Solar Energy Society of Nigeria

PROFESSOR ABUBAKAR SANI SAMBO ANNUAL LECTURE

SOLAR ENERGY: A PANACEA FOR NIGERIA'S ECONOMIC RECOVERY

BY

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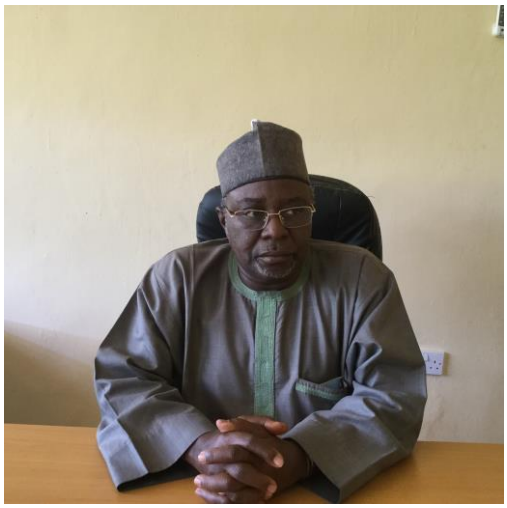

Engr. Prof A. S. Sambo, FNSE, FSESN, NPOM, OON

Born on the 31st July, 1955 in Zaria, Kaduna State, Professor Abubakar Sani Sambo graduated from Ahmadu Bello University, Zaria with a First Class Honours in Mechanical Engineering in 1979. In 1983, he obtained his DPhil degree also in Mechanical Engineering from the University of Sussex, United Kingdom. Prof Sambo started his working career at Bayero University, Kano (BUK) as a Graduate Assistant in Mechanical Engineering Department in 1980 and rose to become a Senior Lecturer in 1987. In 1989 he joined Usmanu Danfodiyo University, Sokoto (UDUS) as Reader (Associate Professor) in Energy Studies and Director of the Sokoto Energy Research Centre (SERC) of that University. In 1991 he was appointed Professor of Energy Studies at Sokoto. From 1995 to 2004 Prof Sambo served as the Vice Chancellor of Abubakar Tafawa Balewa University (ATBU), Bauchi. He served briefly, that was between August to December 2004, as the pioneer Vice Chancellor of Kaduna State University before his appointment as the Director General of the Energy Commission of Nigeria (ECN) where he served for two terms of a total of eight years from 1st January 2005 to 31st December 2012.

While at the BUK, between 1980 and 1989, Prof Sambo taught courses in Applied Thermodynamics, Fluid Mechanics, Heat Transfer and Engineering Drawing. He conducted research and development in Solar Radiation Studies, Flat Plate Solar Collectors and Thermosyphon Solar Water Heaters. He also served as the Sub Dean and later Deputy Dean of the Faculty of Technology as well as Head of Mechanical Engineering Department all at BUK. At the SERC of UDUS Prof Sambo, as the Centre's Director, coordinated the research groups to conduct pioneering R&D activities in Solar Radiation Studies, Solar Thermal Conversions, Biogas Digesters & Stoves, Improved Wood Burning Stoves and Solar Photovoltaic Applications. He started the Nigerian Journal of Renewable Energy and produced the maiden edition of the Directory of Renewable R & D Activities in Nigeria. While at UDUS, Prof Sambo also served as the Deputy Vice Chancellor (Academic) for two terms between 1990-1994. At ATBU Prof Sambo strengthened the academic programmes and ensured that all the engineering degree programmes were accredited by both the Council

for the Regulation of Engineering in Nigeria (COREN) and by the National Universities Commission (NUC).

He established the departments of Chemical and Petroleum Engineering as well as three Schools (Faculties): Science Education, Management Technology and the Post Graduate School. For revenue generation Prof Sambo established the University's company, ATBU Trust and Investment Limited and for attracting external projects he established the Directorate of Linkages while for staff welfare he established the institution's Staff Secondary School. At the ECN, being the Government's agency for energy planning, policy formulation as well as advocacy and promotion of sustainable energy practices, Prof Sambo saw to it that the overall National Energy Master Plan was produced and substantial work done on the National Energy Databank as well as the National Energy Master Plan. During Prof Sambo's tenure at the ECN new energy research centres were setup at Bauchi, Benin City, Ilorin and Lagos and two new departments were established at the head office. The energy modelling activities were strengthened by using newly acquired computer modelling tools and the pilot projects of the Commission were also strengthened by securing more funds from the National Assembly. Prof Sambo established the Journal of Energy Planning Research and Development (JEPRD) and modernised the Commission's Newsbulletin.

Prof Sambo has supervised 14 PhD and 10 Masters degree candidates to successful completion and has written more than 200 articles in books, journals, conference proceedings and seminars and workshops. He is registered by COREN to practice as a Mechanical Engineer and he is a FELLOW of the following 9 associations: 1. Nigerian Academy of Engineering; 2. Nigerian Academy of Science; 3. Nigerian Society of Engineers; 4. Solar Energy Society of Nigeria; 5. Nigerian Institution of Mechanical Engineers; 6. Nigerian Association of Energy Economists; 7. Renewable and Alternative Energy Society of Nigeria; 8. Nigerian Institute of Management and 9. Energy Institute of the U. K.He has served as the Vice Chairman for Africa of the World Energy Council from November 2007 to October 2013. He was named the Special Adviser to the President on Energy in July 2011. He is the recipient of two national honours: the National Productivity Order of Merit (NPOM) in 1997 and the Officer of the Order of the Niger (OON) in year 2000. He is happily married and has four children.

Profile of the Lecturer

Engr. Kashim Abdul Ali, PPNSE, FNSE, NPOM, MNIM, FNATE, mni

Engr. Kashim Abdul Ali, was born on June 10, 1958 to the Omale Aliyu family of Ofugo, Ankpa Local Government Area. He grew up under the tutelage of his grandfather for whom he has abiding fond memory. After his secondary school education in Ochaja Secondary School, he wanted to be a fighter pilot, but a wrong blood genotype result however cut short the dream and opportunity for possible exploit and fame, for a young man growing up in a military era. He thereafter proceeded to acquire a Higher National Diploma from Kaduna Polytechnic, then a Bachelor of Engineering degree from the Federal University of Technology, Owerri both in Civil Engineering, and several postgraduate professional trainings, within and outside Nigeria.

Professional Career

Engr. Ali commenced his professional practice with the Benue State Government in July 1982 and was involved in several engineering projects few of which are:

Direct labour construction of the 54m – length Reinforced Concrete Bridge at Ikpa-Mbatierev, on Wannune – Igbor Road;

Planning/Progress Engineer responsible for the collation of designs and co-ordination of the annual Traffic Census for Federal Roads within Benue state;

Resident Supervision of internal roads and civil works in the Commissioners' village and the Benue Hotel Makurdi projects.

Planning, Engineering Design and Direct labour construction of erosion control structures for heavily eroded sections of Anyigba – Idah Road in Kogi State, and part of Katisna –Ala township roads in Benue State.

In 1992, he joined the services of the Federal Capital Development Authority (FCDA) as a Principal Engineer, and rose steadily with a trail of legacy projects in Water supply and railway infrastructure as testimonial.

He was appointed Director/CE of the FCT Water Board in September 2005, where he proved his mettle, when under his leadership the Water Board moved from a distressed public utility enterprise with heavy debt burden, to a buoyant one with surpluses in the first year! He repeated a similar feat in 2012, on the Abuja Rail Mass Transit project, moving the progress status rapidly, and now running its planned schedule.

Engr. Ali has also served nationally in various capacities at different times:

Member, Governing Council of the Nigerian Content Development Board (NCDMB)

Member, Board of the National Inland Waterways Authority (NIWA)

Member, Governing Board of the National Agency for Science and Engineering Infrastructure (NASENI)

Member, Nigeria Integrated Infrastructure Master Plan (NIIMP) Committee

Member, Vision 2020 Steering Committee

Co-Chair, Infrastructure Policy Commission of the Nigerian Economic Summit Group (NESG)

Member, Policy Support Group (Technical Advisory Committee of Nigerian Economic Management Team)

Special Adviser (Utilities) to the FCT Minister

Member, Inter-Ministerial Technical Committee on Additional Potable Water Supply Sources for the Southern Part of the FCT- 2004

An avid and consummate professional engineer and recipient of the World Federation of Engineering Organizations (WFEO) Presidential **Gold** medal, Engr. Kashim is a Registered Engineer, Fellow and Past President of the Nigerian Society of Engineers (NSE) and current President of the Council for the Regulation of Engineering in Nigeria (COREN).

He is also a Member of the National Institute (mni), Nigerian Institute of Management (NIM), the American Water Works Association (AWWA), and member of the governing board of the International Science, Technology and Innovation Centre (ISTIC) for South –

South Cooperation under the auspices of the UNESCO. Engr. Kashim was conferred with the 2016 National Productivity Order of Merit (NPOM) Award by His Excellency, Muhammadu Buhari, GCFR, President, Commander-in-Chief of the Armed Forces, Federal Republic of Nigeria.

He was given the royal titles of **Olimene-Ata** by His Majesty, the AttahIgala and **Galadima Ankpa** by His Highness, the Eje of Ankpa respectively 2008.

A family man and great respecter of women, Engr. Ali enjoys reading, current affairs, travelling, walking and watching extreme sports. He is happily married to Hajiya Hadiza Ali and they are blessed with children.

1.0 INTRODUCTION

The Wikipedia defines **solar energy** as radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics, solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis.

It is an important source of renewable energy and its technologies are broadly characterized as either **active solar** or **passive solar** depending on how solar energy is captured and distributed or its conversion into solar power. Active solar techniques include the use of photovoltaic systems, concentrated 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.

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, enhances sustainability, reduce pollution, lower the costs of mitigating global warming and keep fossil fuel prices lower than otherwise. These advantages are global.

2.0 SOURCES OF ENERGY AND POWER STATIONS IN NIGERIA

There are currently two main types of power plants operating in Nigeria:

a) Hydro-Electric and
b) Thermal or Fossil fuel power plants.

With a total installed capacity of 8457.6MW in early 2014, thermal power plants (gas-fired plants) dominate the Nigerian power supply mix. Electricity production from hydroelectric sources in Nigeria was reported to be 17.59% in 2014, according to the World Bank collection of development indicators, compiled from officially recognised sources.

There are two main types of fossil fuel/thermal power plants in the country:

i. Coal-fired and
ii. Natural gas-fired

3.0 OWNERSHIP OF POWER PLANTS

The following shows classification of power plants based on ownership:

3.1 Fully owned by the Federal Government of Nigeria (NGN).

There is a plan to privatize these power plants.

3.2 Owned by the Niger Delta Power Holding Company (NDPHC).

The NDPHC is owned by the three tiers of Government in Nigeria (Federal, State and Local). These power plants are referred to as part of the **National Integrated Power Project (NIPP)**.

3.3 Wholly owned by state governments and / or private companies / individuals. Such power plants are referred to as Independent Power Plants (IPP).

4.0 CAPACITY, GENERATION AND DEMAND

As of December 2013, the maximum capacity of the power plants was 6,953 MW. Available capacity was 4,598 MW, while actual average generation was 3,800 MW.

As of December 2014, the total installed capacity of the power plants was 7,445 MW. Available capacity was 4,949 MW. Actual average generation was less than 3,900 MW, while the Presidential Task Force on Power's peak demand forecast is 12,800 MW (April 2015).

5.0 FOSSIL FUEL POWER STATIONS

Natural Gas

Power station	Community	Coordinates	Types	Capacity	Status	Year completed	Gas supply source
Afam VI Power Station (IPP)	Afam, Rivers State	$4^0 50' 58'' N$ $4^0 50' 58'' N$	Combined cycle gas turbine	624 MW	Partially operational	2009 (Gas turbines) 2010 (steam turbines)	Okoloma gas plant
Alaoji power station (NIPP)	Abia State	$5^0 04' 00'' N$ $4^0 50' 58'' N$	Combined gas turbine	1074MW	Partially operational	2012 - 2015	Norten Option Gas Pipeline from Obigbo gas plant
Okapi power station (IPP)	Okapi		Combined cycle gas turbine	480 MW	Operational	2005	Obiafu-Obrikom (Ob-Ob) gas plant
Oloruns ogo II Power station (NIPP)	Olorunsongo		Combined cycle gas turbine	675 MW NDPHC (4x112.5MW and 2x112.5MW steam turbines) Working below capacity due to gas supply issues.	Partially Operational	2012	Escravos-Lagos Pipeline System

Power station	Community	Coordinates	Types	Capacity	Status	Year completed	Gas supply source
Ibom Power Plant	Template: I kot Abasi		Combined cycle gas turbine Ibom power plant presently consist of two GE Frame 6B and one Frame 9E turbine generators installed in a simple cycle configuration, using the conventional open cycle gas turbine (OCGT) technology. These three gas turbines are: GTG 1(Model PG 6561B), GTG 2(Model PG 6561B), and GTG3 (Model PG 9171E) combined to give an installed capacity of 191MW.	191MW	Operational since 2009	2010 →	Uquo CPF by frontier Oil Limited / 7E JV}

Power station	Community	Coordinates	Types	Capacity	Status	Year completed	Gas supply source
Egbin Thermal Power Station (FGN but Privatized)	Egbin	6⁰33′47″N 3⁰36′55″E	Gas-fired steam turbine	1320 MW (six 220 MW units) Egbin-Thermal Power Station in Egbin, Nigeria	Partially operational (1000 MW)	1985-1986	Escravos-Lagos Pipeline System
Sapele Power Station-Privatized	Sapele	5⁰55′31″N 5⁰38′44″E	Gas-fired steam turbine and Simple cycle gas turbine	1020 MW (Phase 1: 1978-1980 6× 120 MW Gas-fired steam turbines, Phase ll: 1981 4×75 MW gas turbines)	Partially operational (135 MW)	1978-1981	Escravos-Lagos Pipeline System
AES Barge (IPP)	Egbin	6⁰33′33″N 3⁰36′54″E	Simple cycle gas turbine	270 MW	Non-operational	2001	Escravos-Lagos Pipeline System
Aba Power Station (IPP)	Aba, Abia State	5⁰09′11″N 7⁰18′38″E	Simple cycle gas turbine	140 MW		2012	
Afam IV-V Power Station (FGN)	Afam, River State	4⁰51′05″N 7⁰15′17″E	Simple cycle gas turbine	726 MW (Afam IV-6×75MW(GT 13-18), Afam V-2×138 MW GT 19-20))	Non-operational	1982 (Afam IV)-2002 (Afam V)	Okoloma gas plant

Power station	Community	Coordinates	Types	Capacity	Status	Year completed	Gas supply source
Calabar Power Station (NIPP)	Calabar	5°11′21″N 8°16′25″E	Simple cycle gas turbine	561 MW	Non-operational	2014	UQUO gas plant (planned)
Egbema Power Station (NIPP)	Imo State	5°33′56″N 6°44′18″E	Simple cycle gas turbine	338 MW	Non-operational	2012-2013	Gbarain Ubie gas plant (planned)
Geregu I Power Station-Privatized	Geregu Kogi State		Simple cycle gas turbine	414 MW	Partially operational	2007	Oben-Geregu pipeline, Oben gas plant
Geregu II Power Station (IPP)	Geregu Kogi State		Simple cycle gas turbine	434 MW	Partially operational	2012	Oben-Geregu pipeline, Oben gas plant
Ibom Power Station (IPP)	Ikot Abasi	4°33′53″N 7°34′06″E	Simple cycle gas turbine	190 MW	Partially operational (90 MW)	2009	
Ihovbor Power Station (NIPP)	Benin City	6°24′20″N 5°42′00″E	Simple cycle gas turbine	450 MW	Partially operational	2012-2013	Escravos-Lagos Pipeline System
Oloruns ogo Power Station	Olorunsogo	6°52′55″N 3°18′52″E	Simple cycle gas turbine	336 MW, (8×42 MW)	Partially operational	2007	Escravos-Lagos Pipeline System
Omoku Power Station (IPP)	Omoku		Simple cycle gas turbine	150 MW (6×25 MW gas turbines)	Operational	2005	Agip (Obiafu-Obrikom (Ob-Ob) gas plant)

Power station	Community	Coordinates	Types	Capacity	Status	Year completed	Gas supply source
Omoku II Power Station (NIPP)	Omoku		Simple cycle gas turbine	225 MW (2×112.5 MW gas turbines)	Non-operational	Incomplete	
Omotosho I Power Station (FGN-Privatized)	Omotosho	6°44′09″N 4°42′39″E	Simple cycle gas turbine	336 MW; (8×42 MW)	Non-operational	2005	Escravos-Lagos Pipeline System
Omotosho II Power Station (NIPP)	Omotosho		Simple cycle gas turbine	450 MW, (4×112.5 MW)	Partially operational	2012	Escravos-Lagos Pipeline System
Sapele Power Station (NIPP)	Sapele	5°55′40″N 5°38′41″E	Simple cycle gas turbine	450 MW, (4×112.5 MW)	Partially operational	2012	Escravos-Lagos Pipeline System
Transcorp Ughelli Power Station (privatised) known also as Delta power station	Ughelli, Delta State	5°32′28″N 5°54′56″E	Simple cycle gas turbine	900 MW	Partially operational (900 MW)	1966-1990 plant was built in 4 phases. I: 1966 (decommissioned), II: 1975 6×25 MW, III: 1978 6×25 MW, IV: 1990 6×100 MW	Utorogu, Ughelli East gas plant

Proposed natural gas power plants

Power station	Community	Coordinates	Types	Capacity	Status	Year completed	Gas supply source
Azura Therma Power Station (IPP)	Benin City		Simple cycle gas turbine	1,500 MW	In development	TBD	

Coal

Power station	Community	Coordinates	Types	Capacity	Status	Year completed	Additional Description
Itobe Power Plant	Itobe, Kogi State		Circulating Fluidized Bed Technology	1,200 MW	Planned	2015-2018 (first phase 600 MW)	The first phase consists of four 150 MW units. Actual effort is focused on development mining to establish additional coal resources. The project is actually a 1200 MW power plant to be divided into 4 phases of 2 units each. The project has almost achieved financial close and execution of construction agreement

HYDROELECTRIC POWER STATIONS

In Service

Hydroelectric station	Types	Capacity (MW)	Year Completed	Name of Reservoir	River
Kainji Power Station	Reservoir	800	1968	Kainji Lake	Niger River
Jebba Power Station	Reservoir	540	1985	Lake Jebba	Niger River
Shiroro Power Station	Reservoir	600	1990	Lake Shiroro	Kaduna River
Zamfara Power Station	Reservoir	100	2012	Gotowa Lake	Bunsuru River

Under Construction or Proposed

Hydroelectric station	Community	Coordinates	Types	Capacity (MW)	Year Completed	Name of Reservoir	River
Kano Power Station			Reservoir	100	2015		Hadejia River
Zamfara Power Station			Reservoir	100	2012	Gotowa Lake	Bunsuru River
Kiri Power Station			Reservoir	35	2016		Benue River
Mambilla Power Station	Taraba State	$6^0 41' 46'' N$ $11^0 09' 16'' E$	Reservoir	3050	2018	Gembu, Sum-Sum and Nghu Lake	Domga River

6.0 APPLICATIONS OF SOLAR ENERGY

A. Solar Powered Transportation

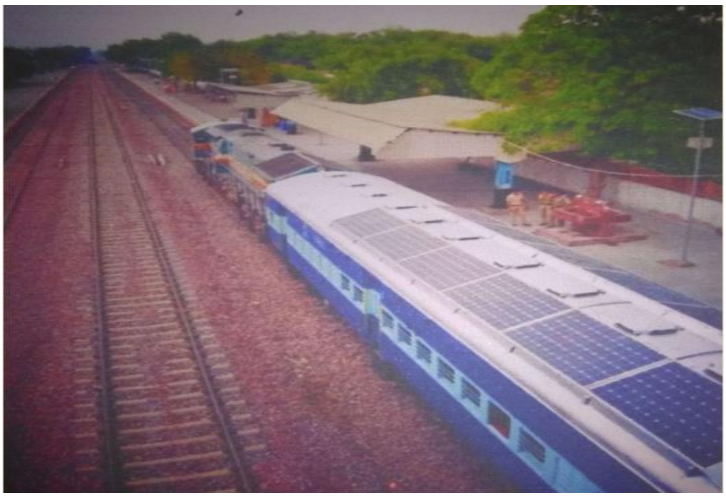

Figure. 1: A Solar Powered Train

An innovative practice to effectively make use of the sunshine is with transportation powered by photovoltaic (PV) energy. Railroads (fig. 1), subways, buses, planes, cars and even roads can all be powered by solar, and solar transit is becoming a popular offering in the renewable energy sector. Recently, the solar powered-aircraft Solar Impulse 2 made its way around the world, soaring across the Pacific and making big splashes in conic photographs. Meanwhile, solar buses are helping China reduce its carbon footprint while simultaneously maintaining efficient mass transit in densely populated cities like Beijing. Finally, solar cars are starting to play a role in racing competitions around the world, especially in Australia where the **Solar Spirit** model has gained major recognition. With these advances and more, there's no question that solar power is transforming transportation sector around the world.

B. Wearable Solar Technology

Powering consumer electronics has become a common solar power use in today's world-solar-powered chargers like Anker's. Power port can charge devices like: cell phones, tablet and e-reader. There are even solar-powered flashlights that can be charged by being exposed to sunlight.

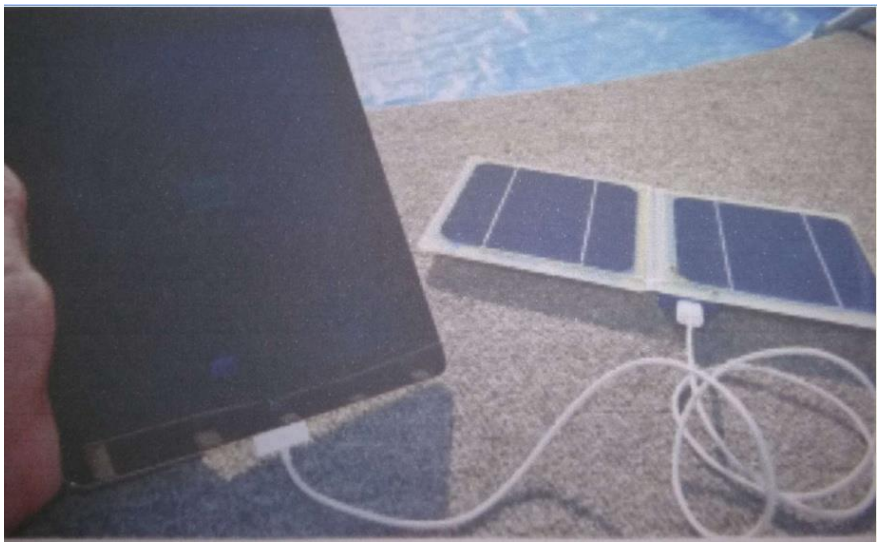

Figure 2: A Solar Phone Charger

Application of solar energy can also be seen in cell phones (fig. 2), wearables, music speakers, solar air conditioning and tablets. Other devices are solar visor radios, freezers/mini-fridges, rechargeable flashlights, thermostats and solar dryers.

As the world moves away from fossil fuels and seeks renewable sources for everyday electronics, there's no doubt that solar will continue to be adopted by the masses for any product that can be exposed to sunlight. The ultimate goal: use solar products to reinvent the way we think about power usage, and reverse the expectation for how devices should be charged. And as the conversion efficiency of solar continues to improve, this trend will expand into new markets and new products.

For example, wearable solar could soon make Apple Watches and Fitbits much more appealing to consumers – unlike their standard counterparts, solar powered smart watches don't need to be plugged in to recharge every night.

C. Solar Lighting

One of the easiest ways to improve home efficiency is to add outdoor solar lighting to your property. Unlike traditional exterior lights, solar lighting requires no complicated setup as the lights are wireless and harness sunlight during the day to circumvent the need for grid-supplied electricity at night (fig. 3). Though solar lights are not yet as common as solar

panels, they are quickly joining the likes of LED light bulbs and smart home thermostats as a cheap product that can reduce electric bills and improve the efficiency of your home.

Figure 3: Solar Powered street light

Additionally, the aesthetic of modern solar lighting can significantly improve the outdoor decoration of a property. Elaborate lighting arrays that can improve the exterior design of a property, are often as cheap as N7, 000 per light. The availability and low cost of these lighting products are added advantages.

D. Solar Heating

Figure 4: Solar Heated water

Many homeowners are unaware that solar heaters and solar space heaters are an effective way to heat one's home without making the larger investment of installing solar panels. Solar space heaters harness sunlight and convert it into thermal energy with the use of liquid or air as a medium (fig. 4), while solar water heaters use water as a method for thermal transfer. These solar heating systems can either be passive or active- while passive systems utilize natural circulation, active systems use pumps to circulate water and generate heat. Homeowners who install a thermal solar array on their roof can expect 5 to 10% returns with a system that costs a fraction of a full solar panel installation.

A major benefit of solar thermal technology is the ability to heat your pool at a more cost-effective rate than conventional alternatives such as oil and gas pumps. According to the U.S. Department of Energy, "solar pool heating is the most cost-effective use of solar energy in many climates."

At its simplest, the technology uses a solar collector that harnesses sunlight and converts it into heat. Water is then drawn through the collector as a means of heating the pool. This technology can also be used to cool the water at night (typically necessary only in hotter climates).

E Rooftop Solar

Figure 5: Solar Powered House

With so many amazing gadgets and devices available under the sun from 2016 and beyond, it's easy to overlook the most important use of solar energy: rooftop solar (fig. 5). While solar energy can be used to fly an aircraft and charge a battery, it can also be used to save homeowners thousands of Naira every year by cutting their energy use, carbon footprint and electricity utility bills. This potential solar saving can serve as an investment of household finance.

7.0 BENEFITS OF SOLAR ENERGY

A. Fuel Sourcing

Fossil fuels must be located, excavated and transported before they can be used. These processes are invasive and detrimental to the land through side effects such as erosion and ecological and geologic instability. Then the deposit or well is depleted. Energy from the sun is infinite and free. It can be harnessed and turned into power anywhere a solar panel can be mounted.

B. Power Generation

Fossil fuels must be burned to produce electricity. Burning them creates unwanted by-products that can create air and water pollution and release huge amounts of greenhouse gasses into the atmosphere. When in use, solar panels produce power without waste or emissions, and do so through a natural process called photovoltaics.

C. Cost of Consumer Electricity

With utility rates climbing regularly, each year, much more is saved with the usage of solar energy.

D. The Human Element

Fossil fuel deposits are scattered and finite. Their economic worth and uncertainty are enough to cause disagreements that can lead to labor strikes, price volatility and even war. Solar energy is available nearly everywhere, and will be for another 5 billion years.

E. Purity

Solar power systems derive clean, pure energy from the sun. Installing solar panels in homes helps combat greenhouse gas emissions and reduces our collective dependence on fossil fuel.

Traditional electricity is sourced from fossil fuels such as coal and natural gas. Solar panels create absolutely no waste or emissions while in use. Unlike fossil fuel power plants, they produce clean, renewable energy from a fuel source that requires no locating, excavation, transportation, or combustion. It's a simple, cheaper, cleaner, and all-round better energy solution.

8.0 SOLAR ENERGY – A WAY OUT OF ECONOMIC RECESSION AND ECONOMIC DEVELOPMENT IN NIGERIA

The increasing demand for electricity, the fluctuating cost of petroleum products, as well as the growing concerns for the preservation of the environment and human health is some of the major factors forcing us to embrace and accept the use of alternative energy sources. Currently there are quite a number of renewable energy sources that are being applied to generate power in order to meet the demands of our growing population. Solar energy is pivotal in this bracket, having gained a fast momentum due to the fact that it is a sustainable alternative option that can be utilised in a lot more ways, and can be deployed for many applications and facilities, as already outlined earlier.

It is basic knowledge that Nigeria as a country is struggling with generating constant and stable power to meet the demand of its energy needs. Exactly the reason the Government is partnering with the UK government to develop a renewable energy solution for the country, tagged the Nigerian –n UK Solar Energy Partnership. This is part of the Energy Africa campaign, intended to bring solar power to millions of homes in the country and help improve the power situation generally. It will also provide employment opportunities for the people, thereby reducing the rate of unemployment in the country. Similar models have been successfully deployed in Kenya and Tanzania.

The aim of this partnership by the UK government is to make an effort to shorten the time required for universal electricity delivery, by involving various arms of the government in Nigeria. This will bring economic benefits to many regions, because most of the projects will be located away from the urban centres which will help stimulate economic activities, generate revenue and bring about sustainable development in local communities.

Solar energy has been rightfully chosen because it is a renewable energy source of choice, and is good for our energy portfolio. They are inexhaustible and they do not contribute to the

pollution of the environment, i.e. they do not emit harmful pollutants and gases into the atmosphere.

Moreover, all parts of the country have access to sunlight, so harnessing this source of renewable energy would be a good democratising force, offering affordable and abundant power supply to everybody in the country and promoting economic development.

9.0 CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion

In the course of this discuss, solar energy has been clearly defined, key energy sources have also been identified and analysed in terms of benefits, value for money and environmental impact. The benefits of solar energy, which includes easy access, purity, and economics, have also been brought to the fore. Given the potentials of solar energy to support transportation, mobile power support, lighting, heating and domestic power supply, it can be concluded that solar energy can indeed lead our beloved country out of the embarrassing energy crisis that we are presently confronted with, in addition to stimulating economic activities in those critical areas that grow the GDP.

9.2 Recommendations

In the light of the fore-going, the following recommendations are proffered:

i. That the energy policy has to be reviewed to give the deserved pride of place to solar energy, given its vastness and availability in all parts of the country;
ii. The solar Energy Society should upscale its advocacy to create knowledge base in all segments of the society to appreciate the potent potentials of solar energy as an energy source of choice;
iii. The Nigerian government should invest more in Solar energy Research and Development using the NASENI, University of Sokoto and other indigenous platforms, with a view to banning the importation of solar panels into the country in the shortest possible time.

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