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Assessment of Mtn Lumos Box Solar Energy as an Alternative Source of Electricity Power Supply in Nigeria: Case Study of Mubi, Adamawa State North Eastern Nigeria

[1] **Sunday Ayigun , [2]Yassah H.N and [3]Romanus I.O**
[1,2 &3] Department of Applied Physics, Federal Polytechnic Mubi, Adamawa State, North Eastern Nigeria.

ABSTRACT: *This research was carried out in Mubi, Adamawa State North Eastern Nigeria. Mubi lie within latitude 10 ^{0}015$'$N and 10^0 025$'$N and longitude 13^0 015 $'$E and 13^0 025 $'$E. The research was aimed at accessing the MTN Lumos box solar energy as an alternative source of electricity power supply with the purpose of having another source of electric power supply in Nigeria, off the National grid and discourages the uses of electric power generator due to high cost of fueling and maintenance. The equipment's were connected properly according to the manual specifications; the equipment's includes the following: the solar panel, cable, MTN Lumos box, inverter 60W, LED bulbs and a Television LG 32 inch. The research was carried out in six days: 24th August, 2021, 26th August, 2021, 30th August, 2021, 23rd December,2021, 24th December, 2021 and 28th December, 2021. These six days the MTN Lumos box battery was allowed to charge to 100% and 74% minimum. From the experiment and the result obtained, it was observed that the solar energy conversion system supply electricity power for three hours twenty minutes to the low power consumption house hold electric appliances uninterrupted, double panel MTN Lumos box electricity power supply should be used for further research.*

KEY WORDS*:* utilization, solar energy, MTN Lumos box, inverter, solar panel

INTRODUCTION

The Sun our closet star, is a spherical gaseous self-gravitating body consisting mainly of hydrogen. It is located at the center of the solar system, on average 1.5 x 10^{11}m from Earth. At the inner core of the sun, the gravitational force creates a pressure which generates nuclear fission that turns that turns hydrogen into helium. In this process a portion of the mass is converted into abundant amount electromagnetic radiation, which makes the sun the dominant source of radioactive energy is the solar system (Joakim & Munkhammar, 2019). The sun has a complex physical structure and consists of several regions, from the dense inner core to the outer atmospherically layer, the corona . Both the corona and the core are very hot, in the order of 10^6 - 10^7K, while the intermediate regions that transport and emit energy as outgoing radiation are cooler (although hot by earthly standards) (Joakin & Munkhammar, 2019).The sun has played an important role in human cultures throughout history. The abundance of the sun's energy and its seasonal availability has naturally set the limits of human life and societal prosperity and growth, governing the turn of seasons. However direct use of solar radiation for specific purposes such as heating and providing power made its appearance relatively late in the history. (Cohen, 2010).

In 1861 Augustin Mouchot , a French Mathematics teacher manage to produce enough steam to drive a small engine. After years of research and development he succeeded in producing an engine large enough to power a printing press, which was presented to the world at the universals Exhibition in Paris in 1878. Even if wide spread use of solar power was to take another one hundred old years to emerge , the technology for producing mechanical work with the help of the sun was in place (Cohen, 2010).The technology for producing solar electricity was also in place, by adding a generator to Mouchot's engine. In fact, the first solar power plant went into construction in Egypt in 1912, but after the first World War Oil and Coal provide more competitive means of producing electric power instead, a completely different technology was to harness the solar irradiance on a large scale. Soon after a breakthrough with silicon solar cells at Bell Lab in the U.S. the first commercial photovoltaic (PV) panels, called "Solar Batteries" were produced in the 1950s (Cohen, 2010).

The word 'photovoltaic' consists of the two words, photo and Volta. Photo stands for light (Greek phõs, photós: light) and Volta (Count Volta, 1745–1827, Italian physicist) is the unit of the electrical voltage. In other words, photovoltaic means the direct conversion of sunlight to electricity. The PV generates direct current (DC) electricity when sunlight falls on it (Gardas & Tendolkar, 2012). Power generation involves the conversion of energy from an available source (sun) to electrical energy in a form that is suitable for distribution, consumption and storage (Emodi & Boo, 2015). Solar PV is capable of powering off-grid single homes, and mini-grids incorporating from several kW to many MW (Irena, 2016). Power generation using solar energy can be done in two ways, namely, solar-thermal conversion (Reif & Alhalabi, 2015) and solar electric (photovoltaic) conversion (Archer & Green , 2015). Solar energy is one of the renewable energy endowments of Nigeria (Ozoegwu *et al.,* 2017). It can be used for powering remote villages disconnected from the nation's grid and its power can also be fed into the national grid (Milosavljević *et al.,* 2015).

Solar energy is used in rural clinics, powering of schools, vaccine refrigeration, street lighting, traffic lights, and kiosks, among others. Solar technology is gradually being implemented in Nigeria. It is already implemented for solar crop drying, solar incubators, solar chick brooding, solar evaporative cooling and so on. This research was focused on accessing the capability of MTN Lumos box solar energy as an alternative source of electricity power supply in Nigeria. Case study: Mubi-Adamawa State, North Eastern Nigeria.

LITERATURE REVIEW

Soroush & Muhammad (2016) worked on Basic introduction of solar collectors and energy and exergy analysis of a heliostart plant different types of solar collectors was examined in terms of strength, behavior and areas of applications for the purpose of solar energy conversion for human need and existence. Manimeklai , Harikumar & Ragharan (2013) carried out a research on An overview of Batteries for photovoltaic (PV) systems, stand-alone (PV) was considered in terms of environmental condition, Batteries maintenance. Selection of batteries and the principle of operation of stand alone PV system with storage batteries that can serve as a source of electricity

power supply for human use. The advantages of using solar PV are numerous just to mention a few such as its cleanliness, pollution free, and in exhaustible was discussed in their findings. Imam *et al.* (2020) conducted a research on Design and implementation of Battery charging system on solar tracker base stand-alone PV using fuzzy modified particle swarm optimization. This research was to improve on the PV system. The solar tracker that was developed contributes greatly to tracking of solar energy for the purpose of optimum performance of PV solar system in terms of power supply. Smart battery charging systems was developed and was able to store the electricity generated by PV system. Algorithm was introduced into the system which has been able to improve the solar charging unit (controller) importantly and there was increase in PV performance.

MATERIALS AND METHOD

Materials

The materials used were Solar Panel (PV), Lumos box, two led bubs, Cable and inverter.

Method

The Solar Panel (PV) was installed on the roof of the building where it was exposed to the direct beam radiation of the solar energy. The solar energy collected by the solar panel was converted to direct current (dc). The cable attached to the solar panel (PV) transferred the generated direct current into the lumos box which comprises of battery and control panel. Battery is an electrochemical device that converts chemical energy into electrical energy and electrical energy to chemical energy by oxidation-reduction reactions. The terminal voltage during operating condition is known as nominal voltage 12V. The battery was charged base on the solar intensity on the solar panel and this energy was stored for used in the night. Inverter was connected to the output power source from where it was finally used to power the home appliances such as television, laptops, charging of phones and satellite receiver.Solar PV panel of Lumos box and other accessories was installed on the building's roof on 15th August. 2020 for the purpose of electricity power supply. The research was conducted in six (6) days with the following days : 24th August, 2021, 26th August , 2021, 30th August , 2021, 23rd December,2021, 24th December, 2021 and 28th December, 2021. In all these days the lumus box battery was allowed to charge during the day and the research was carried out in the evening of each day. On 24th August, 2021 the lumos box battery was charged to 100%. Television LG 32 inches, satellite receiver and a LED bulb was connected to the Lumus box through extension wire, at every twenty minutes intervals battery discharge rate was measured and recorded. This procedure was repeated for the remaining five (5) days; the results obtained were analyzed and discussed

Affordability and Maintenance of the Lumos Box

The solar energy converter (Lumos box) is been controlled and worked based on the MTN network from the controlling unit in MTN office (TX Light Power Solution) Lagos office, Nigeria. Maintenance and subscription to power source via network availability is from the office. Lumos box and the accessories are affordable and easy to maintain since the company is ready to maintain the system for the users / customers.

Solar Panel (Per panel) Specification
Peak Power (Pmax) Puissance maximale…….. 80W
Minimum open circuit voltage (voc) Tension min……17V
Production tolerance……0 + 3%
Lumos box specification
Output voltage …… 12V DC nominal
Output Current ……7.5A (maximum)
Dimension ……H=200mm x L=275mm x W = 245mm.
Weight ……...7.5 kg Net.
Maximum ambient charging temperature 50^{o}C.

Solar energy electricity conversion

Energy is derived from the sun through the form of solar radiation. Solar powered electrical generation relies on photovoltaic and heat engines. The photovoltaic system consists of solar modules, a control device, rechargeable batteries, a load or device and the associated electrical connections. The cells absorb sunlight and convert the solar energy into electrical energy which is then passed to the control unit. Since the electrical energy produced is Direct Current (DC), an inverter is occasionally needed to convert the electricity to AC. The entire system is relatively simple. A photovoltaic system is essentially pollution free. The PV system generates electricity approximately 60% (Sophia & Sathya, 2015)**.**

RESULTS AND DISCUSSION

Results

Table 1

Time (s)	Battery Percentage	Battery Discharged Time (pm)
0	100	4:32
20	94	4:52
40	89	5:12
60	82	5:32
80	76	5:52
100	70	6:12
120	64	6:32
140	58	6:52
160	51	7:12
180	44	7:32
200	36	7:52

Lumos box discharge rate on 24th August, 2021.

Table 2

Time (s)	Battery Percentage	Battery Discharged Time (pm)
0	98	6:04
20	91	6:24
40	82	6:44
60	74	7:04
80	65	7:24
100	56	7:44
120	47	8:04
140	38	8:24
160	31	8:44
180	22	9:04
200	13	9:44

Lumos box discharge rate on 26th August, 2021.

Table 3

Time (s)	Battery Percentage	Battery Discharged Time (pm)
0	100	6:12
20	91	6:32
40	82	6:52
60	73	7:12
80	64	7:32
100	55	7:52
120	47	8:32
140	38	8:32
160	30	8:52
180	21	9:12
200	12	9:32

Lumos box discharge rate on 30th August, 2021.

Table 4

Time (s)	Battery Percentage	Battery Discharged Time (pm)
0	84	5:42
20	79	6:02
40	73	6:22
60	66	6:42
80	60	7:02
100	52	7:22
120	46	8:42
140	38	8:02
160	32	8:22
180	25	8:42
200	19	9:02

Lumos box discharge rate on 23rd December, 2021.

Table 5

Time (s)	Battery Percentage	Battery Discharged Time (pm)
0	100	6:13
20	94	6:33
40	87	6:53
60	80	7:13
80	74	7:33
100	68	7:53
120	61	8:13
140	54	8:33
160	49	8:53
180	40	9:13
200	33	9:33

Lumos box discharge rate on 24th December, 2021.

Table 6

Time (s)	Battery Percentage	Battery Discharged Time (pm)
0	73	4:36
20	67	4:56
40	62	5:16
60	55	5:36
80	49	5:56
100	42	6:16
120	35	6:36
140	29	6:56
160	23	7:16
180	17	7:36
200	11	7:56

Lumos box discharge rate on 28th December, 2021.

DISCUSSION OF THE RESULT

The experiment in table 1 was carried out on 24th August, 2021. The Lumos box battery was allowed to charge in the afternoon to 100%. The experiment was carried out for three hours twenty minutes (3hours 20 minutes). Then from the result obtained it was noted that at twenty minutes interval the battery discharge at 6% to 7%. From the table 1 above the experiment started as at 4:32 pm and stopped at 7:52pm.The Lumos box worked for three hours twenty minutes which was used to power a Television LG 32 inches, satellite receiver and a LED bulb.

The experiment in table 2 was carried out on 26th August, 2021. The Lumos box battery was allowed to charge during the afternoon. The battery of the Lumos box was at 98%. The experiment started at 6:04pm to 9:44pm. From the result obtained, at twenty minutes intervals the battery of

the Lumos box discharged at average of 7% to 8%. The Lumos box worked from 0 minutes to 200 minutes (three hours twenty minutes), The Lumos box was used to power a Television LG 32 inches, satellite receiver and a LED bulb.

The experiment in table 3 was carried out on 30th August, 2021. The Lumos box battery was charged to 100% during the afternoon. It was used to power a Television LG 32 inches, a satellite receiver and two LED bulbs. From the table 3 it was observed that at twenty minutes interval the battery of the Lumos box discharge at 9%. The experiment was carried out for 200minutes, which was three hours twenty minutes from 6:12pm to 9: 32pm.

The experiment in table 4 was carried out on 23rd December, 2021. The Lumos box battery was allowed to charge during the afternoon. The battery of the Lumos box was at 84%. The experiment started at 5:42pm to 9:02pm. From the result obtained, at twenty minutes intervals the battery of the Lumos box discharged at average of 5% to 6%. The Lumos box worked from 0 minutes to 200 minutes (three hours twenty minutes), The Lumos box was used to power a Television LG 32 inches, satellite receiver and a LED bulb.

The experiment in table 5 was carried out on 24th December, 2021. The Lumos box battery was allowed to charge in the afternoon to 100%. The experiment was carried out for three hours twenty minutes (3hours 20 minutes). Then from the result obtained it was noted that at twenty minutes interval the battery discharge at 6% to 7%. From the table above the experiment started as at 6:13 pm and stopped at 9:33pm.The Lumos box worked for three hours twenty minutes which was used to power a Television LG 32 inches, satellite receiver and a LED bulb.

The experiment in table 6 was carried out on 28th December, 2021. The Lumos box battery was charged to 100% during the afternoon. It was used to power a Television LG 32 inches, a satellite receiver and two LED bulbs. From the table it was observed that at twenty minutes interval the battery of the Lumos box discharge at 6% to 7%. The experiment was carried out for 200minutes, which was three hours twenty minutes from 4:36pm to 7: 56pm.

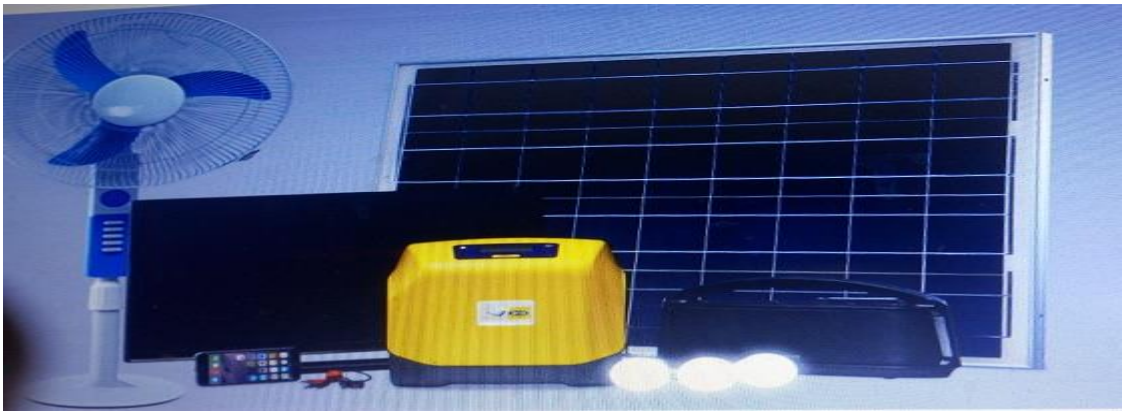

Plate 1: Showing the solar panel, lumos box and some low power consumption home appliances

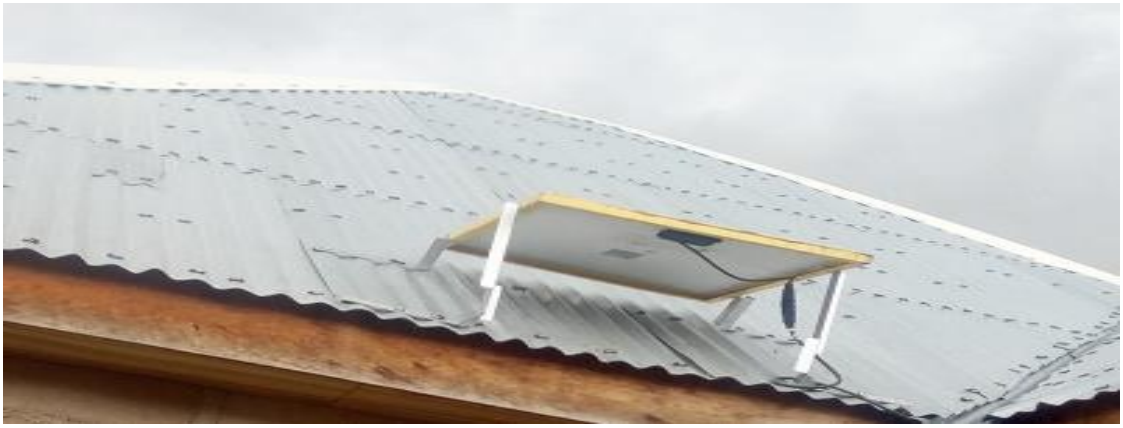

Plate 2: Showing the installation of solar panel on the roof of a building

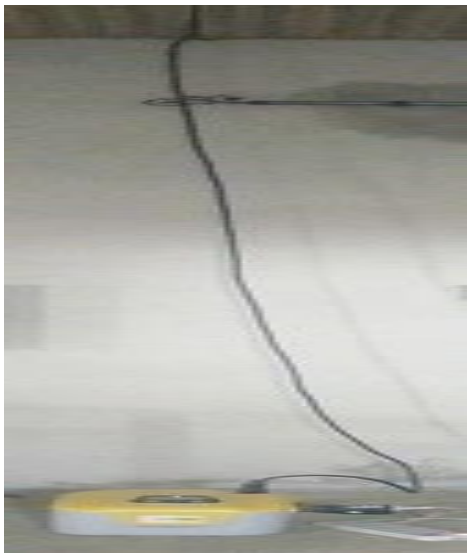

Plate 3: Showing the connection of a cable from solar panel connected to the MTN Lumos box.

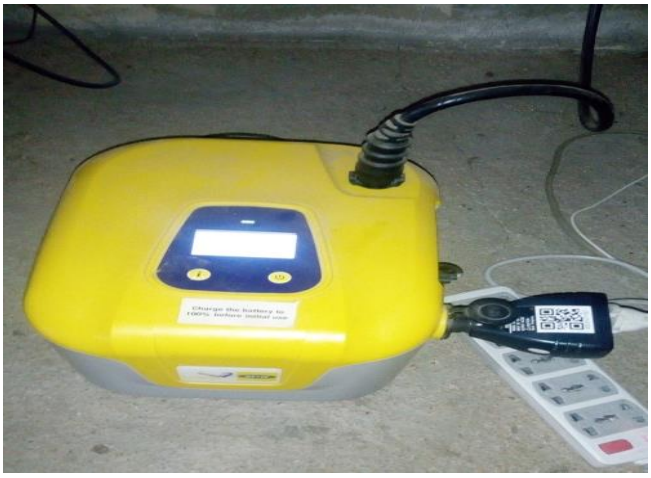

Plate 4: Showing the MTN Lumos box with an inverter that convert dc current to ac current.

Implication to research and practice

Base on the result obtained from the research and discussed above, it was observed that MTN Lumos electricity photovoltaic system actually served as a source of electricity power supply for three hours thirty minutes. In practice it can be used in in our homes, offices, rural and urban communities.

CONCLUSION

This research was carried out with MTN Lumos box (solar energy) electricity supply in Mubi Adamawa State North Eastern Nigeria. The research shows that the Lumos box electricity supply can be used as an alternative source of electricity power supply to homes, shops and schools if properly installed and maintained to power LED light bulbs and some of low power consumption home appliances instead of using generators that produces noise and high cost of maintenance.

Future research

The MTN Lumos box (solar energy) electricity power supply used in this research is a single plate Photovoltaic (PV) system, double panel MTN Lumos box electricity power supply should be subject to research for the purpose of determining the battery charging and discharging rate of MTN Lumos system and the load carrying capacity. Apart from MTN Lumos box (solar energy) electricity supply, there are other solar energy electricity power supply that can be installed in homes, schools, hospitals etc. these can also help in stabilizing electricity supply off the national grid.

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