SOLAR ENERGY APPLICATIONS IN NIGERIA

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ABSTRACT

The 1973 oil crises brought a global realization to use renewable energy resources to meet increasing demand for energy. In 1979, Energy Commission of Nigeria was established to conduct researches and develop renewable energy technologies as well as to popularize the applications. Solar radiation, being abundantly present in Nigeria, is one area of focus among the renewable energy resources. Researches were carried out and technologies produced for direct harnessing of solar energy in six energy centres across the country. Some state governments, in collaboration with non-governmental agencies, also sponsored solar energy projects in some rural communities that are not connected to the national grid. The technologies for solar energy applications are yet to be fully accepted as household commodities. Once this is done, applications of solar energy will augment fossil fuel energy resources to ensure availability of energy to meet the increasing demand in socio-economic activities and improved standard of livelihood of the people.

Key words: Applications of solar energy, solar energy technologies.

INTRODUCTION

Energy is a vital and important necessity for all earthly processes. The socio-economic activities of modern society revolved around the hub of energy availability. The 1973 oil crises, chaos caused by the Arab oil embargo, in western countries brought a sudden global realization to use renewable energy resources such as solar energy, hydropower, wind energy, wave energy, biomass and biofuels (Animalu and Adekola, 2002). This campaign for using renewable energy resources is becoming stronger today because of the finite nature of fossil fuel energy resources as well as the greenhouse gases emission which many scientists believe cause global warming. (Nwoke et al, 2008). Effective applications of renewable energy resources to augment energy supply from fossil fuel energy resources (using cleaner for fossil fuel technologies) will enhance availability of energy with minimum environmental effect.

In response to global demand for applications of renewable energy resources, the Energy Commission of Nigeria (ECN) was established in 1979. The Energy Commission now has six centres spread across the country. The centres are: (1) National centre for energy research and development (NCERD) at University of Nigeria, Nsukka. (2) Sokoto energy research centre (SERC) at Usman Dan Fodiyo University, Sokoto. (3) National centre for petroleum research and development (NCPRD), Abubakar Tafawa Balewa University, Bauchi. (4) National centre for energy efficiency and conservation (NCEEC), University of Lagos, Lagos. (5) National centre for hydropower research and development (NCHRD), University of Ilorin, Ilorin. (6) National centre for energy and environment (NCEE), University of Benin, Benin City. The energy research centres have mandate to conduct researches and develop renewable energy technologies as well as to popularize the applications of renewable energy resources.

Nigeria is blessed with abundant quantities of fossil fuel energy sources such as petroleum, natural gas, coal, lignite, tar sands and renewable energy resources. The renewable energy sources include hydropower, solar radiation, wind, fuel wood, animal waste and crop residue. A greater percentage of energy services in domestic, commercial, industrial and

transport sectors are provided by petroleum and electricity derived from either burning fossil fuels or hydroplants (Animalu and Adekola, 2002).

Solar radiation being abundantly present in Nigeria, is one area of focus among the renewable energy resources. Nigeria receives an average solar radiation of about 7.0kWh/m^2-day (25.2MJ/m^2-day) in the far north and about 3.5kWh/m^2-day (12.6MJ/m^2-day) in the coastal latitudes (Ileoje, 1997). The various energy centres are making giant strides in production of solar energy technologies for direct harnessing of solar energy since the country is situated in the high solar radiation belt of the world. The energy research centres are also making intensive efforts to popularize the applications of these devices to become household commodities. Some state governments, in collaboration with non-governmental agencies sponsored some solar energy projects in some rural communities. The estimate of potential solar energy in Nigeria with 5% device conversion efficiency is 5.0×10^{14} kJ of useful energy annually (Onyebuchi, 1989). This is equivalent to about 258.62 million barrels of oil produced annually and about 4.2×10^5 GWh of electricity production annually in the country (Akinbami, 2001).

Majority of the people in Nigeria live in rural communities where there are difficult terrains, no good roads, electricity grids and no easy access to fossil fuel energy resources. Effective harnessing of solar radiation using solar energy technologies to augment energy supply from fossil fuel energy resources (using cleaner fossil fuel technologies) would enhance availability of energy for socio-economic activities and to improve the standard of livelihood of the people.

SOLAR ENERGY TECHNOLOGIES

Solar energy has numerous applications when it is converted to heat, electricity or biomass. The technologies for conversion of solar energy into heat and electricity can be classified into solar thermal systems and photovoltaic (PV) or solar electricity respectively (Eze, 2004).

SOLAR THERMAL DEVICES

Solar thermal devices are solar energy technologies for conversion of solar radiation into heat using solar energy collectors. Efficiencies of solar collectors can be improved by using spectrally selective surfaces. A spectral selective surface has maximum absorption for short wavelength solar radiation (0.3 – 2.5μm) and minimum emission for long wavelength thermal radiation (3.0 – 30.0 μm) (Ilenikhena et al, 2008, Ilenikhena and Mordi, 2005). The heat produced could be employed in solar water heaters, solar cookers, solar dryers, solar stills, solar pasteurizers and solar chicken brooder devices (Nwoke et al, 2008).

SOLAR WATER HEATERS

Various types of solar water heaters are available. A thermosyphon solar water heater was developed at the national centre for energy research and development (NCERD), University of Nigeria, Nsukka. The system can produce hot water supply at temperature range of 70 – 80^0C for use in hospitals, hotels, industries and homes. The Sokoto research centre also developed solar water heating systems. A unit of this system is installed at the Uthman Dan Fodiyo University Teahcing Hospital, Sokoto. (Animalu and Adekola, 2002).

SOLAR CROP, FISH AND MANURE DRYER

Solar crop dryers are mechanized methods of using solar radiation to dry agricultural crops that excludes the traditional method of open to sun or air drying. Different types of solar crop dryers produced by many agencies include solar dryer for grains such as maize, rice, beans, vegetable, pepper, melon, and root crops. A large scale natural circulation 2-tonne capacity rice dryer was developed at the national centre for energy research and development (NCERD), Nsukka and a 2-tonne capacity forage dryer was constructed by the Sokoto energy research centre (SERC), Sokoto. A natural circulation solar manure dryer for drying poultry waste, cow dung, pig dropping were developed at the Nsukka centre. Solar dryers for fish and meat are also available (Ileoje, 1997, Okeke, 2002, Oparaku, 2007). The solar dryers are more efficient, enhance

complete drying and longer storage compared to open-air drying (Eze, 2004).

SOLAR COOKERS

Solar radiation is further harnessed for cooking food by concentrating them in solar cookers. Different models of solar cookers have been developed by various researchers including the national centre for energy research and development (NCERD), Nsukka and Sokoto energy research centre (SERC) Sokoto. A common problem is that cooking is done outdoor during the day (Ileoje, 1997, Okeke, 2002, Oparaku, 2007). They can be used with partially overcast skies and attain temperatures of 50 – 100^0C (Ileoje, 1997). Concentrating solar cookers with reflectors to focus light on cooking tray can attain temperatures up to 315^0C.

SOLAR CHICKEN BROODERS

Solar chicken brooders of various sizes have been developed by national centre for energy research and development (NCERD), Nsukka. The chicken brooders use solar radiation as source of heat in place of electricity bulbs, kerosene lamps or stoves to provide heat for freshly hatched chickens. The technology eliminates the emission of product gases that are hazardous in health of both man and chicken. The system traps heat in a water-filled tank covered with glass and store for brooder space heating during the day and night at temperatures of 35 – 25^0C. The design has provision for feeding and watering of chickens as well as collection and discharge of chicken droppings. Solar egg incubators are also available (Ileoje, 1997, Okeke, 2002, Oparaku, 2007).

SOLAR ELECTRICITY

Most of the photovoltaic (PV) systems that are currently in use such as PV modules for street lighting are government sponsored projects. Some are pilot projects sponsored by government agency such as Energy Commission of Nigeria (ECN). The photovoltaic (PV) systems are also being employed to provide electricity service to rural communities that are not connected to the country's electricity grid. One of the earliest solar photovoltaic (PV) project in Nigeria is 7kWp village PV

lighting in Tunga-Buzu and Gotomo villages that was financed by Sokoto state government in 1985. The Sokoto energy research centre (SERC) installed another 7.2 kWp rural electrification system in Kwakwalawa village in Sokoto state in 1993. The national centre for energy research and development (NCERD), Nsukka has a 1.5kWp capacity standby PV system to supplement power supply from electric company. The energy centre also built a 2kWp capacity PV system at Iheakpu-Awka community in Enugu State and a 2.85kWp solar PV plant at Hu-Mbauzo in Abia State (Animalu and Adekola, 2002).

PHOTOVOLTAIC (PV) INSTALLATIONS

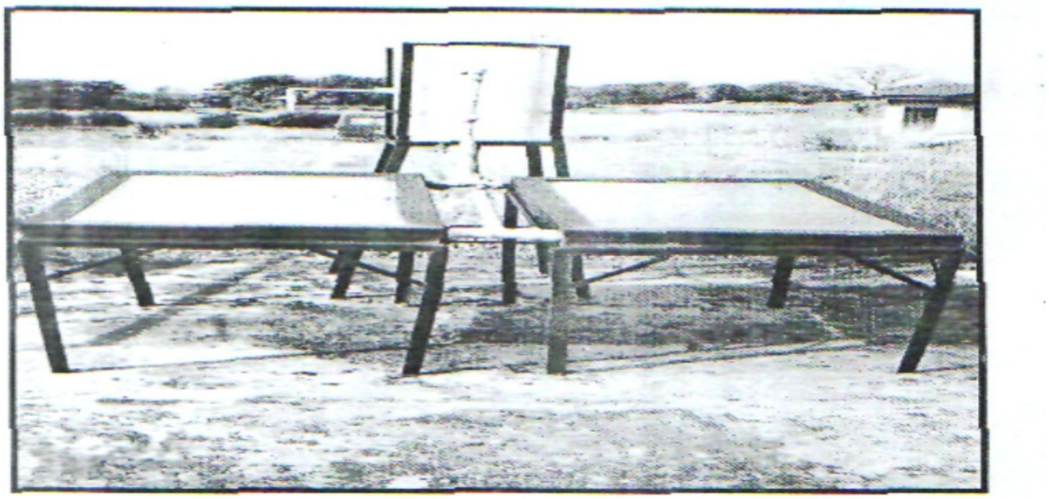
Many photovoltaic (PV) systems are installed and in use in different parts of the country. The status of photovoltaic (PV) systems installed in nine states of Nigeria is shown in Table 1 (Okeke, 2001).

Table 1: Status of PV system installed in nine states of Nigeria (Animalu and Adekota, 2002, page 200)

Application	Period Installed	Number Installed	Status		Total Capacity (kWP)
			Operat-ional	Not operat-ional	
Water pumping	1992-1995	61	52	9	58.5
Refrigerat-ors	1988-1995	26	26	0	7.0
Lighting	1991-1995	6	6	0	5.0
Radio/Tele-com/TV	1987-1993	13	11	2	6.25
Village electricity	1895-1993	2	1	1	10
Total		108	96	12	86.75

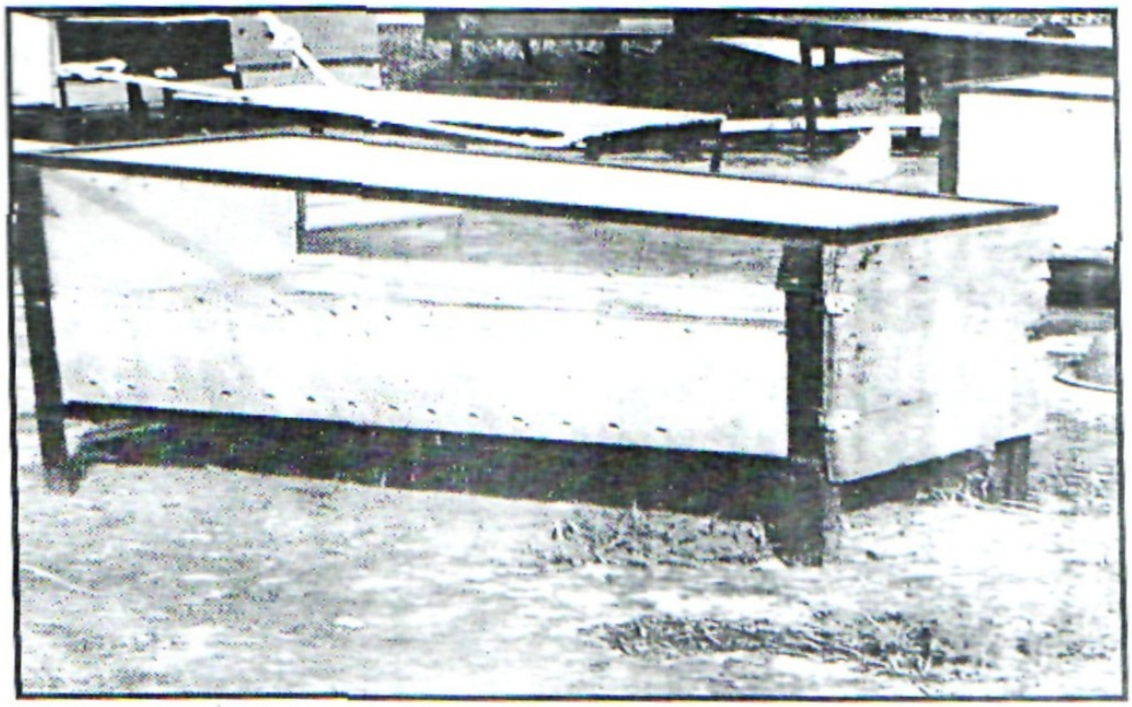
Some other photovoltaic (PV) systems which are not captured in the above summary include sixteen solar powered water projects commissioned in Nassarawa State in April, 2003. The Jigawa State government in partnership with a U.S. based non-governmental organization, Solar Electric Fund, sponsored some solar projects which include installation of solar home systems, solar powered water pumping systems, electrification of village health clinics and schools in some selected villages in June 2003. The Cross River State government also used solar energy to generate and supply electricity to Okundi community, Obude cattle ranch and Kanyiang game reserve in Boki local government area (Eze, 2004).

Solar Water Heater (Single Collector) for Domestic use

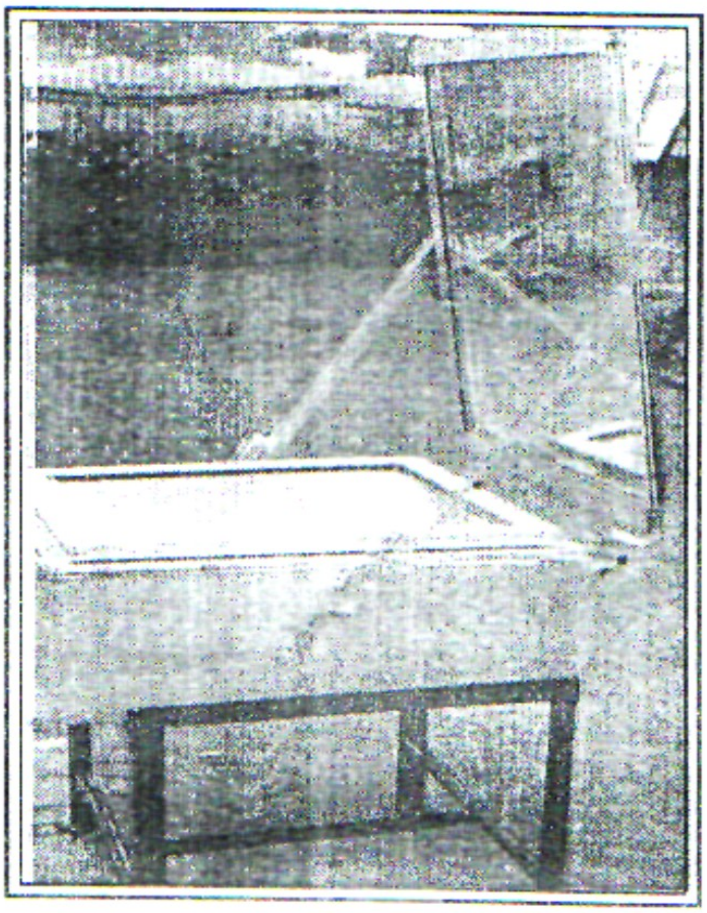


Solar Water Heater (Twin Collector)

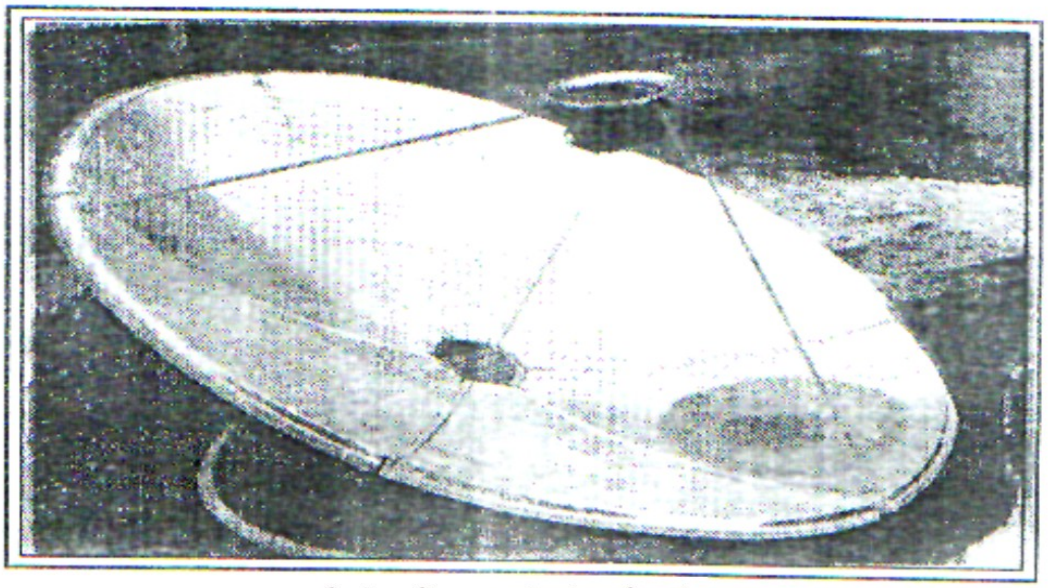
Staff Working on a Solar Dryer for drying of grains, vegetable e.t.c.



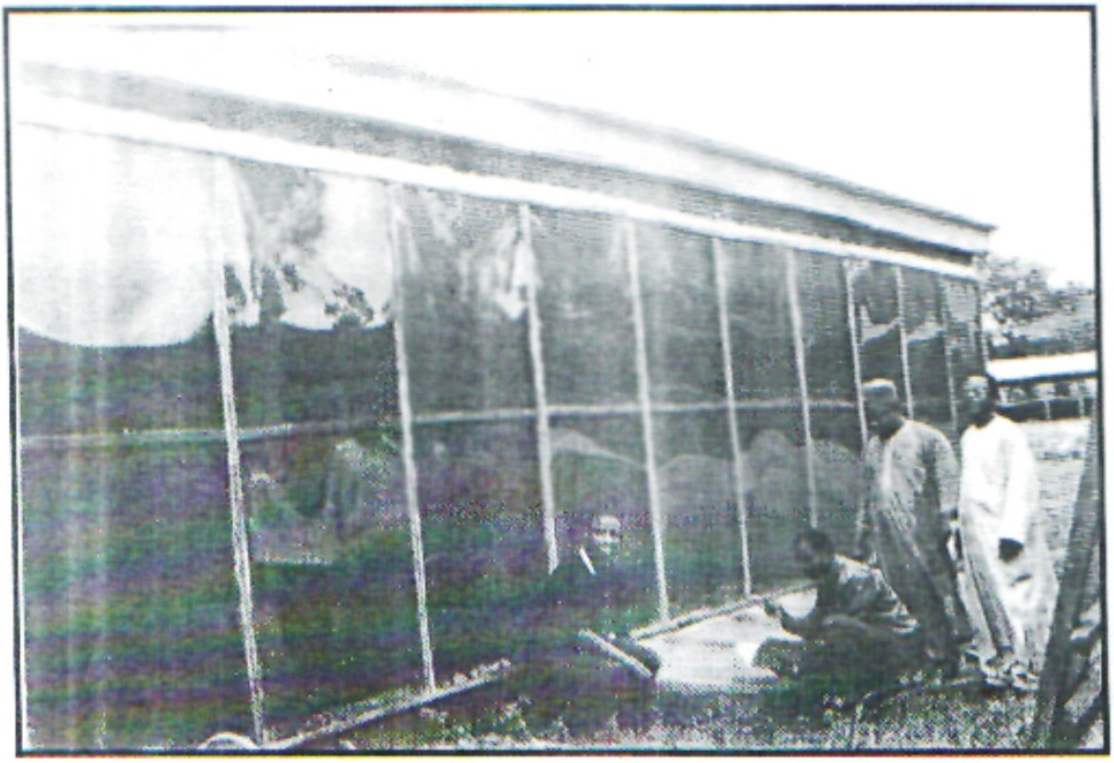
Solar Crop Dryer



Solar Box-type Cooker

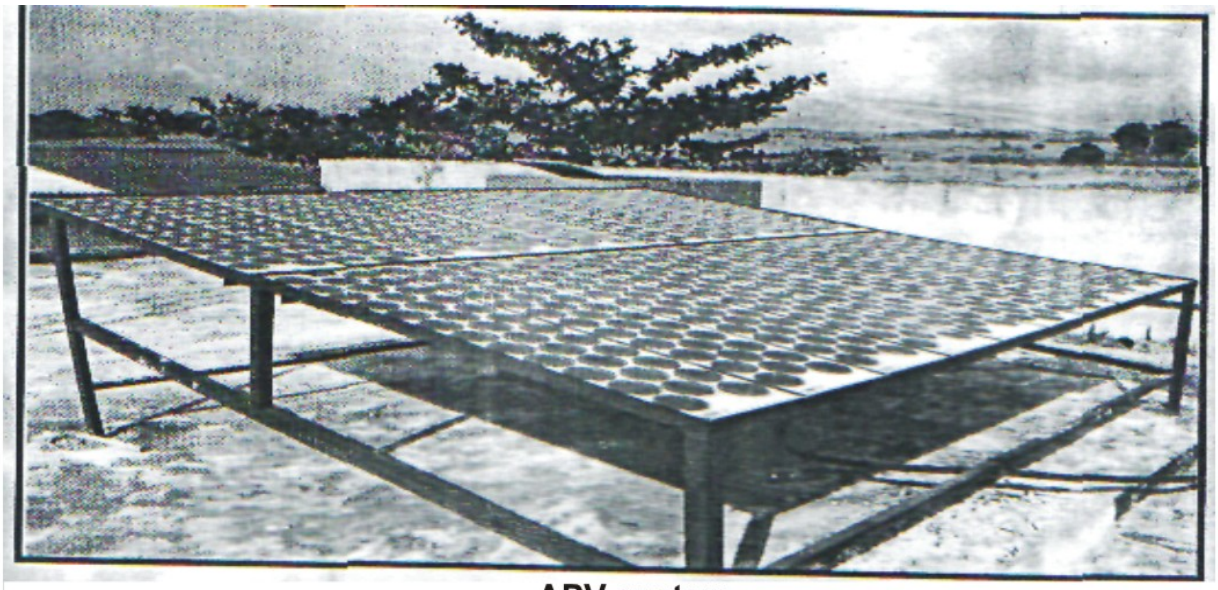


Solar Concentrator Cooker

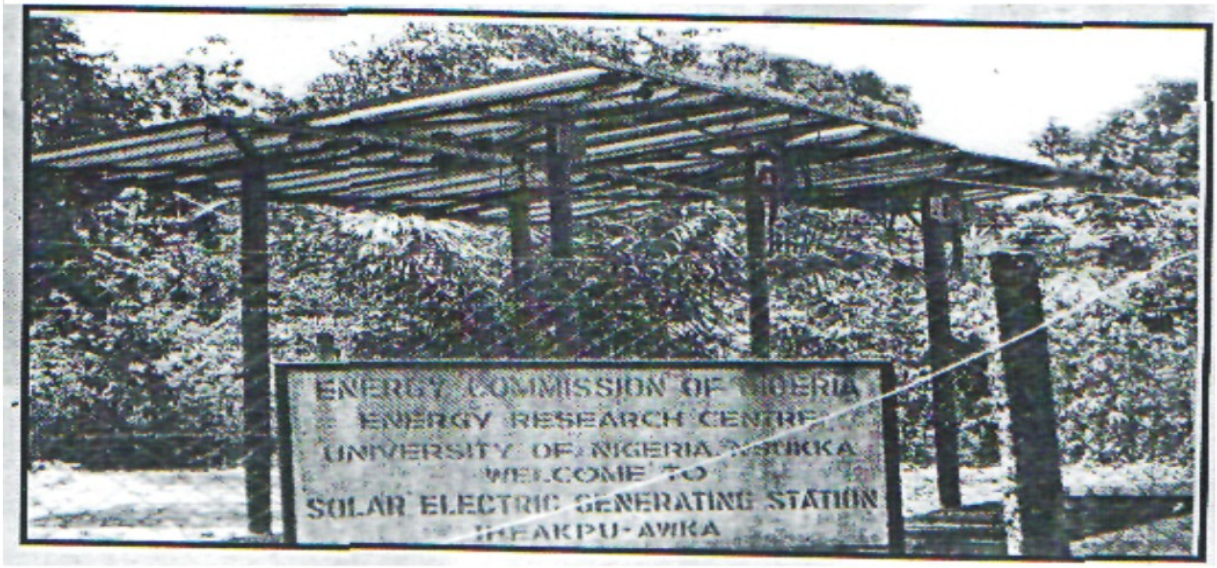


Trombe wall solar energy poultry chick brooding house located at a commercial farm

Solar energy poultry chicks at eight weeks old



APV system



Village Electrification System at Iheakpu - Awka in Igbo - Eze south L.G.A. Enugu State

CONCLUSION

Energy is a vital and important necessity for all earthly processes. As a result of 1973 oil crises, Energy Commission of Nigeria was set up in 1979. The energy commission now has six centres across the country to conduct researches and develop technologies for applications of renewable energy resources. Solar radiation being abundantly present is one area of focus among the renewable energy resources. Solar energy technologies have been produced for direct harnessing of solar energy. Some state governments and non-governmental agencies also promoted the applications of solar energy by sponsoring solar energy projects in some rural communities that are not connected to national grid.

Inspite of the efforts to create awareness on the effective use of solar energy, the technologies for solar energy applications are yet to become household commodities. A greater percentage of all energy services are provided from electricity derived from burning of fossil fuel energy resources and hydroplants. The applications of solar energy to augment energy from fossil fuel energy resources using cleaner fossil fuel technologies will ensure availability of energy to meet the increasing demand in socio-economic activities and improved standard of livelihood.

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