

A REVIEW OF RENEWABLE ENERGY RESOURCE; DEVELOPMENT AND UTILIZATION FOR SUSTAINABLE ENERGY IN NIGERIA

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Abstract

The need for alternative energy sources to fuel wood and diversification of energy utilization into clear, secure and renewable energy is a major concern to energy research institutes in Nigerian energy policy. This paper presents the status of renewable energy activities in Nigeria, activities in which solar and renewable energy sources already developed are being used and further actions required, renewable energy availability potentials, achievements, applications and utilization in Nigeria, as well as the range of technologies for efficient energy utilization using the Korean experience as a successful case of technological development through partnership model.

Introduction

The Energy Commission of Nigeria was set up to put in place a realistic energy policy and master plan to ensure that each source is utilized in the most efficient and economic manner.

The Energy Commission of Nigeria (E.C.N) was established in 1989 as the National Focal Point and the apex organization that coordinates and monitors activities in the energy sector. It has been encouraging the development and use of renewable energy in the country (ECN, 1992).

Energy is an important factor of production and economic growth, and the availability of energy in sufficient quantity is central to all developmental activities. Supply of energy to meet this objective is now increasingly referred to as sustainable solutions. However, the development of energy sources is highly cost intensive and results in environment degradation. Therefore, the energy sources have to be not only widely available but should also be eco-friendly. Technology plays the most important role in meeting this need by ensuring the effectiveness and efficiency of energy supply which must be considered in order to met the challenges of the complex interlink of population growth, economic

growth, consumption patterns, energy and environment. Today, about 4.5 billion of the world's approximately 6 billion people live in development countries many in poverty.

Expert predictions now are that by the year 2010, the world's population will be more than 7.2. Billion of which about 6 billion will be in the developing countries WHO (1997). Their energy requirements would be enormous in Africa, the energy sectors assuming greater significance. As we are at the initial stage of development of building our energy infrastructure, we are of necessity obliged to commit a considerable part of our resources to this sector.

Sustainable Energy And Development

Generally, sustainable energy solutions are defined in line with sustainable development: Sustainable energy meets the basic needs of the current generation without fore-going or discounting the needs for future generations. (ALO, 2003) Sustainable energy solutions, therefore, are those which conserve natural energy stocks like fossils fuels for future generations and increasingly use renewable sources like solar energy, biomass, wind and small-scale hydro power, thereby reducing the ecological and environmental hazards and risks emanating from the use of fossil fuels and nuclear energy (sustainable energy news, 1994).

Thus, sustainable energy solutions essentially consist of renewable energy technologies and technologies for increasing the efficiency of energy systems, while at the same time emphasizing the adaptation to local needs and popular control. It is to be noted that sustainable energy solutions, are to by nature based on the utilization of local, both human and natural resources. As a result, sustainable energy solutions inevitably create employment at different levels of society, including the micro level such as villages. Thus sustainable energy solutions have potentials of alleviating poverty not only through ready access to energy sources, but also through employment creation. Equally important is the fact that renewable energy sources- when applied and adapted, appropriately- is capable of harnessing local resources and reinforcing community organization and active Objective community participation, thereby leading to social integration (Ojosu, 1992).

Objectives Status Of Reenable Energy Activities In Nigeria

The energy commission of Nigeria has been developing vigorously within past years, a policy to ensure diversification in energy usage based on practical and economic viability. In this regard, the ECN, as the national focal point, is involved in the training of qualified personnel in the design, manufacture, marketing,

operation and maintenance, marketing, operation and maintenance of solar energy systems through its national energy research and development centres. The ECN is also providing active support for a number of pilot project in various parts of the country. The ECN is setting up a databank on solar energy resources and system the status of research and development projects, the solar energy experts and the marketing companies involved in solar energy technology utilization in the country in order to further facilities and accelerate commercialization of solar energy systems. This will be used as input into the national energy databank. The initial results of the national energy survey conducted by ECN, show that a modest market exists for rural electrification of small and isolated communities, water pumping, food preservation, refrigeration of medicine in remote health clines powering transmitters in telecommunications in remote areas, cathodic protection of oil pipelines and storage tanks.

All of the above benefit from a widespread and large scale use of renewable energy. Efforts are being geared towards ensuring that renewable energy systems are considered for these projects.

The energy Centers working with individuals, research institutes, are involved in implementing and monitoring pilot projects in different parts of the country. Some of these are the 2 tones per cycle-Ada rice project solar dryer, at Sokoto, the solar PV water pumping scheme at Sokoto the solar PV lighting system at Kwalkwalawa village and solar incubator project at Nsukka. Considerable progress has been in the development of solar cookers, solar water heaters, solar stills refrigeration and solar Photovoltaic. Some of these innovations are awaiting commercialization (Sambo, 1991).

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|-----------------------------|---------------------------------------|--|---|
| | | in storage - Natural, correction biogas plants | industries and local gas. Production distilled water |
| improved | Prototypes and pilot plants available | Solar dryers solar hot-box, biogas plants | 4. Frying/ processing of Cam |
| Ready for commercialization | Pilot plants available | Solar dryers solar hot-box, solar green house | 3. Drying of agricultural produce e.g. fish, ground-nut, cocoa, corn and wood seasoning |
| More research work needed | | Solar green house | 4. Farming agricultural yields |
| Ready for commercialization | Prototypes available | Solar hot-box solar hot-box, solar hot-box | 5. Space heating for livestock in cold weather |

Table 1: shows the various solar energy system that could be used for common food and industrial processes.

Table 1b captivities in which solar energy and renewable energy system already developed are being used in Nigeria and further actions required

| Processes | Alternative Solar Energy and Renewable energy systems | Stage of development in Nigerian of the solar and renewable Energy Technology | Further Action required |
|--|---|---|--|
| 1. Cooking | Solar Cookers, Solar water heaters Biogas and improved stoves | The technology is Fully developed waiting commercialization | Mass Production commercialization/popularization/promotion |
| 2. Heating & purification of portable drinking water for domestic and small scale industries, clinic hotels and hospital | Solar water heater, Solar skills, biogas planets, improved wood and sawdust stoves | The technology is fully develop & awaiting commercialization | Ready for commercialization |
| 3. Production of ethanol for industries and local gins. Production distilled water | Solar still, solar water heaters,- integral/built in storage - Natural, convection biogas plats | Fully developed | Ready for commercialization |
| 4. Frying/ processing of Garri | Solar dryers, solar hot-box, biogas planets | Prototypes and pilot plants available | House hold types improved |
| 5. Drying of agricultural produce e.g fish grand-nut, cocoa, corn and wood seasoning | Solar dryers, solar hot-box, solar green house | Pilot plants available | Ready for commercialization |
| 6. Improving agricultural yields | Solar green house | | More research work needed |
| 7. Space heating for livestock in cold environment | Solar dryers solar powdered refrigeration's solar cookers | Prototypes available | Ready for commercialization |

| | | | |
|---|--|----------------------|---------------------------------------|
| 8. Preservation of food and agricultural refrigeration for preservation of medical supplies space cooling | Solar dryers powered refrigeration's solar cookers | Prototypes available | More research and pilot plants needed |
| 9. Desalination and distillation of salty and brackish water in reverine area | Solar pond | Prototypes available | More research and pilot plants needed |

It is estimated that the maximum energy obtainable from 25m diameter wind turbine with an efficiency of 0.90 at a height of 25m is about 57MWh/year (or 20kWh/m²/year) for Kano in the high wind speed region (average wind speed is greater than 1.5 m/s). The wind speed exceeds the 2.5m cut for more than 80% of all the stations investigated. Substantial energy could be generated using wind turbines/wind turbines. For more details on many research institutions.

Solar photovoltaic

In Nigeria, studies carried out show that there is considerable potential for solar photovoltaic (PV) electricity generation in rural and isolated communities. The following are the areas where solar PV systems have been identified:

- (i) Storage of drugs and vaccines in remote health clinics;
- (ii) Powering remote telecentres in telecommunications and railway stations;
- (iii) Powering remote telecentres in telecommunications and railway stations;
- (iv) Powering remote telecentres in telecommunications and railway stations;
- (v) Cathodic protection of oil pipelines and storage tanks;
- (vi) Television viewing centres;
- (vii) Street lighting.

However, in spite of the country's high levels of solar radiation which indicate the existence of immense potentials, solar PV systems have not found wide application in the country due to importation of funding and economic constraints.

Renewable Energy Availability Potentials In Nigeria

Solar Energy

The solar radiation regime on a horizontal surface in Nigeria ranges between 3.7 KWhm⁻² day⁻¹ along the coastal areas to about 7.0KW hm⁻² day⁻¹ along the semi-arid zone. A greater percentage of Nigeria receives on the average a solar radiation level of about 5.5 KW HM⁻² day⁻¹ this solar radiation is attenuated during the harmattan period of the dry season and during the rainy season. Nigeria receives about 5.01 X 10¹² KWH of energy per day from the sun with more than 2,000 hours of sunshine per day from the sun with 10% efficiency to cover 1% of the country's surface area could generate energy output equivalent to about 10million barrels of oil per day. This is about 8 times the present level of oil production in Nigeria (energy commission of Nigeria, 1995). However, solar energy use is negligible on a commercial scale.

Wind Energy:

It is estimated that the maximum energy obtainable from 25m diameter wind turbine with an efficiency of 30% at a height of 25m is about 97MWh/year for Sokoto and 50 MWh/year for Kano in the high wind speed region (average wind speed is greater than 1.5 m/s). The wind speed exceeds the 2.2m/ cut for more than 80% of all the stations in Nigeria. substantial energy could be generated using small size wind turbines. Prototypes are available in many research institutions.

Achievements In Renewable Energy Application And Utilization In Nigeria.

Solar photovoltaic

In Nigeria, studies carried out show that there is considerable potential in;

- (i) Rural electrification of small and isolated communities;
- (ii) Water pumping
- (iii) Storage of drugs and vaccines in remote health clinics;
- (iv) Powering remote transmitters in telecommunications and railway signaling;
- (v) Cathodic protection of oil pipelines and storage tanks;
- (vi) Television viewing centers;
- (vii) street lighting.

However, inspite of the country's high levels of solar isolation which indicate the existence of immense potentials, solar PV systems have not found wide applications in the country due to improper funding and economic situation.

Other Renewable Energy Systems And Micro Hydro Schemes.

Considerable work has been done and completed on the scale hydro potential distribution according to states and its distribution among the river basins. Most small scale hydro stations schemes are around Jos Plateau, where there is 2 Mw station at Kwall Falls on N'Gell River (Kaduna River) and a 4MW station on Kura Falls developed by a private company, NESCO. The large hydro power sources about 1938 MW are made up of Kainji 760MW, Jebba 578.4MW and Shiroro 600Mw which were developed by PHCN. It is important that ECN should plan to extend the mini and micro hydro power generating schemes.

Wind Energy

There are some isolated wind mills and wind turbines for pumping water which were installed over thirty-five years ago in various parts of Nigeria (Ojosu, J.O. 1990) A reactivation of the wind energy programme will enhance application for pumping clear potable water from boreholes for domestic, agricultural and industrial uses. UAC-TAE is now manufacturing some windmills in Lagos.

Some of these wind mills are installed at Goronyo in Katsina State and in Bauchi and Sokoto States for water pumping.

Sawdust And Agricultural Residue Briquettes

A project in sawdust and agricultural briquetting was started in 1994. The survey of sawdust potentials in the country, should be carried out while small scale briquetting machines and binders should be developed and tested at the Energy Research Centres with supervision by ECN

Biogas

Pilot biogas projects are being developed all over the country. FIIRO developed a tank biogas plant which uses animal wastes and water hyacinth. They are located at Oshodi in Lagos, Ondo and Imo State. ECN should urgently liaise with the Nigerian Poultry Association and the Natural Resources conservation council (NARESCON) to develop prototype commercial biogas plants for their poultry farms and housing estates.

Recommendations

The Energy Research Centres have facilities for testing the performance of Photovoltaic System Components (Solar PV cells, Solar PV Panels, Solar batteries, inverters and controllers). The testing and certification of installation will further encourage the marketing forms to conform to international standards.

Table 3

| Technology | Availability | Comments |
|---|--------------|--|
| Oil Deepwater/arctic technology | C,R | Existing technologies that are promising for deepwater areas guyed and buoyant towers, tension leg platforms, and subsea production units. Advances in material and structural design critical innovative maintenance and repair technologies important |
| Enhanced oil recovery techniques-10 thermal recovery - 11 miscible flooding -12 chemical flooding | C,R | Widely adopted over the past two decades |
| Oil shale and tar sands - surface restoring - modified in situ | C,R | Uneconomic at present oil prices |
| Natural gas - Hydraulic fracturing | C N,R N R. | Small scale units commercial. Utility scale AFBC in demon stage. PFBC is less well developed; pilot plant stage Demonstration stage; primary advantages are its low emission and high fuel efficiency. Research and development needed in utility-scale batteries to improve lifetime cycles, operations, maintenance costs. Promising batteries are advanced lead lead, zinc -chloride and high -temperature sodium sulfur. First U.S plant (110MW) to begin operation in |

The grass-roots approach, which involves the local government and the grassroots are crucial for the success story now that the focus for energy development is for the rural dwellers.

Conclusion

Energy has become universal in character. There is a growing body of opinion world wide which recognizes that energy as such is sufficiently important that it cannot as at present, remain discretely in the background. In the background to the deliberations of the U.N in the background to politics, in the background to the growing social and environmental debate, and in the background- most important of all- to economic development (Lindsay, 1994). The technologies for new and renewable energy sources to be adopted and applied within our economy for sustainable growth abound. If one recalls the proposals from the African energy policy statement and considering the national initiatives hereby presented, some areas of focus still exist for necessary and further actions by the federal government in particular, ECN and industrial organizations and public corporations in general.

In concluding, it is important to drive home the following for consideration and follow up actions:

- * Supply of adequate energy for optimal economic development.
- * Conservation and improvement in energy efficiency.
- * Promotion of the use of more integrate and sustainable energy sources such as renewable.
- * Efforts to commercialize energy sources such as wind, solar biogas, etc. are necessary.
- * Renewable should be seen as part of the integrated energy supply option.
- * There is the urgent need for fundamental restructuring of energy infrastructure in Nigeria, if we to obtain sufficient energy supplies with which to develop our economy.
- * Increased funding in research and development in sustainable energy with an emphasis on community involvement and on social context in which technologies are to produced and used.

References

- Abraham M, et al. (2003),
Solar electricity for people who can afford less. CMES efforts with new strategies. Seminar in the role of renewable and alternative energy sources for national development (SRRAEND), Bangladesh.
- Alo B.I (2003):
Sustainable Development and the environment Managing the interface. A paper presented at the 13th Annual conference of the Nigerian environmental society, Yanagoo, Nigeria.
- Daniel Weisser and Raguel S. (20005):
Garcia Instantaneous Grind Energy Penetration in Isolated electricity grids concepts and review. Journal of Renewable Energy Vol. 30. Issues 8, pp 1299-1308.
- Energy commission of Nigeria (1992) ECN Annual reports.
Energy commission of Nigeria (1995) NIGERIA: National Energy Profile.
- Jon-dall Kim (1995)
Korea's changing Energy Efficiency: Policies and Sustainable Development WEC journal Pp 57-64.
- Lindsay, I. W (1994)
WEC INTO THE 21st CENTURY, WEC Regional Energy Forum for Southern and East Africa.
- Ojosu, J. O. (1992)
Impact of Recent Energy Strategies and it's implications for Renewable Energy Technologies in Nigeria, UNN, Nigeria.
- Ojosu, J.O. (1990)
Wind Energy Development in Nigeria, Nig. Journal of Solar Energy, No. 9, Pg. 206-222,
- Sambo, A. S. (1991)
Sokoto energy Research centre: Documentation of solar Energy System Developed and ready for commercial production.
Sustainable Energy New (1994)
- World Health Organization (1997)
Work plan on Environment, UNDP/World Bank/WHO Special programme for Research and Training.