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Renewable energy, as an alternative source of energy in Nigeria

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ABSTRACT
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. Power supply in Nigeria is easy but, the problem is that we don't have the right leadership in the government to deal with this power sector. The power sector is all about looting Nigerians and NERC is their enabler. We need to break up the power sector, allows any investor to generate, transmit and distribute within one entity. solar energy is still a perfect alternative for hydropower in Nigeria because it is a clean source of energy and it is also renewable which makes it qualified for power supply and it is free, which means it is gotten out of nature.

Key words: *Renewable energy, solar energy, concentrated solar cell, solar cell.*

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I. INTRODUCTION

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 bio fuels for transportation. (Wikipedia, 2017)
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 can not be exhausted and is constantly renewed. (Wikipedia, 2017)
Renewable energy resources are those that can be replaced as they are used up. They can be continually replenished as they are exploited and utilized. Examples are:

a) Solar energy
b) Wind energy
c) Water energy or hydroelectric power
d) Biomass
e) Tidal power
f) Bio fuel

Renewable energy is an alternative to fossil fuels and nuclear power, and was commonly called alternative energy in the 1970s and energy consumption came from renewable, with 13% coming from traditional biomass which is mainly used for heating and 3.2% from hydroelectricity. New renewable (biomass, wind, solar, geothermal and bio fuels) accounted for another 2.7% and growing very rapidly the share of renewable in electricity generation is around 18% with 15% global electricity coming from hydroelectricity generation 3% from renewable (Wikipedia, 2017).

AIMS AND OBECTIVES OF THE STUDY

This study is a review research aimed at identifying the energy challenges in Nigeria and identifying the means of mitigating those challenges by exploring solar energy as alternative source of energy for Nigeria.
Since it is obviously that we Nigerians were suffering much because of the problem of electricity, we found that in Nigeria due to lack of power supply we get only a few hours of electricity a day.

ELECTRICITY IN NIGERIA

The minister of state for environment Ibrahim Jibril has said that the federal government will delay the issuance of its green bonds until the 2017 budget is passed.
The government had planned to launch the N20 billion bond in April to fund projects to reduce carbon emissions ad develop renewable energy. Disclosing the news yesterday in Abuja, Jibril said that following a cabinet meeting, the government shelved plans to launch the green bonds till the 2017 budget is passed. Adding that the budget was paramount and must be agreed by the parliament before it could be signed by the president.
All is set for its formal launch but the budget has to be passed first before the issuance and the budget which was first presented to law makers by President Muhammad Buhari in December.

ENERGY SECTOR OF NIGERIA

Nigerian will seemingly not take pleasure in stable energy provide for a few years to come back for three main causes aside, other regularity hitches funding challenges and local whether not so pleasant to buyers.

May be electricity was a social good years again when the Nationwide Electric Energy Authority (NEEA) was totally in command of all parts of energy technology, transmission and distribution however not anymore. Below the present frame work the place non-public companies handle the era and distribution of electricity.

The authorities via the transmission firm of Nigeria (TCN) and the Nigerian Bulk Electricity Buying and selling firm (NBET) has retained management of the transmission of the transmission section. NBET buys electricity in bulk from the technology corporations.

In current months, the current authorities lead by president Muhammad Buhari has managed to calm the unrest within the Niger Delta and this ready to make sure elevated fuel provide to energy plant which ought to result in elevated energy technology if different constraints are equally addressed.

The capital expenditure provision for TCN underneath the multi-yr Tariff order (MYTO) 2015 monetary Mannequin (which signifies quantities that should be spent) is N418.504bn however solely N40bn has been earmarked for transmission tasks below the 2017 price range.

Using an trade role of thumb estimation that roughly serves round 1,000,000 individual in a inhabitants Nigeria must generate at the very least a hundred and fifty mw of electricity to adequacy cater for its inhabitants land meet in distribution objectives.

COMMITMENT TO SELF SUSTAINANCY POWER SECTOR TARRIF.

Power sector operators rose from 14th monthly meeting with the minister of power works and housing in Osogbo, Osun state, with the federal government expressing its commitment to tariffs that would ensure a self sustaining power sector and supporting the Nigerian electricity regulatory commission in applying sanctions where appropriate to ensure operators comply with the roles.

The meeting received confirmation from Independent System Operator (ISO) that the iniation of paras-energy (a private generating company) to sell 60mw internationally waltz not Jeopardize the power purchased by the Nigerian bulk electricity trader (NBET).

While TCN announced a 9% improvement in energy delivered to DISCOs from the transmission company of Nigeria for the month of February. DISCOs were talked based on metering progress NBET and market operator remittance amongst other indicators. Its good to now have the commissioner of the Nigerian Electricity Regularity Commission fully on Board and demonstrability show that they know why Mr. President appointed them and expectedly they will commit to delivering on the mandate given to them by law and y the appointment he said adding that if the commission succeeds his ministry could succeeds while the operators. Business would do well and Nigeria would have better access to electricity.

ELECTRICITY FIRMS DEBT ROSE TO N107BN IN 2016

The 11 electricity distribution companies (DISCO) debts for services provided by six electricity market participants amounted to 170billion December, 31, 3016.

ENERGY CHALLENGES IN NIGERIA

Power supply in Nigeria is easy but, the problem is that we don't have the right leadership in the government to deal with this power sector. The power sector is all about looting Nigerians and NERC is their enabler. We need to break up the power sector, allows any investor to generate, transmit and distribute within one entity.

The supply of secure, clean and sustainable energy is arguably the most important scientific and technical challenge facing humanity in the 21st century. Sustainable development through energy security, national security, environmental security and economic security can likely be met only through addressing the energy problem within the next 10-20years.

Despite the abundance of energy resources in Nigeria, the country is in short supply of electrical power. Only about 40% of the nations over 150million has access to grid electricity and at the rural level, where about 70% of the population live, the availability of electricity drops to 15%. Nigeria requires per capital power capacity of 1000 watts, per person or power generating/handling capacity 140,000 mw, this will put Nigeria slightly below South Africa with capital power. Capacity of 1,407 watts with per capital power capacity of 1,266 watts and above, Brazil with per capital power capacity of 480 watts, currently, Nigeria has per capital power capacity of 28.57 watts, and this is grossly inadequate even for domestic consumption, to achieve the goals of development, a strong energy is essential. Many countries especially in developing countries are faced with serious energy crises, they are unable to meet the energy needs of their countries. In a quest to realize this, many have turn to different sources of energy which among them are renewable energy sources (solar energy included) (Odinaka dotnet.com, 2011). The federal government of Nigeria approved the national energy supply to articulate the sustainable exploitation and utilization of all liable energy resource. The key elements in the national policy in the development at application of renewable energy and its technologies are:-

1) Keep abreast of international developments in renewable energy technologies and application.
2) To develop, promote and harness the renewable energy resources of the country.
3) To promote decentralized energy supply.
4) To de-emphasize and discourage the use of wood and fuel.

Nigeria has a high potential to harness energy from renewable sources including solar energy. Solar energy technology are divided in two broad groups:- solar thermal and solar photovoltaic. In solar thermal application, solar energy as electromagnetic waves is converted to heat energy. The heat energy may then be used either directly as heat or converted into other energies such as electrical or mechanical energy.

In solar photovoltaic applications, the solar radiation is converted directly into electricity. Nigeria has a capacity of 1,500 mw for large hydropower and only 1972 mw has being exploited while for a small hydropower, the country has about 3,500 mw and only about 64.2 mw has being exploited. (Sambo, 1978).

SOLAR ENERGY

The energy produces or radiated by the sun. Also solar power is the conversion of energy from sunlight into electricity, either directly using photovoltaic (PV) or indirectly using concentrated solar power. (http//.en.m.wikipedia.org.

Solar energy is radiant light and heat from the sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaic, solar thermal energy, solar architective, molten salt, power plants and artificial photosynthesis. (United Nations Development Programme and World Energy council, 17, January, 2017)

It is an important source of renewable energy and its technologies are broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power, active solar techniques include the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy, passive solar techniques include orienting a building to the sun, selecting materials with favourable thermal mass or light-dispersing properties, and designing spaces that naturally circulate air.

The large magnitude of solar energy available makes it a highly appealing source of electricity, the United Nations Development Programme in its 2000 World Energy Assessment found that the annual potential of solar energy was 1,575-49,837 exajoles (EJ), this is several times larger than the total world energy consumption, which was 559.8 (EJ) in 2012. (Key World Energy Statistic, 2014).

In 2011, the International Energy Agency said that “the development of affordable inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the cost of mitigating global warming. (hhttps://en.m.wikipedia.org).

POTENTIAL

The earth receives 174 potentials watts (PW) of in coming solar radiation (insulation) at the upper atmosphere; approximately 30% is reflected back to space while the rest is absorbed by clouds, oceans and land masses. The spectrum of solar light at the earth’s surface is mostly spread across the visible and near-infrared ranges with a small part in the near ultraviolet. Research Center, 17, October, 2006.

Solar radiation is absorbed by the earth land surface; oceans which cover about 71% of the globe and atmosphere warm air containing evaporated water from the oceans rises, causing atmospheric circulation or convection.

When the air reaches a high altitude, where the atmosphere is low water vapour condenses in to clouds, which rain onto the earths surface, completing the water cycle. Inter-government Panel on Climate Change, 29, September, 2007.

The latest heat of water condensation implies convection, producing atmospheric phenomena such as wind, cyclones, and anti cyclones sunlight absorbed by the oceans and land masses keeps the surface at an average temperature of 14^0c. (Smil, 2006)

The total solar energy absorbed by the earth’s atmosphere, oceans and land masses is approximately 3,850,000 Exajoules (EJ) per year. This was more energy in one hour than the world used in one year. Photosynthesis captures approximately 3,000 (EJ) per year in Biomass. (Nicholas et al, 2013). The amount of solar energy reaching the surface of the planet is so vast that in one year it is about twice as much as will ever be obtained from oil of the earth’s non-renewable resources of coal, oil, natural gas and mined uranium combined. (Mathew L. 2013).

The potential solar energy that could be used by humans differs from the amount of planet because factors such as geography time, variation, cloud cover, and the amount of solar energy that we can acquire. Geography affects solar energy potential because areas that are closer to the equator have a greater amount of solar radiation. However, the use of photovoltaic that can follow the position of the sun can significantly increase the solar energy potential, in areas that are further from the equator. (Solar Energy Perspectives, 2011). Time variation affects the potential of solar energy because during the nighttimes there is little solar radiation on the surface of the earth for solar panels to absorb. This limits the amount energy that solar panels can absorb in one day.

CONCENTRATED SOLAR POWER (C.S.P)

Concentrated solar power (also known as concentrating solar power, concentrated solar thermal, and CSP) systems generate solar power by using mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy unto a small area.

Electricity is generated when the concentrated light is converted to heat, which drives a heat engine (usually a steam turbine) connected to an electrical power generator or powers a thermo chemical reaction (experimental as of 2013) heat storage in molten salts allows some solar thermal plants to continue to generate after sunset and adds value to such systems when compared to photovoltaic panels (Wikipedia, 2017).

Concentrating solar power (CSP) system use lenses or mirrors and tracking systems to focus a large beam of sunlight in to a small beam. The concentrated heat is then used as a heat sources for a conventional power plant

CURRENT TECHNOLOGY

CSP is used to produce electricity (sometimes called solar thermo electricity, usually generated through steam).

Concentrated solar technology systems use mirrors or lenses with tracking systems to focus a large area of sunlight onto a small area. The concentrated light is then used as heat or as a heat source for a conventional power plant (solar thermo electricity). The solar concentrators used in CSP system can often also be used to provide industrial process heating or cooling, such as in solar air conditioning.

Concentrating technologies exist in four optical types, namely;

1. Parabolic trough
2. Dish
3. Concentrating linear fresnel reflector and
4. Solar power tower

PHOTOVOLTAIC CELL (PV) CELL

A solar cell or photovoltaic cell previously termed (‘solar battery’) is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect which is a physical and chemical phenomenon. (http://en.m.wikipedia.org, 2017). Also, a photovoltaic cell (PV) or solar cells is a device that converts light into electric current using photovoltaic effect. It is a form of photoelectric cell, defined as a device whose electrical characteristics, such as current, voltage, or resistance, vary when exposed to light. Solar cells are the building block of photovoltaic modules, otherwise known as solar panels.

Solar cell are described as being photovoltaic, irrespective of whether the source is sunlight of an artificial light. They are used as a photo detector light. (For example infrared detectors), visible range, or measuring light intensity.

The operation of a photovoltaic cell (PV) cells requires three basic attributes:-

1. The absorption of light, generating either electron hole pairs or excisions.
2. The separation of charge carriers of opposite types.
3. The separate extraction of those carries to an external circuit.

The photovoltaic effect was experimentally demonstrated first by French Physicist Edmond Bacquerel in 1839 at age 19, he built the worlds’ first photovoltaic cell in his father’s laboratory. Willoughby Smith first described the ‘effect of light on selenium during the passage of an electric current’ in a 20 February 1873 issue of nature. In 1883 Charles Fritts built the first solid state photovoltaic cell by coating the seem conductor selenium with a thin layer of gold to form the junctions,

In 1888 Russian physicist AleksandrStoletor built the first cell based on the outer photoelectric effect discovered by Heinrich Hertz in 1887. (Inter-governmental Panel on Climate Change). In 1905 Albert Einstein proposed a new Quantun theory of light and explained the photo electric effect in a landmark paper, for which the received the noble prize in physics in 1921. (Radiation Budget, 2006).

VadimLashkaryou discovered p-n junctions in Cu2O and silver sulphide photo cells in 1941. (Richard, 2007). Russell Olic patented the modern junction semi conductor solar cell in 1946 while working on the series of advances that world lead to the transistor. (http://www.nature.com).

The first practical photovoltaic cells were publicity demonstrated on 25 April, 1954 at Bell laboratories. The inventors were Calvin Southern Foller and Gerald Pearson. Solar – cell gained prominence with their incorporation onto the 1958 Vanguard I Satellite. (Energy conversion by photosynthesis organism food and agriculture organization of the United Nation).

Picture shows a conventional crystalline silicon solar cell

THEORY OF SOLAR CELL

The solar cell works in several steps (Wikipedia, 2017).

(i) Photons in sunlight hit the solar panel and are absorbed by semi conducting materials such as silicon.
(ii) Electrons are excited from their current molecular/atomic orbital. Once excited an as heat and return to its orbital or travel through the cell until it reaches an electrode. Current flows through the material to cancel the potential and this electricity is captured. The chemical bonds of the material are vital for this process to work and usually silicon is used in two layers, one layer being doped with boron, the other phosphorus. These layers have different chemical electric charges and subsequently both drive and direct the current of electrons. (International Energy Agency, 2011).
(iii) An array of solar cells converts solar energy into a usable amount of direct current (DC) electricity.
(iv) An Inverter can convert the power to alternating current (AC).

The most commonly known solar cells are configured as a large – area p-n junction made from silicon.

EFFICIENCY OF SOLAR CELL

Solar cell efficiency refers to the portion of energy in the form of sunlight that can be converted via photovoltaic into electricity.

The efficiency of the solar cell used in a photovoltaic system, in combination with latitude and climate, determines the annual energy output of the system. For example, a solar panel with 20% efficiency and an area of 7 m^2 with produce 200 watts standard test conditions, but it can produce more when the sun is high in the sky and with produce less in cloudy conditions and when the sun is low in the sky. In central Colorado, which receives annual isolation of 5.5 kwh/m^2/day, such a panel can be expected to produce 440 kwh of energy per year. However, in Michigan, which receives only 3.8 kwh/m^2/day, annual energy yield with drop to 280 kwh for the same panel. At more northerly European latitudes, yields are significantly lower: 175 kwh annual energy yield in southern England. (http://en.m.wikipedia.org, 2017).

Several factors affect a cells conversion efficiency thermodynamic its reflectance efficiency, thermodynamic efficiency, charge carrier separation efficiency, and conduction efficiency value, because these parameters can be difficult to measure directly, other parameters are measured instead, including Quatum efficiency, Vo_c ration, and fill factor. Reflectance losses are accounted for by the Quantum efficiency value, as they affect "external Quantum efficiency" Recombination losses are accounted for by the Quantum efficiency, Vo_c ration and fill factor values, resistive losses are predominantly accounted for by fill factor value, but also contribute to the Quantum efficiency and Vo_c ratio values.

As of December 2014, the world record for solar cell efficiency at 46% was achieved by using multi-junction concentrator solar cells, developed from collaboration efforts of soitec, CEA – Leti, France, together with Fraunhofer ISE Germany. (Natural Forcing of the climate system, (2007).

Solar cell efficiency may be broken down into:-

1. Reflectance efficiency
2. Thermodynamic efficiency
3. Charge carrier separation efficiency
4. Conductive efficiency

The overall efficiency is the product of these individual metrics. (Wikipedia, 2017). A solar cells has a voltage dependent efficiency curve, temperature coefficients, and allowable shadow angles. (Wikipedia, 2017).

Due to the difficulty in measuring these parameters directly, other parameters are substituted: thermodynamic efficiency, Quantum efficiency, integrated Quantum efficiency, Vo_c ration, and fill factor. Reflectance losses are on portion of Quantum efficiency under "External Quantum efficiency". Recombination losses make up another portion of Quantum efficiency, Vo_c ratio and fill factors, but also make up mirror portions of Quantum efficiency Vo_c ration. The fill factor is the ratio of the actual maximum obtainable power to the product of the open circuit voltage and short circuit current. In 2009, typical commercial solar cell had a fill factor > 0.70 grade B cell were usually between 0.4 and 0.7 cell with a high fill factor have a low equivalent series resistance and a high equivalent shunt resistance. (Wikipedia, 2017).

In 2014, three companies broke the record of 25.6% for a silicon solar cells. Panasonics was the most efficient. The company moved the front contacts to the rear of the panel, eliminating shaded areas.

In 2015, a 4-junction GaIn/GaAs/GaIn ASP/GaIN As. solar cell achieved a new laboratory record efficiency of 46.7% (concentration ratio of sunlight = 312) in a French-German collaboration between the Fraunhofer institute for solar energy system (fraunhofer ISE), CEA-LETI and SOI TEC. (Wikipedia, 2017).

MATERIAL AND METHOD

SEMI CONDUCTOR MATERIALS FOR SOLAR CELLS

Solar cells are fabricated from semi-conductor materials prepared in three physical states – single. Multicrytal many small crystal (polycrystalline) and a morphous (noncrystaline).

SINGLE CYRSTAL SILICON

Silicon solar cells are commonly used for both terrestrial and space applications. The basic raw material is sand (SiO_2) from which silica (Si) is extracted and purified repeatedly to obtain the metallurgical grade silicon. It contains about 1% impurities and further processed to convert it to purer semiconductor grade silicon. It is then finally converted into a single crystal ingot.

A single crystal ingot is a long cylindrical block of about 6cm to require 300 km to 400 km of absorber material; the ingot is sliced in wafers below. These wafers are the starting material for a series of process steps such as surface preparation, dopants diffusion, anti-reflection coating, contact grid on the surface and base contact on the upper surface and base contact on the upper surface and on the lower one.

Solar cells are fixed on a board and connected in series and parallel combinations to provide the required voltage and power to form a PV module as shown below.

To protect the cells from damage a module is hermetically sealed between a plate of toughened glass and layers of ethyl vinyl Acetate (EVA). A terminal box is attached to the back of a module where the two ends of the solar string are soldered to the terminals. When the PV module is in use, terminals are connected directly to the load. Single PV modules of capacities ranging from lowp (peak walf) to 120 wp can provide power for different loads. Several panels of modules constitute an array, which is rated according to peak wattage it delivers at noon on a clear day for higher outputs an 'array field' is created.

The size of an individual cell varies from 10 cm^2 to 100 cm^2 and a module contains about 20 cells to 40 cells. A standard module constituting 30 cells each of 7.5 cm diameter can provide electrical parameters of 12voltage, 1.2 ampere, and 18 watts peak power. To reduce cost, methods have been developed to produce a ribbon of single crystal silicon from the molten pure silicon. The ribbon can be cut with minimum wastage in to required sizes and processed directly to make solar cells.

POLYCRYSTALLINE SILICON CELLS

The production cost of a single crystal silicon cell is quite high compared to the polycrystalline silicon cell. Poly silicon can be obtained in thin ribbons drawn from molten silicon bath and cooled very slowly to obtain large size crystallites. Cells are made with care so that the grain boundary causes no major interference with the flow of electrons and grains are larger in size than the thickness of the cell.

The polycrystalline silicon solar cell can be fabricated in three designs, namely p-n junction cells, metal isolation. Semi conductor (MS) cells, and conducting oxide-insulator semi conductor cells. For a p-n junction solar cell, a polycrystalline silicon film is deposited by chemical vapour deposition on substrates like glass, graphite, metallurgical grade silicon and metal. An MIS cell can be developer by inserting a thin insulting layer of Si02 between the metal and the semi conductor. A nicely developed cell with chromium metal base with $Si0^2$ insulation over it, the p-type-crystalline silicon can give efficiency up to 12% at AM-1 conduction with cell dimension of 0.2cm^2.

AMORPHOUS SILICON CELLS

Amorphous silicon is pure silicon with no crystal properties. It is highly light absorbent and requires only 1 NM to 21 m of material to absorb photons of the incident light thin amorphous layers can be deposited on cheap substrates like steel, glass and plastic. Hydrogenated amorphous silicon (a-Si:H) is a suitable material for thin film solar cells, mainly due to its high photo-conductivity, high optical absorption of visible light with optical band gap of 1.55 ev, thin films of nearly 0.7ev can produce solar cells comparatively at low cost. Amorphous silicon cells can be fabricated in four structures.

i) Metal, insulator – semiconductor (MIS)
ii) P – n devices
iii) Hetro junction
iv) Schottkybarries

The p-i-n junction, Si-solar cells are beneficial for commercial production due to their good performance. A common type of p-i-n junction a-si solar cell, consists of a deposited layer of boron doped a-si: H (200%) and above it, is a deposited layer of n-doped u-si: H (80A) the, a 70% thick layer of indiom tin oxide (ITO) it deposited over the n-type layer which serves in two ways i.e. conducting electrode and anti-reflective coating.
In a single junction (a-si :H) solar cell, a part of solar radiation with less energy than band gap remains un utilized and wasted as heat, causing law cell efficiency. This drawback is solved by adopting a 'tandem structure' that involves stacked junctions where semiconductors having different energy gaps are erected on top of each other with decreasing band gap in the direction. Hitachi of Japan has developed tandem thin film solar cells. Consisting of three amorphous payers having different band gaps as shown 6.9(a). The top layer is of transparent conducting oxide and the first two cells are the standard a-si:H cell serving as the intrinsic layer and the third (last) layer is an alloy of silicon, germanium and hydrogen (a-siGe:H).
In this structure, the a-Si:H cell utilize the blue-green end of the spectrum, while a-siGe:H cell utilizes the red part of tandem cell is shown in figure 6.9(b) which shows the solar spectrum performance of each cell and the summation of tandem cells.
The spectral response is improved in long wavelength zones by the material provided with narrow band gap characteristic controlled by Ge contents. This three layered tandem cell with band gaps of 2.0, 1.7 and 1.45ev respectively can attain theoretical efficiency vp to 24%.

SOLAR POWER PLANT USING A SATELLITE

Solar energy is a huge energy resources but difficult to utilize due to low density of the energy flux which is further decreased by atmospheric absorption and rotation of the earth. This constraint created an idea of a solar – powered generating satellite in space. It was proposed that solar powered PV devices be arrayed in space as a circling satellite in a geo-synchronous orbit (36000 km away from the earth). Solar energy will then be received 24 hours a day and the efficiency of the system will not be hampered on account of the cloud cover the earth.
The power output from the solar array is converted to a narrow microwave beam (about 10 cm wavelength) by a magnetron and transmitted to the earth to be received by an antenna and is then reconverted in to commercial frequency electric power. The microwave beam sent from the satellite plant to the earth does not constitute any threat either to space air craft or birds. At present such schemes are in the planning stage and yet to be implemented as long-term solution to the energy shortage problem.

PLASTIC SOLAR CELLS WITH NANO-TECHNOLOGY

Photovoltaic devices will be used more and more in the near future as the production cost goes down. The fabrication of a simple semiconductor cell is a complex process and requires controlled conditions of high vacuum with temperature between 400^0c and 1400^0c. Ever since the discovery of conducting plastic in 1977, there has been a constant quest to use these materials for the fabrication of solar cells. Plastic radiation into electricity is how compared to semiconductor cells. A new generation solar cell that combines nanotechnology with plastic electronics has been launched with the development of a semiconductor polymer photovoltaic device, such hybrid solar cells will be cheaper and easier to make in a variety of shapes.
Semiconductor nano-rods are used to fabricate energy efficient hybrid solar i.e. semiconductor are polymers provide a double advantage. Inorganic semiconductors with excellent electronic properties are goods for solar cells organic polymers can be suitable processed at room temperature which is economical and also allows to use fully flexible substrates like plastics.
In a semiconductor solar cell, the two poles are made from n-type and p-type semiconductors. In a plastic solar cell they are made from hole-acceptor and electron-acceptor polymers.
To fabricate such a hybrid solar cell, a semi-crystalline polymer known as poly (3-hyxylthiophene) is used for the hole-acceptor, i.e. negative pole and nanometre (nm) sized (7 nm diameter and 60 nm length) cadmium salenide (cdse) rods for a positive pole. The use of rod shaped nano crystal provides a direct path for electron transport and is a basic requirement to improve the performance of the solar cell. This type of hybrid solar cell (plastic PV device) has achieved a Monochromatic power conversion efficiency of 6.9% to obtain a higher efficiency, an important step is to increase the amount of sunlight absorbed in the red part of the spectrum.

SOLAR ELECTRICITY IN NIGERIA

For decades, solar thermal has been constantly enjoying very high level utilization by rural dwellers for agricultural processing's in purposes including drying of agricultural product such as grains, cassava (tubers or march), yam flakes, meat, fish, fruit, kernels, drying or manure, hides and skins, cooking and frying of agricultural products which are not preserve or sold raw. Other areas of solar energy utilization include heating and lighting of animal pens, pumping of water and irrigation, food and vaccine storage. In addition to these, solar energy has also found wide usage in Nigeria viz: solar street lightings, solar refrigerators, solar cookers, solar-powered water pumps, etc. different applications exist in the form of solar thermal and solar PV. Solar energy devices (mainly solar thermal) have been designed, built or adapted by research institutes and tertiary institutions across the country. Notable among the product in existence locally is the built 1000 little capacity solar water heating system at the UsmanDanfodiyo University Teaching Hospital, Sokoto in 1988 by the Sokoto energy centre (SERC), solar driers, solar chick brooders and solar adsorption refrigerators. Developed at the National Centre for Energy Research and Development (NCERD). Solar PV found widespread usage in street lighting, but other pilot projects including water pumping vaccine refrigerators, communities lighting and few stand-alone mim grids installer and scattered across the country by the government or any or its agency like the energy commission of Nigeria (ECN), Federal Ministry of Power (FMOP) and the Federal Ministry of Science and Technology (FMOST) also exist. (Yohanna JK, 2010).

APPLICATION OF SOLAR ELECTRICITY IN NIGERIA

Solar power is not topic in 21st century, as it is offering US electricity more efficiently at much cheaper rates. In system converts sunlight into electricity directly or in directly. Direct means o conversion are photovoltaic and in direct means concentrated solar power is used. These indirect means use lenses or mirrors with some tracking systems. These systems few an large area of sunlight but extract only those beams which contain protons. (www.yourarticlelibrary.com)

Solar power today is used indifferent places and for different purposes. Some major application of solar electricity is as follows:-

a) Solar water heating
b) Solar heating of building
c) Solar distillation
d) Solar pumping
e) Solar drying of agricultural and animal products
f) Solar furnaces
g) Solar cooking Solar electric power generation
h) Solar thermal power production
i) Solar green houses.

LATEST ACHIEVEMET OF SOLAR ENERGY IN NIGERIA

Over the years, the members of the society spread all over the country have successfully designed and fabricated solar cookers, solar heaters, solar stills, solar-stoves, solar dryers, improved wood-stoves, biogas digesters passive solar houses, solar refrigerators and air-conditioners, traffic lights, solar pilot water supply systems and even attempt at the local production of silicon solar cells. Model solar energy villages have been set up in some parts of the country through the efforts of the members of the society.
(www.sesn.ng.org/achievement.html).

The polytechnic BirninKebbi has set up three solar energy villages at TungaBuzu, Gotomo, and U/Jario in Kebbi State. The energy commission of Nigeria through the National centre for Energy research Centre (NCERD), university of Nigeria, Nsukka also set up another model solar energy village at Iheakpu-Aka in Igbo-Eze LGA of Enugu state. Sokoto Energy Research Centre (SERC), of the UsmanDanfodio University Sokoto has also powered some challenges with solar energy notably at Kwalkwalawa village in Sokoto. In all the places where the solar energy project is set up the quality of life of the populace has been enhanced. Some of the facilities in the solar villages have been installed for the water supply, television viewing and community health centres, mosque, the Qur'anic school, and a mass literacy campaign centre, in March 1987, the society undertook a survey for the Kano state government on the feasibility studies for rural energy systems fir health, television viewing centres and water supply systems all employing solar technology. The present manner of harnessing our existence energy sources in Nigeria from all practical and economic considerations is rather un-coordinated. The society, through some of the members have strongly advocated for desirable comprehensive energy policy for Nigeria. The efforts of the members speeded up the gazetting of the renal decree on the amended energy commission laws of 1979 and 1983, the energy commission of Nigeria (ECN) was this established later with one of the members of the society, professor I.H Umar as the director general of the commission. Presently one term president of the society and a former vice chancellor of

AbubakarTafawaBalewa University, ATBU, Bauchi, Professor A.S Sambo. Solar energy society of Nigeria aroused the interest of the government towards establishing two National solar energy Research centre at University of Nigeria, Nsukka and UsmanuDanfodio University Sokoto. During the solar energy conference at University of Lagos, 25-27 March 1981, then vice president, Dr. Alex Ekwueme announced that N3.3million was ear marked for setting up an institute for solar energy training, research and development at the University of Nigeria, Nsukka this was later followed by the establishment of similar institute at UsmanuDanfodio, University Sokoto.

The society has organised several workshop and in April 2000, photovoltaic workshop was organized at Abuja. This workshop was organized at Abuja. This workshop contributed to the initiation of a bill “the solar energy (Development and Utilization) fund Bill” in the house of representatives. The observation and recommendation of the workshop were made available to the initiators of the bill by the society, and the society has continued to make input to the national assembly on the bill, as it goes through its various staged. Since 1997, the society started energy quiz competition among secondary schools during its yearly NASEF and prices are awarded to winners. Finally, it is the wish of the society that the annual NASEF would continue to encourage research and development in areas of solar energy and other energy resources especially in the present dispensation where energy is one of the seven point agenda of the federal government.

CHALLENGES OF SOLAR ENERGY IN NIGERIA

How can we make this solar power solution possible in Nigeria?

Where can the everyday Nigeria get the money for solar power generator?

The first thing about a solution is accepting it as a solution. I have gone through a quiz from friends on how can recoup my money if I install it for consumer. However my goal is not to install for a consumer but to install for very Nigerian and African at large.

There is one thing every Nigerian should know, any service rendered or commodity consumed must be paid for, else that service of commodity will cease to exist let us take an example why has NEPA/PHCN/DISCOS failed to provide power to Nigerians adequately? The answer is simple, most Nigerian prefers to consume electricity from the grid without making any payment. Initially, it was a problem of lack of electric meters, this made NEPA/PHCN to send out-estimated bills to customers. Note the phrase estimated bill which consumer. In another right frame of mind the pay for an estimated bill as far as he/she does not see the actual bill. Another problem with estimated billing is that the managers at the various distribution centres largely manufacture estimated bills for customer without any references to energy that was supplied to the region they managed this coupled with electricity touching ed to customers making illegal connections, it become a norm to the society, then the DISCOS debt recovery agents failed her duties by taking bribes from consumers and allowing them to use electricity without making of from payment or having a concrete agreement to make payment. (www.newenergysage.com).

Furthermore, with illegal connection now the norm, consumers of business categories hardly pay bills. Most welder shops, mechanic shop, barbing saloons, woodwork specialists shops, metal work specialist shops, ladies of hair dressing saloons, bukas (mini restaurant) beer pubs, mini guest houses etc do not have any electric meter installed at their places of businesses these businesses run mostly of private generators which are fuel expensively, with the illegal connections, they utilise a few hours electricity from the grid, and at the end of the month the DISCOS agent will deliver an enormous energy bill to them, these bills are estimated bills. These businesses already pay a lot by running private generators these enormous estimated bills without any evidence gets ignored, consequently ignoring bills are now normal in the society.

In addition even customers that are genuinely billed now ignore energy bills because, there is inadequate supply of electricity and why should one customer pay when another is enjoying electricity illegally. As a result, when energy is utilized and no payment is made the utility company NEPA/PHCN/DISCOS will definitely go in to extinction like dinosaurs.

Coincidentally other utility companies that were operated by the government has suffered the same fate-extinction, namely NITEL, NIPOST (operators below at capacity), state water companies etc other potential utility companies such cooking gas companies internet companies are not developing as a result of this problem as well. NITEL was the sole operator of telecommunications in Nigeria prior to the year 2000. Having a telephone at home or in the office was considered a luxury, less than 20% of the population had telephone at their homes, however, with the advent of GSM which was pioneered by ECONET, the spread of communication gadgets in Nigeria increased, initially to obtain a SIM card was expensive and then centre the competition MTN, NITEL, Globacom, Etisalat, and other CDMA networks this competition eventually lowered the cost of the acquiring mobile phone subscription in Nigeria, now we have nearly 100% mobile subscription for every adult in Nigeria.

ALLEVIATING NIGERIAN ENERGY PROBLEM WITH SOLAR ENERGY

Being noticed and believed by everybody and its people as a big oil exporter, and its people are suffering from energy problem, series of attempts have been made by different governments in order to overcome the problem of energy in Nigeria but unfortunately no one of them could even alleviate the problem. Power is a key priority of any nation and it wille agreed that any effort at developing a nation cannot be successful unless we solve the power problems (booksie.com, 2017).

There are better and more efficient and environmentally friendly ways of generating electricity, the following sources must be tapped – biomass, geothermal, hydropower, nuclear (fission and fusion), ocean waves solar wind and other pollution free renewable sources.

Nigeria capacity to overcome its energy challenges in the year 2020 will be a reality challenge in the year 2020 will be a reality if it invests of carbon dioxide (CO2), the heat trapping pollutant that courses global warming, coal fared power plants are also responsible for pollution that are also responsible and worsens environmental problems like acid rain, haze, smog, and other air and water pollution.

However, we the technology and know-how to move beyond air dependence on pollution power plants using clean safe, and affordable renewable energy, by harnessing renewable sources of energy such as solar, wind, geo-thermal waves, biomass and other; we can transform how we produce electricity for instance, modern wind farms are leading the drive a way from polluting sources of energy by capturing the massive wind power potential of the mid west.

Today's solar panels efficiency transform sun-light into electricity blending into the design of homes and office building. In addition, concentrating solar parts (CSP) are large enough to replace coal fared power plants. In order to harness this potential we need a renewable energy standard (RES) for example an RES has requires us to get 20% of our energy from renewable source by 2020 would create.

II. SUMMARY, CONCLUSION AND RECOMMENDATION

SUMMARY

It has been found out that Nigeria despite the fact that it is a big producer of oil, its people only get electricity for few hours in every day. Nigeria also has large source of liquid natural gas (LNG) despite the infra-structure in place, the country cannot harness this energy. In fact many people have to supplement electricity provided to them by their own generators, these cause another challenges of Nigerian people by causing air pollution across the country.

The total grid capacity of Nigeria is about 5924.7 mw but only 4586 mw has available thus, 22% of the installed capacity was unavailable; this may be due to operational inadequacies and inability of unit to operate at fuel capacities of the generating stations and their respective percentages contributions to the total energy products.

In order to overcome the energy problem in Nigeria government should invest in renewable energy particularly solar energy as alternative source of energy for Nigeria.

CONCLUSION

Nigeria is located on the West Africa with other 150million people, according to the Nigerian energy policy report from 2017, it is estimated that the people population connected to the grid system is short of power supply over 60% of the tone. Additionally, less than 40% of the population is even connected to the grid

Renewable energy particularly (solar energy) can be suitable for developing countries. In rural and remote area, transmission and distribution of energy generate from fossil fuels can be difficult and expensive interest in renewable energy has increased in recent years due to environmental concerns about global warming and air pollution.

Sambo (2005) states that there are many solar thermal systems especially solar water heaters and solar dryers in used in many part of the country.

RECOMMENDATION

Notwithstanding solar energy has some few disadvantages that are of less significance such as it is initially expensive i.e. during installation is expensive and sometimes the availability of sunlight is not constant, and it is not always reliable, and installation needs space and to some its inefficient.Despite this advantages, solar energy is still a perfect alternative for hydropower in Nigeria because it is a clean source of energy and it is also renewable which makes it qualified for power supply and it is free, which means it is gotten out of nature. Solar energy cost very to maintain compare to hydropower plants. It can also be used for multiple purposes not just electricity supply but also medically etc. So therefore, there is not harm when it comes to multi-installation of solar-power-plants, which as a result can provide Nigeria with multiple power sources and also can result to more power supply to the nation. And definitely, this can resolve the problem of lack of sufficient power supply to the country. Having said this, I strongly believe that solar energy is a perfect substitute to hydropower plant, so therefore recommending it as an alternative source of energy for Nigeria.

REFERENCES

[1]. A New Innovations in Solar thermal Popular mechanics.com (1, November, 2008). Retrieved on 22 April 2013.
[2]. Molki (2010) "Dust affects solar cells efficiency" physics education. 45:456-458. Bibcode.2010 phyedu.45.456m.
[3]. Ausra's Compact Linear Fresnel reflector (CLFR), and lower temperature Approach.
[4]. Boerema, Nicholas, Morrison, Graham, Taylor, Robert, Rosengarten, Gary (2013-11-01). "High Temperature solar thermal central-receiver billboard design. Solar energy:97:356-368.
[5]. Booksie.com, 2017 Solution to Nigerian Power Outrage http:/bookies.com.
[6]. Billy Robert (2008), Photovoltaic solar resource of the United States. National Renewable Energy Laboratory.Retrieved April, 2017.
[7]. Chaves, Julio (2015). Introduction to Nonimaging Optics, second edition, CRC press ISBN 978-1482206739.
[8]. Christopher L. Marten; D. Goswami (2005).Solar Energy pocket reference.Earthscan, p.45.ISBN 978-1-84407-306-1.
[9]. Dulfie J.A and W.A Beckham, Solar Engineering of Thermal processes, John Wiley USA, 1980.
[10]. Energy and the Challenge of Sustainability (PDF). United Nations Development Programme and World Energy Council, September, 2000. Retrieved, 17 January, 2017.
[11]. Energy and the Challenge of Sustainability (PDF).United Nations Development Programme and World Energy Council. September, 2000 Retrieved 17 January, 2017.
[12]. Garg, H.P Solar Energy TMH, New Delhi 1997 Integrated Energy Policy, Planning Commission, Gov't of India, August, 2006.
[13]. Holhani, D.P Power System Engineering TMH, New Delhi, 2004.Maheshwar Loyal, Energy Today and Tomorrow Publication Division, Gov't of India 1989.
[14]. Integrated Solar Thermochemical Reaction System U.S Department of Energy.Retrieved 11 April, 2013.
[15]. Listverse.com/2009/05/01/top-10-renewable energy source/p-10-renewable.energies-sources.
[16]. Law, Edward W. Prasad, Abhnic A: Kay, Merlinde Taylor, Robert A. (2014-10-01). Direct Normal Irradiance Forecasting and its application to concentrated solar thermal output forecasting.A review solar energy.108.287-307.
[17]. Law, Edward W: Key Merinder, Taylor, Robert A. (2016-02-01) "Calculating the financial value of a concentrated solar thermal plant operated using direct normal irradiance forecast. Solar energy, 267-281.
[18]. Mathew L. Wald (10 April, 2013), New Solar Process Gets more out of Natural Gas The New York times.
[19]. Mangal, B.S Solar Power Engineering, Tanct, 1993.(Fourth Reprint).
[20]. Mathur, G.N and D.K Jain (Editors) Renewable energy International conference 2004, central Board of Irrigation and Power New Delhi, 2004.
[21]. Mukherjee D. Renewable energy system, new age International, New Delhi, 2004.
[22]. Natural Forcing of the Climate System Inter Government Panel on Climate Change. Retrieved 29 September, 2007.
[23]. Powering the Planet; Chemical Challenges in Solar Energy Utilization (PDF) Retrieved 25 May, 2008.
[24]. Radiation Budget", Nasa Langley Research Center, 17 October, 2006. Retrieved 29 September, 2007.
[25]. Roland Winston, Juan C. Minano, Pablo G. Benotez, (2004) Nonimaging optics Academic, ISBN 978-0127597515.
[26]. Roland Winston, Juan C. Minano, Pablo G. Benitez (2004) Nonimaging Optics, Academic press, ISBN 978-0127597515.
[27]. Renewable Energy Sources and Emergency technologies, second edition. D.P Kothri (Director General Raisoni group of Institutions, formed Vice Chancellor VIT University, Vellore former Director – incharge Indian Institute of Technology Delhi.
[28]. Ruhle, Suen (2016) "Tabulated values of the schockley-Quesser limit for single Junction Solar Cells". Solar energy, 130-137.
[29]. Rabel, S, and G.B Parulekar, Energy Technology Non-conventional, renwable and convention 3rd Edition, Khanna Publisher, New Delhi, 1996.
[30]. Sierraclub.com, 2017: Renewable Energy Clean Energy Solution http://www.sieraclub.org/energy/renwable. Retrieved August, 2017.
[31]. Solar Energy Perspective: Executive Summary, International Energy Agency, 2011. Achebe from the Original (PDF) on December, 2011.
[32]. Solar Energy Perspectives: Executive Summary, International Energy Agency, 2011. Achieved from the Original (PDF) on 3 December, 0211.
[33]. Somervule, Richard, :HistoricalOveriew Of Climate Change Science" (PDF) Inter-government Panel on Climate Change. Retrieved 29 September, 2007.
[34]. Sunshine to Petrol (PDF).Sandia National Laboratories.Retrieved 11 April 2013.
[35]. Solar Photovoltaics: data from a 25-M2 array in Cambridgeshire in 2006, http://www.inference.phy.cam.ac.uk.
[36]. Shockley, Williams, QueisserItens J, (1961) "Detailed Balance Limit of Efficiency of p-n Junction solar cells (PDF) Journal of applied physics.
[37]. Vermass, Wim (2007) "An Introduction to Photosynthesis and its Applications.Arizon State University.Retrieved 29, September, 2007.
[38]. Vignarooban, K. Xinhai, Xu (2015) "Heat Transfer Fluids for Concentrating solar power systems – A review Applied Energy via elsevier science direct.
[39]. www.google.com/m = extension.PSV.edu%fnatural-resouce%2F energy % 2f what+ literature.com.
[40]. Wikipedia, 2017 or https://en.m.wikipedia.org//solar .com
[41]. Wikipedia, 2017
[42]. YohannaJK, Umogbai VI, Solar energy potentials and utilization in Nigeria agriculture, Environment issueesAgric Dev. (tries 2010;)

D. Dahuwa "Renewable energy, as an alternative source of energy in Nigeria." The International Journal of Engineering and Science (IJES), vol. 6, no. 12, 2017, pp. 51-61.