,
Ekiti State, Nigeria.
Email:Kojaomo@yahoo.com