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Solar Energy Electric System: an Alternative Rescue to the Sorry State of Electricity Generation and Supply to Building Infrastructures in Nigeria

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ABSTRACT: This treatise focuses on the energy sector in Nigeria, very precisely, the electricity sector where demand is inadequate. Due to this discomfort, an individual operates diesel /fuel generators to compensate for the inadequacies in energy supply. To this end, an alternative sustainable energy generation such as renewable energy is chosen to address this shortfall arising from the electricity sector in Nigeria. This treatise therefore discusses the planning on how to extract energy from solar energy and the design of the system in order to provide and make available, clean reliable electricity that adds value to lives and for use as an alternative to the conventional Electricity Distribution Companies (DisCos) in Nigeria whether in the rural or urban areas of Nigeria. For years, Nigerians have depended on the sun to dry their clothes and convenient/allowable working seasons but with the discovery/emergence of solar power energy, Nigerians now have more use of the sun in providing stable electricity for homes, rural communities, private and government sectors.In conclusion, proper planning, accurate design and precise installation/construction of PV or CSP in homes, rural electrification, solar powered water boreholes, buildings, transportation, rural electrification, road ways and telecommunication/satellites results in maximizing the use of energy received from the sun and is conveniently preferred as an alternative to the conventional sources. Hence the conclusion is that solar energy will not only be a perfect supportive alternative energy source, but is also both more economical and environmentally friendly. It will also generate employment opportunities for the unemployed.

KEYWORDS: electricity, sunlight, photovoltaic (PV), Concentrating Solar Power (CSP), photovoltaic array, Solar Cell, concentrating photovoltaic (CPV), solar radiation, photovoltaic modules, solar loop.

I. INTRODUCTION

Obviously, the motivation for this subject of discussion is about the sorry state of electricity generation and supply in Nigeria and its negative effect on the economy, social development and the environment. Thus the consideration/ recommendation of renewable energy as an alternative to improving on the economic growth, social development and environmental friendly energy. The sun is more readily available than any other form of renewable energy hence the choice of solar power energy as a case study.

Background information on solar energy is as the days of old. It may sound as a surprise but the generation of electricity from the sun is a thing of centuries ago. From ancient Greeks and Romans who used the sun's power/ability to light and heat indoor spaces and to present days when solar technology has made so much achievements and not only competing with other known energy sources but poise to replace them, not only in Greek and Rome anymore but all over the world, Nigeria inclusive.

The solar power history dates back to 1861 when Augustin Mouchout used the CSP's parabolic trough technique to produce steam for the first solar steam engine (active solar motor) in 1866. And the first solar cell was constructed by Charles Fritts in the 1880s based on the discovery by Alexander — Edmond Becquerel on noticing that some types of photovoltaic cells materials (thin film, monocrystalins silicon, polycrystalline silicon and amorphous cells) and some types of CSP releases electrons when hit with rays of photons from light thereby producing an electric current.

Nigeria is a country rich in energy resources such as petroleum, natural gas, coal, tar, sand and biomass. The consumption of large amount of liquefied petroleum gas, motor spirits, kerosene, diesel oil, fuel oil and gas oil which are energy sources gives so much impact to climate change and environmental problems. But solar

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energy as an alternative energy to oil energy in Nigeria being one of the renewable energy that has a massive potential for developing and implementing energy sources that are far more economical and environmentally friendly.

The 1970's world energy crisis created a global realization of the need to explore and harness other energy resources apart from the well-known exhaustible fossil fuel resources. Nigeria even with her abundant fossil fuel reserves was not left out in a bid to diversify its energy resources like other developing and developed countries as doing so will obviously be disastrous in view of the ever increasing energy demand in the domestic, commercial and industrial sectors of the economy. The need therefore, to harness the abundant solar and alternative energy resources in the country was then recognized to compliment the fossil fuel reserves and so also the recognition of the creation of an enduring culture of efficient energy utilization in the economy as most plaurable ways to conserve existing energy resources as well as saving the environment.

Consequently, in 1980, the Federal Government of Nigeria established the National Centre for Energy Research and Development (NCERD), University of Nigeria, Nsukka among others. The Centre is charged to carryout research, development and dissemination of solar and other renewable and alternative energy technologies and to train personnel in various technology options. And since about two decades running, the solar power revolution started.

The Problem Area

The most essential need of everyone in the world is electricity. Fossil fuels electricity (coal, oil and gas) is most used but are nonrenewable and destructive to the environment. The world's greater energy comes mainly from solar energy which is defined as energy from the sun and it is renewable, infinite and environmentally friendly. The searching of non-renewable energy is costly and does not create sufficient and reliable power for Nigeria's utilization. Considering therefore the high prices of fossil fuels, the destructive consequences of nuclear power, and the unpredictability of hydropower, solar energy then remains the best solution.

This presentation is about the Nigeria's energy sector development and the future of sustainable energy in the country and this is why it is believed that the biggest part of Nigeria's energy sector development could be largely influenced by solar energy correlation with the present energy produced from fossil fuels if we concern ourselves with sustainable energy.

The interest of this presentation therefore, is to formulate acceptable proper planning, design and installation techniques and methods of provision of solar power to the people of Nigeria thereby improving Nigeria's socio-economical and environmental situation. This discuss is limited to building infrastructures only but mention will be made of other civil engineering usage areas.

Problem Formulation

The economical and environmental benefits of accurate planning, design and installation of solar power provision for building infrastructures in implementing solar energy in urban and rural areas of Nigeria in order to support the current fossil fuel generators and hence ensure constant electricity supply, the status quo of electricity sector and energy use in urban and rural areas of Nigeria, and whether there are any other energy alternatives suitable for Nigeria will be researched and possible solution/suggestions will be provided.

II. THE THEORY OF SOLAR POWER

The generation of electricity from the sunlight is called solar power which could be direct with photovoltaic (PV) or indirect with concentrating solar power (CSP). The concentrating solar power focuses on the sun's energy to boil water which is used to provide power. The sterling engine dishes that uses a sterling cycle engine to power a generator is one such technology. This research is only centered on photovoltaic technology but not CSP but mention will be made of CSP where necessary and informative enough.

A device that converts light into electric current using photoelectric effect is a solar cell or the photoelectric cell. Initial use of photovoltaics centered on the mere powering of small and medium sized applications such as calculator which is powered by a single solar cell to off-grid homes powered by photovoltaic array. Costs of solar power plants can face high installation costs but over the years there has been steady decreasing value in supply and installation cost due to what may be called the learning curve and due to the realization of the fact that solar electricity is actually cost effective and even cheaper for the following reasons:

- Its life span is 25 to 30 years
- It has great low risk investment
- It is obviously cheaper than the always cumulative cost of buying, maintaining and

replacing fossil oil gasoline or diesel generators.
- It actually saves money because after the initial purchase, there is no running cost this is due to the fact that sunlight is the fuel it needs to operate and of course, sunlight is free, abundant and inexhaustible.
- It is virtually maintenance free because it has no moving parts hence no wear and tear effects and wahala (problem free).
- If expertly designed, solar systems improves our bottom line by elimination of high cost of running diesel generators and hedging of businesses against rising energy costs.

How it Works

The photovoltaic cell works base on the principle that when a material of solar cell releases electrons when it hit with rays of photons from light and then produces an electric current. That is photovoltaic are the methodology for the generation of electric power by the use of solar cells which converts energy from the sun into electricity. The photon of light that knocks electrons into higher states of energy to create electricity is referred to as the Photovoltaic effect. Photovoltaic denotes the operating mode of a photodiode where current through the device is entirely due to the transduced light energy. Almost all photovoltaic devices are some kind/type of photodiode.

When solar cells produce direct current electricity from the sunlight, it is used to power equipment or to recharge a battery. Initial practical applications of photovoltaic were the powering of orbiting satellites and other space craft, but majority of photovoltaic modules are used for grid connected power generation. This is why an inverter is needed to convert the DC to AC.

Protection

Cells required protection from the environment and are therefore packaged very tightly behind a glass sheet. If more power required then a single cell can deliver, cells are then electrically connected together to form what is known as photovoltaic modules or solar panels. An emergency telephone can be powered by a single cell but for a house or power plant, the modules should be arranged in multiples as arrays.

Solar water heating systems can be either passive or active solar but the most common are active system. Installing solar electric panel systems in homes can be quite more economical rather than be expensive. Though, more economical passive solar techniques can be incorporated into the design of a new home or added to an existing home.

In passive solar homes, the heat movement and heat storage technique through conduction, convection, radiation and thermal capacitance must be understood and known. Passive solar (solar thermal) uses the sun's heat energy and compliments solar power electric photovoltaic. Homes can be kept warm in the raining reasons and also kept cool in the dry seasons by using passive solar features.

Active solar energy technology generally refers to electrical or mechanical devices required to take advantage of the sun's energy. Passive solar techniques require few or no such devices and are usually easier and less expensive.

To circulate water, active solar water heaters rely on electric pumps and controllers or some kind of other heat transfer fluids through the collectors. There are two types of active solar water heating system. These are current circulation systems and indirect - circulation system.

The Storage of Solar Energy

The obvious is that solar energy is not available at night since solar energy is energy from the sun. Therefore, there must be technique of making energy storage an important issue so that provision of the continuous availability of energy in the night is guaranteed. Wind and solar energy are example of intermitted energy sources. This means that available output must be taken as when it is available and then stored till when the need for use arises and or transported over transmission line to where it is required/needed for use. Both are complimentary to each other hence in locations that experience more wind in the dry seasons of Northern Nigeria and more rains in the South, the difference can be made up in seasons where there is no wind or sun. Salts are an effective storage medium since they have a high specific heat capacity and can deliver heat temperatures compatible with conventional power systems and capable of the potential to eliminate the intermittency of solar power by storing spare solar power in the form of heat and using the heat overnight or at periods of time when solar power is not available to produce electricity. These techniques of storing solar power is potentially capable of making solar power dispatchable as the stored heat source can be used to generate electricity at will.

In practice, installations of solar power are supplemented by storage or the provision of another energy source for instance, winds power

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and hydropower. An off-grid photovoltaic system uses rechargeable batteries to store excess electricity. If a building is at a considerable distance from the public electricity supply (or grid) such as in remote, new layout or mountainous areas, PV should be the preferred option for the generation of electricity, better still; PV can be used with wind, diesel generators and hydroelectric power. In situations where off-grid circumstances are such as described, electric power storage is with the use of batteries.

Considering Environmental Impacts

Solar power does not lead to harmful emissions during operation like fossil fuel based technology is known for, though panels production leads to some traceable amount of pollution, but this quitemost often referred to as the energy input to output ratio. That is, if in analysis, if the energy input to produce the energy required is higher than the output it produces, then it can be considered environmentally more harmful than beneficial. It has also been established that placement of photovoltaic affects the environment. In the processing of cadmium telluride solar cells (which is only used in a few types of PV panels) by use of cadmium is now a concern because in its metallic form, it is a toxic substance that has the tendency to accumulate in ecological food chains. Though with proper emission control techniques in place, cadmium emissions from module production can be almost zero. Life cycle greenhouse gas emissions are even now in the range of 25 - 32g/kwh and this could decrease to 15g/kwh in the near future.

Photoelectric emission

When a surface is exposed to electromagnetic radiation above a particular threshold frequency (such as a visible light for alkali metals, near ultraviolet for other metals, and extreme ultraviolet for non-metals) the radiation is absorbed and electrons are emitted. This phenomenon was initially used to develop photoelectric cells used to measure the intensity of light. Light is described as composing discrete quanta called photons. The electromagnetic theory of light describes the effect and the quantum theory of light describe the photoelectric effect.

The mathematical description of the photoelectric emission.

$K_{max} = hf — \Psi$

Where:

Kmax implies the maximum kinetic energy of an ejected election, **h** is the plank constant, **f** is the frequency of the incident photon, and Ψ=**hfo**which is the work function which is the minimum energy required to remove a delocalized electron from the surface of any given metal. The work function (which is also denoted by **w** can be written as:

$W = \Psi = hfo$

Where:

fo = the threshold frequency for the metal.

Therefore, the maximum kinetic energy of an ejected electrons is:

$K_{max} = h(f-fo)$

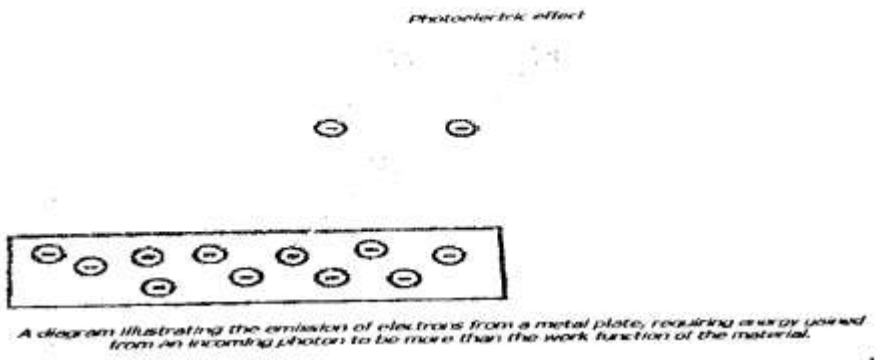
But for the photoelectric effect to occur, the frequency "f" of the incident photon must be greater than 'fo" that is, f >fo, this is because the kinetic energy of theelectron must be positive. The likelihood that photoelectric effect will occur is determined or measured by the cross section of interaction, and this has been found to be a function of the atomic number of the target atom and photon energy. So for some photon energies above the highest atomic binding energy, it is given by:

$r = \text{Constant}\frac{Z^n}{E^3}$

Where: z = atomic number

n = a number varying between 4 and

e = representing the photon energy.



A diagram illustrating the emission of electrons from a metal plate, requiring energy gained from an incoming photon to be more than the work function of the material.

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So by using the photoelectric effect, light is converted to electric current and the device used for the conversion effect is called solar cell or the photovoltaic cell. So a photovoltaic cell is a type of photoelectric cell that uses the photovoltaic effect to generate electrical energy using the potential difference that happens between materials when the surface of the cell is exposed to electromagnetic radiation.

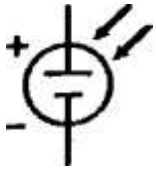

Figure showing schematic symbol for Photovoltaic cell

III. RESEARCH METHOD

Research method in this discus consists of empirical data and theoretical data. The empirical data are basically secondary sources consisting of articles, journals and internet sources relating to the problem formulation of this presentation. The theoretical data are the information from lecture hours and relevant and appropriate available books on the said subject matter.

IV. LIMITATION

Limitation centered around been aware of the reliability and validity of the sources of information regarding the topic of discussion, hence many sources possible were searched for in other to have clear broad scientifically approved information either in articles, reports, journals, internets sources or relevant books.

V. ANALYSIS

In the analysis and discussions of the outcome of the research on accurate planning, design and installation of solar power electric system, discussion will be made of solar energy electric provision consideration prior to new construction or the remodeling of an existing structure such as the one belonging to Engr. Akwenuke O. Moses along Obibi Street, Off Alaka Road in Etevie Community of OzoroTown in Isoko-North Local Government Area of Delta State, Nigeria. Discussion and or analysis will also include the design and installation/construction technique apart from the initial consideration (planning) of the truly energy efficient desired building.

Planning:

Before the design and construction of a truly energy efficient building, some considerations for planning must be put in place. The following are some of such considerations:

- **Solar Orientation:**The sun reaches its zenith (i.e. peak) at a point due south of the-observer (that is, northerly latitudes) and at the time this occurs is defined as the solar noon. Energy - sensitive construction and design experts do understand that a south facing orientation of a building tends to increase solar heat during the coldest season of the year and considering that the said building is located in the southern part of Nigeria, then this means the months of December through January and February to early March. So first thing in the planning, the positioning of the building has to be identified to establish the solar orientation.
- **Eave Protection:**Proper eave protection enables the use of more glass surfaces because solar heat in the winter (cold season) will be permitted and also provide shade to the windows during the warm seasons (summer).
- **Landscape Features:** Trees and shrubs/flowers can provide shading, wind break and more benefits. Trees are usually very helpful and even restrictive in passive solar designs but this depends on how close these trees, flowers or shrubs are to the building and what type of tree is in consideration but they should not be too close or too high to the building roof top if solar photovoltaic are to be used.
- **Window Glass:**To keep dry season (summer) heat from penetrating windows and at the same time allows cold season (winter) solar heat to keep the structure warm even without ruining furnishing, energy efficient window glass should be recommended. Recommended also is inexpensive transparent low emissivity coated window glass apart from consideration of double or triple pane for heat and cooling losses though depending on size of window and compass orientation. Depending on the orientation of the windows, low emissivity coating reduces the amount of solar heat passing through to the building interior in the dry season (summer). If low emissivity is combined with sealed gasses such as Argon (an odourlesscoloured inert gas) in triple or double pane windows, the low emissivity coating keeps heat in and out and also reduces ultraviolet ray penetration.
- **Wind Barriers:**If properly installed, unwanted air flow in the wall and ceiling cavities will be restricted. It becomes uneconomical and waste of fund if not properly installed.

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- **Absorption Materials:**In the interior design, the use of stone, brick or tile is recommended so as to absorb winter (cold season) solar heat during the day through window openings and then releasing it slowly in the evening but to be kept shaded in summer (warm/dry season) months so as not to make the good effects negated/destroyed or made worse.
- **Insulation and Caulking:**Accurate insulation and caulking is to compliment good construction habit. The purpose is to properly seal joints and other noticed and unnoticed openings so that air penetrations into the interior through corners, eaves, sills etc is practically minimized so as to make the building truly energy efficient home.

For energy efficient residential building structure like this case study, the appropriate choice and use of the followings by the planner/owner is absolutely very important:

- **Fresh Air:** A home must breathe and the planner must guide against enabling a home to breathe and then allowing inefficient construction that causes undesirable air flow. To keep the air quality fresh and healthy, a building should have sufficient exhausting in kitchens, baths, lunges, rooms etc.
- **Gas and Electric:**It is less efficient to heat with electricity than gas because electricity is better off on inductive loads like motors and alike but resistive loads as in heat elements are better heated with natural or propane gas, therefore, it is better to use gas for central heating, hot water, kitchen range/oven and even clothes dryer.
- **High Efficiency Appliance:**For use of own electricity off the grid with alternative energy such as solar power electric system, high efficiency appliances is highly recommended. This is because high efficiency refrigerators, water heaters, furnaces, air-conditioners, electronics, cookers etc saves resources and money, reduces environmental impacts and keeps homes cooler in the dry seasons (summer) by eliminating the heat wasted if inefficient appliances was to be a choice.
- **Compact Fluorescent Lighting:**The CF lighting produces five times more light than heat energy have an average life of 8,000 to 10,000 hours (as against the 800 to 1,000 hours of regular light bulbs which produces so much heat energy than light) hence they are warm when touched. So though costlier, they save enough electrical energy to pay for themselves.
- **Colour and Materials:**Exposed surfaces which are to be affected by climatic changes as will be exhibited by dry seasons (summer) and raining or cold season (fall or winter) solar heat is a factor, therefore, surface area and what colour or material is a consideration. Though with proper insulation, caulking and other desired design features there is plenty room for decorative colours, darker colours absorb more heat in the winter and also in the summer most absorbing colours include black, red brown and navy blue.

Other consideration which has to take place before installation commences may include the following:

- Plan and locate the position of the panels.
- Allow the client/customer/home owner to approve the location of the panels.
- Prepare solid support for the solar collector legs.
- Ensure that the contractor understand that solar panels will be place upon the roof and that the roof must be built to proper dimensions.
- Taking note and understanding everything that needs to be done before the work is started.

Design:

If proper design of a solar power electric system is to be achieved or put in place, solar power can be of help by using it to decrease and or eliminate energy cost, reducing impact on the environment and saving funds in the process. The following are basic compulsory essential steps considered in the solar power electric system design:

- The decision of whether the design of the solar power electric system is to be hooked on to existing power grid or whether the design should be off grid was considered. The choice was depended on the nearness of the building location to an existing power line grid. In this case study, the design is off the grid.
- Computation of how much sun is available in Obibi Street of Alaka area of Etevie Community area of Ozoro Kingdom was also considered- There are no any obstructions that may cost shadows on the solar panels.
- Components were chosen based on home owner's requirement and circumstances which included the solar panels, conduits/wiring, appropriate battery or generator and an inverter to convert the panel's DC power to AC use. Controllers, disconnects, mounts and racks are also some of the components.

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In sizing the solar photovoltaic (PV) array and system, the sizes of the major components such as solar panels, solar regulator, the inverter and or the battery has to be computed or determined so as to meet the off-grid system power requirement.
For the purpose of this presentation, the panels will be designed.

Design Calculations and Results
Let total DC load in watt hours = 264wh per day for lighting.
Let total AC load = 480wh per day for say on LCD television.
So that total load = 264+480 = 744wh per day
Add 20% energy losses and emergency.
Hence total load + 20% energy losses = 892.8wh per day
Assume that peak sunshine in Obibi Street area = 1.8hrs
Then required solar panel input = $\frac{892.8}{1.8}$
= 496w

Therefore, this means that an equivalent number of solar panels needed to generate 496 watts per hour and round up to 500 watts will be;
2x250w solar panels
=> 2 solar panels is needed with each of them providing 250woutput.
These solar panels may therefore be connected in series or parallel.

Solar Power Electric System Construction
Geographical locations normally affect peak sun hours so this has to be considered in installation procedures.

- Decide what size of panel, battery, inverter and regulator to be used.
- Solar panels wiring can be in series or in parallel in order to increase voltage (v) or current (A) respectively.
- A solar regulator or charge controller is used to regulate the flow of current (A) from the solar panel to the battery and keeps battery fully charged.
- Batteries must never be overcharged so that they do not get damaged.
- Provide storage batteries that uses and store DC and which have a low voltage output in the range of 12-24V.
- Provide and connect an inverter which is a device that takes the power from the DC battery source to the household AC electricity usually of 240V to run all appliances. The inverter will increase the battery power of 12/24/48 volt to 110/240 AC power.
- Finally, in installing the solar power electric system, determination of the average yearly solar isolation for the location and the daily total loads must be calculated.
- See figure showing components of solar energy plant on page 11

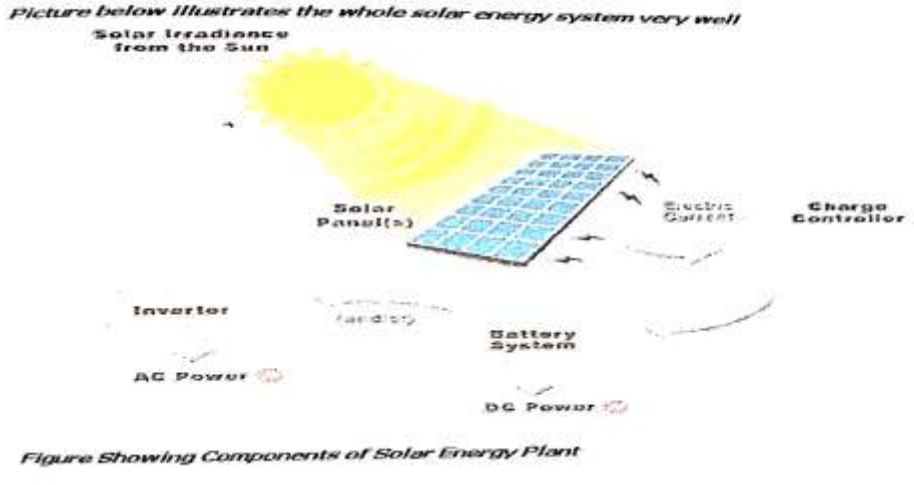

Figure Showing Components of Solar Energy Plant

Solar Power Heating System Construction
The following are the procedures for installation of a solar power heating system, but it is to be noted that the application of this general information to any specific project requires care, diligence and the consideration of all relevant factors. It is also important to consult and comply with any applicable codes. These procedures

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describe the materials and construction methods used for the construction of a typical residential solar power heating system.

- Assemble the Solar Loop: This is where solar energy is collected by the solar collectors.
- Solar collectors are then properly positioned.
- Install the solar panels.
- Plan the location of the solar panels.
- Install the blocking behind the roof. The blocking transmit the solar collector's loads to the rafters.
- Prepare the panels for mounting.
- Mounts solar collectors.
- Carry the solar panels to the roof and ensure securing them.
- Install plumbing mechanical package (PMP), the PMP is where or place where all mechanical components are centered.

After the construction of the solar loop completely, the following tasks are completed;

* Fill the system
* Drain the system
* Flush the system
* Back flush the system
* Get all of the air out and ensure is out.
* Work on anything mechanical without draining the system.
* Prevent reverse thermo siphoning at night.
* Read the system pressure
* Relieve expansion and construction of the working fluid.
* Mount the pump
* Relieve pressure on the solar panels under unforeseen condition.

The next step is to add heat exchangers to exchange the heat that is in the hot anti-freeze condition to domestic hot water.
Next will be the electronic control which works by comparing the temperature at the solar collector with the temperature at the storage sensor. A differential temperature control will turn on the pump whenever solar heat is available to be harvested, and turn the pump off whenever solar heat is no longer available.
Then filling of the solar loop with fluid in order to flush the system.
Finally, insulate all tubes for safety and efficiency.

ADVANTAGES OF SOLAR POWER ELECTRIC SYSTEM

- The sun's energy has no emissions, nothing to burn and no waste stream.
- Solar produced electricity has no pollution to air, water, land or homes unlike messy, smelling, wasteful generators.
- Local power generation at owner's home or business and free from outside issues.
- Decentralized, safe from interference and attack.
- Owing a PV system means owing an electric power plant so no fuel charges and no bills from electricity distribution companies (DisCos) and so no random rate increase.
- Clean reliable electricity for years.
- No running cost.
- Automatic change over.
- Minimal maintenance with long life span.
- Solar energy can be easily expanded.

Economic advantages of solar energy include the following:

* Solar energy creates direct and indirect employment opportunities and even business opportunities.
* Solar energy encourages the development of the micro-enterprises since the enterprise despite the power shortages and even unavailability can still provide the services for its customers without losses.
* Solar energy system can provide a constant and superior lighting at minimum cost compared with the generators or utility power.

CURRENT AND FURTHER APPLICATIONS

* Used to power public street lights and traffic lights
* Used for provision of electricity generation to power lighting & heating of domestic and commercial buildings and related accessories, e.g. security access controls, CCTV, communication facilities, cooking heat.
* For year round food production when used in green houses
* Used for powering water pumps for farm irrigation during low rainfall periods, as well as power portable water supply systems for communities.
* Solar energy can be used for water treatment — disinfection& desalination. Solar distillation can be used to make saline water portable
* Solar energy can be used to generate process heat for factories and industries

VI. CONCLUSION

Based on the foregoing, it is concluded that;

* The technology for solar systems is readily available for use in Nigeria on both small/medium scales.
* The use of solar energy for remote settlements in the country will help to stern. the tide of rural urban drift and reduce the nation's heavy dependence on fossil fuels.
* Inthe case of the discus, it is found out that the demand for electricity is very high, though the supply is inadequate and very epileptic thus forcing many Nigerians into using privately owned fossil fuel generators. By theoretical and empirical data findings, the use of fossil fuel generators is very costly and not environmentally friendly. An alternative therefore such as solar energy became a best choice solution to support and improve the electricity efficiency.
* In analyzing accurate and proper planning, design and installation and or Construction of implementing a solar power electric system, the conclusion is that the cost of electricity supplied by electricity distribution companies (DisCos) and solar Power Plant are almost the same despite the initial high installation costs. Furthermore, from the environmental point of view, solar energy isenvironmentally friendly and long lasting compared to fossil fuel generators and some other kind/type of alternative renewable energy.

* In conclusion therefore, solar power is capable of supporting the current fossil fuel generators and can ensure constant electricity efficiency even at the lowest environmental and economic cost if proper and accurate planning, design and installation of solar power electrical system are put in place. Thus it is no gain saying that solar power energy system is an alternative rescue to the sorry state of electricity generation and supply to building infrastructures in Nigeria.

VII. RECOMMENDATIONS

The following are recommended;

- An energy policy must be developed in Nigeria that recognizes renewable energy sources and their development for future use in the country. This must form part of the country's long term plans, like Vision 2020.
- Due to the vastness of the country and remoteness of some areas, it is impossible to hook up every nook and cranny to the "national grid". In view of the growth expected in the economy, industrialization and human capacity, the national grid is not sustainable. Localized energy generationand distribution should be encouraged via private participation in power generation.
- Solar energy systems should be developed and encouraged to reduce load on the current national grid. Street lighting, traffic lights, sign lighting, communication systems should as a standard be run on solar energy.
- Individuals and corporate organizations who develop or use solar energy should be encouraged via tax breaks, incentives, subsidies as appropriate.
- In order to enhance maintenance and spares interchangeability, there should be standardization of solar systems in the country. This will improve turnaround and uptime of systems.
- Government should embark on feasibility studies and development of solar energy systems for large scale generation as a means of shoring up the electricity level in the country.

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