

**Book of Abstract of the
4th International Conference/Training Workshop
on Energy for Sustainable Development in Africa**

**Energy Solutions for Attainment of Sustainable
Development Goals in Africa**



11th – 13th November, 2020

**Energy Commission of Nigeria
National Centre for Energy Research and Development
University Of Nigeria, Nsukka
In Collaboration with the
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4th ICTWESDA, 11th - 13th November, 2020, NCERD, UNN

Contributed Papers



Technical Session A: Energy and other related issues

Chair/Moderator: Prof. P. Ejikeme

Day One:

Rapporteur: Engr. Gerald Akubue

Wednesday, November 11, 2020

Time: 13:00 - 14:40 PM

Zoom Code Link:

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Paper AI ICTWESDA 02: First-principles investigation of the electronic and thermoelectric properties of SiGe doped with Sn and one percent B

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Abstract

Silicon-Germanium (SiGe) has recently attracted much interest as a room temperature thermoelectric (TE) material for converting heat into electrical output power. With the advantage of silicon being non-toxic, cost-effective, and abundant on earth, a silicon base TE material has a promising future. A first-principle calculation based on the fully self-consistent Korringa-Kohn-Rostoker method with the coherent potential approximation (KKR-CPA) to treat several forms of chemical disorders of SiGe by Sn-doping was carried out. In $\text{SiGe}_{1-x}\text{Sn}_x$, as the Sn content increases the Fermi level shifts to the conduction band edge. Similarly, in $\text{Si}_{1-x}\text{Sn}_x\text{Ge}$, a high Sn content ($x = 0.4$ to 0.9) results in the Fermi level shifting to the conduction band edge. On the contrary, a low amount of Sn content ($x = 0.1$ to 0.3) causes the Fermi level to fluctuate between the conduction band and the valence band states. With the addition of 1% Boron impurity to the alloys $\text{Si}_{1-x}\text{Sn}_x\text{Ge}$ and $\text{SiGe}_{1-x}\text{Sn}_x$, the number of carriers (electron and hole) states was enhanced by 0.05 states/eV. This makes the alloys $\text{Si}_{0.3}\text{Sn}_{0.69}\text{B}_{0.01}\text{Ge}$ and $\text{SiGe}_{0.4}\text{Sn}_{0.59}\text{B}_{0.01}$ promising for application as n-type electrodes in a thermoelectric generator (TEG).

Keywords: *Silicon Germanium, first-principles, thermoelectric material, KKR-CPA.*



Paper A2 ICTWESDA 011: Multi-Power Source and Cloud-Backup Enabled Security Framework for Surveillance in Nigeria

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Abstract

In Nigeria, power is one of the major problems and this deters the reliability and effectiveness of a video surveillance system as the case may be. Also, as criminal organizations tend to destroy every physical storage after an operation, providing a suitable backup to the cloud is a viable solution to serve as a failsafe plan in case of hardware eventualities. This work focuses on the design and construction of a real-time power and data backup surveillance system for security of lives and properties. Construction of a sufficient power bank backup system was developed in real time with average power outage duration in Nigeria considered. A lithium ion battery with a cascade connection was used to provide alternate power to the system in a situation of power outage. An Arduino microcontroller controlling relay modules was used to ensure optimum battery life and efficiency and an IP camera was used for surveillance as well as cloud storage. This research was implemented and evaluated to measure the efficiency of the system. The results show that the entire system has the capacity to switch between the direct power source and the alternative power source; it could last for 100-156hours after full charge in absence of power supply. The data backup was stored to a secured cloud and could only be accessed by authorized users when such is required.

Keywords: *Security, Surveillance, Cloud Computing, Energy, Microcontroller*

Paper A3 ICTWESDA 015: Politics of Energy Sustainability And Adoption Of Modern Day Best Practices: Nigeria In View

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Abstract

The study examines the problems of electricity generation; challenges encountered and proffer solutions to the epileptic electricity supply in Nigeria. The study was a descriptive survey. Three research questions and two hypotheses guided the study. The population comprised 1870 EEDC staff. A sample size of 532 was used for the study. Data were collected through questionnaires, key informant interview (KII) and analyzed



using thematic analysis, mean and ANOVA. The results showed that systemic corruption, etc. were behind insufficient power generation. The study found out that policies implemented to reform power sector is faced with emerging challenges stretching from inadequate infrastructure, inconsistent government policies and huge metering gap. The study also discovered that the solutions to the erratic power supply lies strongly on the decentralization of power sector, building capacity for local manufacturing and repairs of renewable power systems. The paper recommends that government demonstrate some degree of political willingness by formulating and implementing consistent policies, reforms to attract more local and foreign investors into the power sector.

Keywords: *Politics, Energy, Sustainability, Electricity, Nigeria*

Paper A4 ICTWESDA 016: Global Oil Price Changes, Drivers and Key Indicators with Reference to Africa Energy Security – Outlook for 2025 and Beyond

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Abstract

Recent collapse in oil prices around the world from 2014 – 2016 and 2019/2020 has been reported as the most significant downward trend in the history of oil price glut. The COVID 19 pandemic caused additional fall to crude oil price expectedly, given the dynamics of demand and suppl. Following world economic shut down, crude oil prices dipped to all time low. Global economies were heavily impacted by the crude oil price drop and Africa, which is known to be at the top of receiving end of fluctuating oil prices historically, once more suffered negative consequences. Africa energy security and sustainability becomes paramount following the continued negative impact of global oil prices change on the continent. Issues with crude oil transportation, storage and accessibility in Africa remain significant. Nigeria, whose economy is predominantly dependent on revenue from crude oil, witnessed another round of devaluation of the naira and with inflation in the negative direction due to the collapse in oil price. This paper focused on global energy security and sustainability in Africa. It explored the windows of opportunities in areas of transportation, storage and distribution of refined petroleum products and in advanced world and how Africa can adopt such methods. It looked at how Africa can take advantage of the advanced technology deployed in conventional petroleum development globally and in unconventional areas like nuclear, solar and wind energy. The results considered how Nigeria can be preserved from negative oil prices and the technologies available to boost her petroleum industry, particularly developments of unconventional resources beyond 2025 and sustainability of energy security within the polity. Suitable alternative and the sustainability of refined petroleum transportation and distribution is critical with reference to energy security in Africa

Keywords: *Energy Security, Drivers, Global Oil price*



Paper A5 ICTWESDA 028: Optimization of NaOH Treatment Conditions of Baobab Pod Fibres Using Box-Behnken Method

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Abstract

Natural fibres are suitable materials that represent an opportunity to partially minimize on the environmental impacts by integrating them in place of synthetic fibres because of their low cost, biodegradability, low density and renewability. This work is aimed at studying the effect of chemical treatment conditions on the Mechanical properties of baobab fibres. The tensile strength and young modulus of baobab fibres were investigated. Design expert V10 software was used to analyze the experimental data. Results were processed using analysis of variance (ANOVA) technique, namely the Box-Behnken method. The effect of NaOH treatment on functional group, surface morphology and crystallinity of fibres were also investigated. The results indicated that within the limits of treatment conditions used in this study, the proposed models adequately predicted the fibre Tensile Strength and Young Modulus.

Keywords: Baobab fibres, mechanical properties, NaOH treatment, ANOVA

Paper A6 ICTWESDA 032: Supervisory Control and Data Acquisition System in Renewable Energy Management for Sustainable Development in Nigeria

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Abstract

Renewable energy resources has come to stay as a non- fossil energy source but the proper technological devices that will drive and control the sector ranging from manufacturing of relevant components, monitoring and controlling these utilities, maintenance strategies, suitable Machine Vision apparatus, management techniques such as Programmable Logic Control PLC, Supervisory Control and Data Acquisition System to ensure the sector is set to compete on the long run. This paper examined the use of web based application in energy management in Nigeria using PLC and SCADA. Renewable energy utilization and recommendations were discussed and conclusion made that web base application software is an essential ingredient in energy management in Nigeria.



Keywords: *Smart grid; Substation Automation; Remote Terminal Unit RTUs, SCADA Communication Systems; and Master Station.*

Paper A7 ICTWESDA 033: Adoption of appropriate technology for building construction in the tropics; a case of Nigeria

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Abstract

Construction technology from the West has played a vital role in building construction in the Tropics. Due to the level of organization, capital and personnel, some cities within Africa can absorb the latest technology faster and better than other cities; thus, their construction development projects using the western borrowed and learned technology has been verbatim and most times, excessively done. This trend, which cuts across many regions of tropical Nigeria leads to the neglect of folk wisdom. Local construction wisdom is usually substituted for new technology without the geography of the area being considered. In 1996, the economic crisis caused the construction business to come to a halt. The cost of oversea technology significantly increased due to the baht flotation policy. Several manufacturers and contractors went bankrupt at that time, including owners of small property in remote parts. While it seems that construction problems from the past are being alleviated, some signs of financial crisis are still evident in recent times. To prevent such future reoccurrence, the study focuses on appropriate construction technology to create social resilience and promote sustainable development. Utilizing literature review research methodology, the concept of appropriate technology is examined, highlighting the appropriate construction technology for the industry in Nigeria's tropical environment. Photographs of existing building of historic and contemporary architecture were collected and used as a basis for analysis of building construction technology. Benefits and hindrance of appropriate technology are discussed and the research concludes that the only way to achieve economic, social and environmental justice and sustainability is by the adoption of this appropriate technology.

Keywords: *appropriate technology, tropical environment, sustainability, construction, Nigeria*



Paper A8 ICTWESDA 034: Outdoor Performance Evaluation and Modelling of Polycrystalline Photovoltaic Module in Minna, Nigeria

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Abstract

Outdoor characterisation and performance evaluation of Photovoltaic (PV) modules is needed for efficient PV power system. Outdoor assessment of polycrystalline silicon PV module was done in North Central Nigeria, using Campbell Scientific CR1000 software-based data acquisition system. The PV module under test and meteorological sensors were installed on a metal support structure at the same test plane. The data monitoring was from 08.00 to 18.00 hours each day continuously for a period of one year. Maximum value of module efficiency of 10.91 % for the module was recorded at irradiance of 375 W/m². At 1000 W/m² the efficiency reduced to 6.20 %, as against manufacturer's specification of 48 % for the module. The maximum power output achieved for the module at irradiance of 1000 W/m² was 1.323 W representing 13.23 % of the manufacturer's power specification for the module. Accordingly, Module Performance Ratio (MPR) for the PV module is 0.13. The rate of variation of module response variables with irradiance and temperature was determined using a linear statistical model given as $Y = a + bH_g + c T_{mod}$. The coefficient of determination for the fits for the performance variables are: 69.1 %, 93.1 %, 62.4 % and 88.9 % for the open-circuit voltage, short-circuit current, power and maximum power respectively. The overall lack of fit tests for these performance variables is significant at probability, P value of 0.000, signifying good fits. The approach performed creditably as compared with measured data, therefore, it is resourceful

Keywords: Ambient; Module; Photovoltaic; Polycrystalline; Statistical-model



Paper A9 ICTWESDA 037: Centralized electricity grid and the rural economy in Nigeria

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Abstract

Electricity is necessary for economic development and no doubt, the best way to ensure adequate supply is through the grid. Nigeria operates a centralized grid system and little is known about how the centralized grid system impacts on the rural economy. This paper examines the impact of the centralized electricity grid on rural electrification and rural economy of Nigeria. Questionnaires were employed to generate data, from 894 respondents in three senatorial districts, in Imo State. Data analysis was conducted using descriptive and inferential (X^2 - Chi square) statistics. Result shows that the electricity situation in rural areas is abysmal. Consequently, rural living standard is very low, due to lack of income opportunities. It is concluded that given Nigeria's large geographical size, the centralized grid rural electrification is fundamentally inadequate. A decentralized electricity structure with emphasis on mini-grids and a priority on localized generation is recommended.

Keywords: *Rural economy, Centralized electricity grid, Nigeria, Imo State, decentralized electricity structure*

Paper A10 ICTWESDA 041: Development of Carbon Fibre Reinforced Natural Rubber Composite for Vibration Isolation

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Abstract

This study is based on readily available materials within the locality. The extraction of carbon fibre from periwinkle shell is to reduce the high cost of processing carbon fibre from petroleum pitch and to serve as reinforcement to the natural rubber resin. The fibre was activated using potassium hydroxide (KOH) followed by characterization through XRF, tensile test, hardness and impact test. On forming the composite, the reinforced material was calculated on percentages: 10%, 20% and 30% and added differently to 220grams of natural rubber resin. The samples were then prepared for various tests analysis based on ISO and ASTM standard to determine the composite strength in



comparison with the natural rubber for vibration isolation. The basis for this comparison is because natural rubber is widely used as a vibration isolator. The result shows an increased in tensile strength of the composite to 0.20 mega Pascal as against 0.09 mega Pascal of natural rubber resin, good strain rate for improved isolator life and high resistance to thermal expansion.

Keywords: *Activated Carbon Fibre, Composite Materials and Vibration Isolators*

Technical Session A: Energy and other related issues

Chair/Moderator: Dr. Maxwell Omeje

Day Two:

Rapporteur: Dr. Okala Nwoke

Thursday, November 12, 2020

Time: 12:30 - 14:00 PM

Zoom Code Link:

<https://us02web.zoom.us/j/87133613772?pwd=MWpicFdQUIRDKzcwaUpoMIIZZDFMZz09>

Paper A11 ICTWESDA 042: Design And Analysis Of A Butt Welded Pressure Vessel Reactor

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Abstract

This article is focused on the behavioural analysis of butt welded joints of a carbon steel pressure vessels reactor under certain conditions to determine a safe operating condition of the system. ANSYS was used to simulate and evaluate the butt welded joints. The welds were analyzed under load, thermal and fluid flow conditions so as to determine the optimum condition under which the welds and system may deform or become compromised. Simulations showed that the values of induced stress and strain obtained under a thermal load of 160Mpa were 610.10Mpa and 0.0069, respectively. In addition, the maximum principal stress and strain-induced on the butt welded joints under 160 MPa load condition were 1.096x105 Mpa and 0.445, respectively. It can be concluded that the deformation on the system due to residual stresses developed around the heat affected zone of the butt weld will not cause the system to fail.

Keywords: *pressure vessel, welding joints, butt weld, modelling, FEA, ANSYS*



Paper A12 ICTWESDA 043: Optimization Of Nigeria's NIGCOMSAT-1R Earth Station Using Machine Learning

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Abstract

Satellite Communication (SATCOM) is the use of artificial satellites to provide communication links between various points on Earth. On the 11th of November 2008, NigComSat-1 failed in orbit after running out of power due to an anomaly in its solar array. The NigComSat-1R was its replacement having the capacity for aggregation, monitoring and transmission of over 100 direct to home television channels as well as capacity for security monitoring. However, no Pay TV outfit is currently on the satellite. This is partly due to poor link reliability hence the need for the SATCOM link optimization. In this research, machine learning and the firefly algorithm were used to optimize Nigeria's NIGCOMSAT-1R satellite by modeling and calculating the performance of link budget of the SATCOMs earth station in terms of antenna power, transmission efficiency for uplink and downlink, fade margin estimate and carrier to noise ratio. The firefly and machine learning algorithms provided an optimized value of 106.27dB for 274mm/hr rainfall rate with corresponding Mean Absolute Error (MAE), Mean Square Error (MSE) and Root Mean Square Error (RMSE) value of 0.230, 0.064 and 0.048.

Paper A13 ICTWSEDA 045: Security Considerations for Interactive PHP Web applications

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Abstract

There is a rising tendency of moving away from desktop applications towards interactive web applications in seeking for robust and effective enterprise solutions. A key setback to this is the inherent security challenges that characterize the Web. This paper presents an overview of the potential risks of SQL injection and other threats faced by PHP Web applications and briefly describe simple coding techniques that help to avoid them. The work is based on experience in developing an interactive students' portal for a large university.

Keywords:



Paper A14 ICTWSEDA 046: Power Sub- Sector Restructuring And Sustainable Development In Nigeria

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Abstract

The availability of sufficient and quality electricity drives the industries and not machineries; hence the development of any economy is a technical function of stable, sufficient and affordable electricity supply. This study is on the Nigerian energy sector restructuring as a key for its sustainable development. The objective of is to examine the prevailing energy policies vis-à-vis the level of development and suggesting restructuring strategies for sustainable development. The study used the content analysis approach while the scope spans from 1970 to 2019. The study reveals that electricity per capita is 0.016 watts or 16 kilowatts representing one of the lowest in the world. Findings further reveal that renewable energy and its sources are underdeveloped thus underutilized. It is therefore concluded that the existing energy structure in Nigeria prevents sustainable development. The study recommends a total decentralization of electricity generation, transmission and distribution.

Keywords: *Sustainable development, power generation, transmission, distribution and energy*

Paper A15 ICTWESDA 053: Condensation inside smooth and inclined smooth tubes at low mass fluxes: A quick review

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Abstract

This paper gives a quick review of state of the art review on condensation in smooth and inclined tubes with particular emphasis on low mass fluxes. The most relevant experimental investigations during condensation inside horizontal and inclined smooth tubes are explained with a view to identifying the gaps in the literature. Overall, it can be deduced that at low mass fluxes, there needs to be a fundamental understanding between the relationship between of temperature difference and inclination on heat transfer and pressure drops to enable designers optimize heat exchangers.

Keywords: *condensation in smooth and inclined tubes low mass fluxes, heat transfer, pressure drops*



Paper A16 ICTWESDA 055: The Comparative Analysis of Graphene Nano-based and Copper Nano-based Patched Antenna using HFSS

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Abstract

Patch material plays a significant role in controlling the performance and resonating frequency of patch based antennas. In this work, we compared graphene and copper nano-based patch antennas in terms of return loss, bandwidth, gain, directivity and voltage standing wave ratio (VSWR). The simulation is carried out using high frequency structure simulator HFSS. The substrate material used is Silicon dioxide. The antenna is designed to operate in the THz frequency band of (1-15THz) with the fundamental frequency of 5.5THz. The result shows that, the classical metallic antennas with copper material resonant at lower frequency of 3THz while graphene resonant at the higher frequency of 7THz, this is due to high electrons mobility in graphene than in copper. Graphene based patch antenna achieves maximum return loss of -24.4555dB with the corresponding VSWR of 1.0413. The maximum gain of 7.1943dB is achieved with a bandwidth of 522.3GHz; this shows better antenna performance than copper except the bandwidth. The contemporary copper antenna attains return loss of -14.7028dB with the corresponding VSWR of 3.2336. The gain of 4.6219dB is achieved with a bandwidth of 1188.5GHz. With this result, it can be seen that graphene is a suitable choice and can replace copper patch material for patch antennas for wireless applications in terahertz frequency band.

Keywords: *graphene, terahertz frequency, bandwidth, patch antenna*

Paper A17 ICTWESDA 062: Review of Voltage Stability Indices

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Abstract

Voltage stability indices (VSIs) are very vital to voltage stability assessment; they have several areas of application such as distributed generation (DG) placement and sizing,



detection of the critical regions, lines and buses and contingency ranking and planning. These indices can be used to activate countermeasures against voltage instability. This article examines voltage stability indices with particular focus on line VSIs, and it highlights the classification, accuracy of VSIs, and enumerates for some selected line VSIs drawbacks and advantages. The review results provide an in-depth look into line VSIs and advice on the selection of appropriate stability indices for applications such as voltage stability assessment and optimal positioning of DGs to improve efficiency.

Keywords: *Voltage stability, Line Voltage Stability Index, DG placement and sizing, planning, accuracy*

Paper A18 ICTWESDA 079: Mesh Sensitivity Assessment on 2D and 3D Elastic Finite Element Analysis on a Compact Tension Specimen Geometry Using Abaqus/CAE Software

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Abstract

Finite element analysis has been a tool mostly employed by engineers to conduct stress and strain analysis of a given specimen geometry, after which the numerical and analytical results are compared for validation. The validated results can then be used to predict the stress/strain and fracture mechanics behavior of more complicated structures/components. In this study, Abaqus/CAE software was employed to conduct 2- and 3-dimensional (2D and 3D) elastic finite element analysis on compact tension C(T) specimen geometry, given a specimen width of 50mm, thickness of 25mm, initial crack length of 25mm and total applied load of 1000N. Comparisons of the predicted stress distributions along both X and Y directions (S11 and S22) from the 3D model and those of 2D plane stress/strain obtained from mesh sensitivity results were made. The highest maximum stress values along X and Y directions for 2D plane stress/strain were found to be 297.144Pa and 413.51Pa respectively, while the lowest maximum stress values of 121.681Pa and 166.614Pa for 2D plane stress, 118.121Pa and 165.049Pa for 2D plane strain in the X and Y directions respectively were recorded. Similarly, the highest and lowest maximum stress values for 3D plane stress along X and Y directions were 333.8588Pa and 474.417Pa, and 124.458Pa and 173.422Pa respectively. The stress values were found to increase as the mesh get finer, and also convergence start to initiate as the mesh refinement continued.

Keywords: *Abaqus, Elastic, Finite Element, Stress, Strain*



Paper A19 ICTWESDA 082: Rural household energy and implication for indoor BTEX levels in Nigeria

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Abstract

In spite of the fact that household energy and fuels may contribute to indoor air VOC pollution, there is limited information on exposure studies in rural Nigerian homes. By means of a survey conducted in Iheaka and Umuitodo rural communities between 2017 and 2019, we sought to establish the prevalence of various household energy sources in the rural areas, and identify the barriers to uptake of clean technologies and fuels. The indoor (kitchen and living rooms) and ambient concentration levels of BTEX were monitored in 8 randomly selected households for 7 days during the dry season in the Umuitodo. The compounds were sampled in the air by placing Tenax tubes axial diffusive samplers (Markes, Llantrisant, UK); at distance of about 1 meter from the cooking spot and a height of 1.5m above ground. Quantification of BTEX was by thermal desorption Gas chromatography /Mass spectrometry (TD-GC/MS). Majority (89%) of the respondents are not aware of renewable energy. Most households use kerosene (85%) and firewood (90%) as the lighting and primary cooking fuels respectively. More than half of the residents reported eye discomfort (65%) and tears/watery eyes (52%) during cooking in the study areas. The mean indoor levels for benzene, toluene, ethylbenzene and xylenes (sum) were respectively 58.8 ± 43.5 , 29.8 ± 17.6 , 4.9 ± 2.3 , $20.5 \pm 8.9 \mu\text{g}/\text{m}^3$ for kitchen and 15.8 ± 33.8 , 12.5 ± 15.1 , 2.4 ± 2.3 , $16.6 \pm 13.4 \mu\text{g}/\text{m}^3$ for living room. The I/O ratio with respect to the kitchen were 2-48, 2-22, 2-12 and 2-12 respectively for benzene, toluene, ethylbenzene and xylenes (sum) respectively indicating kitchen indoor BTEX sources in the study area.

Keywords: Rural household energy, indoor BTEX, Nigeria



Paper A20 ICTWESDA 087: Addressing Household Cooking Fuel Options In Nigeria

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Abstract

Households constitute the most significant sector in energy consumption in Nigeria. A plethora of energy source endowments exists to fulfill this demand. However, addressing the cooking fuels need arises due to issues relating to economic, health and environmental challenges. This necessitates empirical evidence to effect national efficient choice making and policy formulation to entrench modern energy services. Mixed methods of analysis were employed to assess the economics of household cooking fuel choice, and policy option that would enhance productivity and inform policy for rapid economic growth and environmental sustainability in Nigeria. Given the study findings from survey, the next best alternative household energy for cooking in Nigeria is liquefied petroleum gas (LPG). Unimproved solid fuel use contributing 69.1% and 68.6% clearly dominates the household energy cooking choice over the five year period 2013 and 2018 despite its deleterious effects on the health, productivity and environmental sustainability of the economy. Government support and policy should be used to address the existing energy trilemma of productivity growth, access and security, and environmental sustainability to the economy by effectively utilizing the natural gas (LPG) endowments of Nigeria that was little used of as household cooking fuel choice in the ratio of 2.3% and 14.0% over the same period.

Keywords: *households cooking fuel, natural gas, productivity, climate change, and environmental sustainability.*

Paper A21 ICTWESDA 090: Applications of Audio Visual Aids in Teaching and Learning English Language for Self Reliance and Sustainable in Benue South Senatorial District of Benue State, Nigeria

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Abstract

Application of Audio – Visual Aids in Teaching and learning in Schools in Benue South Senatorial District is essential and critical to modern teaching and learning process. The purpose of this study is to apply audio visual aids in schools in Benue South Senatorial District of Benue State, this research work is a descriptive survey research and one



thousand (1000) researchers will be selected from the population of eighteen thousand (18,000) people through simple random sampling. The research will also look at the advantages of Audio Visual Aids as Audio visual aids like television and radio makes the lessons to be simple, clear and more understandable. Audio visual enables the students to perform well in examination. Audio visual aids reduce the complex nature of teaching English language. It helps the students to recall lessons in English language. Audio visual enables the students to gain proficiency in English language. Recommendations will be made from the researchers that use of audio/visual as teaching aids in the teaching of languages in school system paramount.

Keywords: *mother tongue, audio aids, visual aids, English laboratory and second language*

Paper A22 ICTWESDA 093_Design of a Smart Electrical Energy Meter with Theft and Consumption Report

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Abstract

As energy demand all over the world continues to grow there is also an ever increasing intent by some utility customers to bypass their energy meters, an act referred to as energy theft; this contributes to the ATC&C (Aggregate Technical Commercial and Collection) losses experienced by distribution utilities, a situation that is worrisome and is responsible for the huge low return on investment to DISCOs in Nigeria. This paper focuses on improving the functionalities of energy metering devices by upgrading them from just being STS (System Transfer Specific) one-way communication to AMI (Advanced Metering Infrastructure) two-way communication smart devices. The meter has added functionalities of real time tamper report and user consumption request via SMS. This is made possible with the introduction of micro switches to the chassis of the meter, conduit housing the entry cables and the dedicated report request button. This is implemented to trigger a connected PIC microcontroller in event of a change in any of their digital states as monitored by the microcontroller and instructions in software code using the C programming language. This product in practise will increase distribution utility company's investment on return as customers will be cautious not to engage in energy theft (Tampering of Meter installation).

Keywords: *Potential transformer, Current transformer, PIC18f45k22, Theft, tamper, Meter*



Technical Session B: (1) Solar thermal

Chair/Moderator: Dr. Finba Odoh

Day One:

Wednesday, November 11, 2020

Rapporteur: Mr. Kevin Agbo

Time: 13:00 - 14:40 PM

Zoom Code Link:

<https://us02web.zoom.us/j/81279877650?pwd=N1VQMVZGWWEJDQkhJNG9KNEtUTXpOZz09>

Paper B1 ICTWESDA 040: Preliminary results of a hybrid solar treatment system for water purification

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Abstract

Lack of access to potable water by a significant percentage of the populace in developing countries contribute immensely to the millions of deaths and billions of illnesses recorded annually from water borne diseases. A hybrid solar (thermal and photocatalytic) water treatment (HSTPWT) system was developed with the view of improving access to potable water hence curb the menace of water borne diseases. The HSTPWT system uses the thermosyphon mechanism of natural circulating solar water heating systems as its water pumping mechanism unlike other continuous flow solar photocatalytic systems in which a mechanical device requiring electrical power is used for water circulation. In addition to this natural circulating pumping mechanism effected by the flat plate collector, it harnesses solar thermal energy to pasteurize the circulating water. The photocatalytic reactor of the HSTPWT system harnesses solar ultra violet radiation for advanced oxidation processes of the system. With a flat plate collector measuring 0.8 m by 0.7 m (0.4 kWth) and an optimal catalyst concentration of 0.15 g/L of TiO₂ (P-25) immobilized on two glass rods in the photocatalytic reactor, the system treats on the average, 10.4 litres of water on a sunny day. The HSTPWT system consistently inactivated *E. coli* of 10⁶ (± 105) CFU/ml in water to concentrations below the detection limit of 4 CFU/ml. The percentage degradation of the HSTPWT system for methylene blue concentrations of 5 mg/L and 10 mg/L in water was 99.9% (± 0.01) and 70% ($\pm 3\%$) respectively. These results suggest that the HSTPWT systems could effectively be deployed for the disinfection and mineralization of mild concentrations of organic contaminants in water. The developed HSTPWT system is envisioned as a model for the treatment of filtered roof harvested rainwater for potable uses in homes and communities.

Keywords: *Water treatment, solar, thermal, photocatalytic, E. coli, methylene blue*



Paper B2 ICTWESDA 066: Influence of Rim Angles and Non-uniform Heat flux Distribution Boundary on the Internal Heat Transfer Coefficients of an Absorber Tube for a Parabolic Trough Solar Collector

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Abstract

The parabolic trough solar collector has been the most popular solar concentrator among other concentrating collectors due its successful application in solar electricity generation. This study investigated the influence of collector rim angles and non-uniform heat flux distribution boundaries on the internal heat transfer coefficients of an absorber tube for a parabolic trough solar collector. Laminar flow steady-state condition was considered where buoyancy effects were significant. Numerical simulation was conducted in ANSYS Fluent version 14.5. Sinusoidal non-uniform heat flux distributions boundary conditions were implemented via a user defined function in Fluent. It was found that the absorber tube-wall temperature increased with an increase in the collector rim angle and the circumferential span of the non-uniform heat flux distributions boundary. It was also found that due to the buoyancy-driven secondary flow present, the average internal heat transfer coefficient increased more than twice higher than the pure forced-convection case (no secondary flow effects), and indicating heat transfer enhancement due to the buoyancy effects. Also, with the buoyancy effects present, the average internal heat transfer coefficient increased with the heat flux intensity, the collector rim angle and the circumferential span of the non-uniform heat flux boundary. It was further found that the average internal heat transfer coefficient increased with an increase in the absorber tube inlet fluid temperature.

Keywords: *collector rim angle, non-uniform heat flux, internal heat transfer, secondary flow effects*

Paper B3 ICTWESDA 74: Development of a Steam Powered Incubator with Solar Supported System

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Abstract

This paper reports the development of incubator powered by steam generated from boiled water coupled with the inner components and micro –controller being supported by solar system. The eggs incubator was designed to be powered by steam as the source of energy. The materials selected for the fabrication of the incubator were plywood,



aluminum foil, gas cylinder and aluminum condenser pipe. The inside of the plywood wood was coated with aluminum foil in order to prevent heat loss and six electric bulbs were introduced to complement the heat source. Three D.C fans of 1.3A rating each were also added for uniform distribution and circulating of heat. All these components were controlled by an integrated micro-controller circuit by sensing and processing the data (temperature and humidity). The temperature, humidity and egg turning mechanism were controlled and regulated by configuring micro-controller based on the operating conditions of the incubator. The performance evaluation of the designed incubating machine was carried out for the period of 18-28 days. The incubating temperature range of (37-39 °C) was maintained throughout the incubating period, and the relative humidity ranged from 45% to 60% was also maintained.

Keywords: *Micro –Controller, Steam, Temperature, Incubating.*

Technical Session B: (2) Thin films, Solar photovoltaic and energy storage

Paper B4 ICTWESDA 013: Advancing Energy Storage Technology through Hybridization of Supercapacitors and Batteries: A Review on the Contribution of Carbon-Based Nanomaterials

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Abstract

Fast depletion of fossil fuel and other non-renewable energy resources with their negative environmental impact have raised the quest for eco-friendly and sustainable energy resources. Sustainable energy resources such as solar and wind energy are periodical. Therefore, such energy resources can only be effectively utilized with advanced energy storage technology. Currently, various energy storage technologies such as batteries and supercapacitors are available with various energy storage properties. For instance, batteries are characterized with high energy and low power density. On the other hand, supercapacitors are low energy and high power density



devices. The high power density of supercapacitors results to their faster charging and discharging capability compared to batteries. While batteries can accommodate higher energy compared to supercapacitors. Therefore, to obtain single energy storage material/device with both high energy and power density is a challenge in the energy storage sector. However, various efforts have been made to address this challenge through combinations of various materials or devices. For instance, carbon-based nanomaterials such as graphene and carbon nanotubes have been extensively studied in design of supercapacitors for high energy storage density. While supercapacitors and batteries have been hybridized on the effort to obtain energy storage device with both high energy and power density for advanced energy storage technology. Therefore, this review looks into the contribution of carbon-based nanomaterials in improving energy storage density of supercapacitors and their hybridization with batteries as the way forward to obtain energy storage materials/devices with both high energy and power density for advanced energy storage technology.

Keywords: *Battery, Supercapacitor, Carbon and Nanomaterials*

Paper B4 ICTWESDA 023: Cost Analysis of Building Integrated Photovoltaic (BIPV) System for Urban Home in Nigeria

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Abstract

Building integrated photovoltaic (BIPV) based system is gaining popularity in Nigeria due to the incessant blackout and cost of fuelling petrol generators. However, one of the reasons for slow installation of the BIPV is the cost of the entire system which includes PV modules, storage battery, inverters, etc. This paper analyses the factors that determine the cost of the BIPV system such as building load, and the autonomy of the storage battery. Some electrical appliances were used to develop different load profile for an urban building. The different load profile and the battery depth of discharge (DoD) and autonomy of the battery bank were used to analyse a sustainable and cost effective BIPV system. The paper reveals that a sustainable cost effective BIPV system for urban homes in Nigeria is determined by the type of electrical appliances used, and the appliances usage pattern. Also, the cost of the system is also affected by the depth of discharge (DoD) and autonomy of the battery bank as revealed in the paper.

Keyword: *Photovoltaic, BIPV system, Standalone inverter, Load profile, Depth of discharge.*



Paper B5 ICTWESDA 024: Inspection of Residential Electrical Installations in Bayelsa State, Nigeria

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Abstract

The importance of initial verification and the need for periodic inspection and testing of the electrical installation of residential buildings cannot be overemphasized. Fire in residential buildings is very frequent in Bayelsa State, and mostly attributed to electrical fault. The initial verification and periodic inspection and testing are unavoidable electrical procedures for the continuous safe use of any electrical installation. The periodic inspection and testing of the electrical installation in residential premises would definitely minimise the frequently witnessed electrical fire in residential buildings in Bayelsa State, and consequently guaranty the safety of both the building and the occupants of the property. In this paper, a safe working procedure for the periodic inspector was presented. The use of the schedule of circuit details, and the electrical danger notification (EDN) form is also presented.

Keywords: *Periodic Inspection, Earthing, Conductor, Cables, classification codes*

Paper B6 ICTWESDA 036: Modeling And Performance Assessment Of 6mw Net-Metered Grid Tied Photovoltaic System For Owerri Metropolis

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Abstract

The Nigerian Electricity grid is highly dominated by conventional power plants with a total installed capacity of 12,522MW. Presently, 5420.30 MW of power is being transmitted to the grid which is grossly insufficient for a country that requires about 180,000 MW to stabilize her power sector. Due to this energy crisis, the manufacturing industries are folding up, while others are relocating their production plants to more friendly havens because of the high cost of doing business in Nigeria. This constitutes a serious clog in the wheel of the economic and industrial progress of the country. This paper presents an effective alternative for the energy supply problem by adopting an unconventional PV system which operates in grid-connected mode incorporated with



Net-meter to take charge of energy transaction. The system also contains a battery bank to compensate for seasonal variations. The simulation was carried out using PV_{sol} premium software. The results obtained showed that Owerri has a good solar radiation to build PV system in large quantities, with annual yield factor of 1,098 kWh/kWp and performance ratio of 76.1% respectively. The process also stands the chance of saving about 11,688 kg/year of CO₂ which would have been emitted to atmosphere by conventional power plants.

Keywords: Renewable energy, Filters, Inverter, Net meter, PV_{sol} software.

Paper B7 ICTWESDA 048: A Grid Tied Short-Through Proof Solar Pv Inverter

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Abstract

In this paper, a new grid tied short-through proof solar photovoltaic (PV) inverter that is short-through proof is presented. Detailed presentation of this new solar inverter is preceded by a brief explanation of the generalized solar PV inverter, its types and some representative grid tied solar inverters (mainly micro-inverters) that are currently trending in the solar PV power conversion industry. The merits of each of these briefly explained solar inverter types and power circuits are emphasized. The new grid tied galvanic isolated solar inverter power circuit is then explained in detailed, analyzed and the steady state time varying circuit voltages and currents given. In addition to being short through proof, the new grid tied solar inverter is scalable from solar PV micro-inverter to solar PV central inverter in output power capability unlike the conventional grid-connected single phase inverters.

Keywords: *Grid, Short-through, Tie, Photovoltaic, Proof*



Paper B8 ICTWESDA 056: Barium Titanate Perovskite Ceramics Synthesized By Solid State Combustion

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Abstract

The need for clean energy sources has given rise to a high demand for efficient storage devices. BaTiO₃ is a perovskite with multifunctional applications, especially as a dielectric material in capacitors owing to its high dielectric constant and low dielectric loss. In this study, high temperature solid state combustion synthesis in an inert environment was employed to obtain BaTiO₃ powders which were subsequently consolidated by Spark plasma Sintering (SPS). Dense ceramics was obtained at 1400°C with a mechanical pressure of 40 MPa within 19 min of sintering. Conventional sintering techniques usually require longer hours of sintering and higher mechanical pressure to obtain optimum dense ceramics. XRD analysis showed single phase tetragonal structure was obtained after a post annealing treatment at 1200°C for 3h.

Keywords: *Spark plasma sintering, dense, BaTiO₃.*

Paper B9 ICTWESDA 059: Many-body effects of Cu- Phthalocyanine crystal for Solar Cell application

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Abstract

Performance of organic semiconductor material is very sensitive to the reactivity of electrical and optical properties. Structural properties of Cu-Phthalocyanine molecular crystal (β -CuPc) are studied via first-principles approach within density functional theory (DFT) framework. The calculated structural parameters are close to experimental result. Many-body perturbation theory (MBPT) based on convolution of non-interacting Green's function (G_0) and a screened Coulomb interaction (W_0), G_0W_0 approximation were used for quasiparticle (QP) band structure and optical properties calculations. The bandgap value of 1.71 eV calculated with G_0W_0 +RPA is in good agreement with experimental value. Optical properties calculations show that the results obtained within G_0W_0 plus random phase approximation (RPA) are close to available experimental results. Interestingly, optical gap of 1.71 eV and strong absorption of β -CuPc in the visible light and ultraviolet regions shows that the investigated material is suitable for



optoelectronic and solar cells applications.

Keywords: *Cu- Phthalocyanine, DFT, GOWO, Electronic, Optical spectra.*

Paper B10 ICTWESDA 061: Optical and Morphological Properties of Electrodeposited Thin Films of ZnS

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Abstract

Zinc sulphide (ZnS) thin films were grown on glass/fluorine-doped tin oxide (FTO) substrates using the simple and inexpensive electrodeposition technique. The deposition electrolytic bath was prepared from aqueous acidic solution of ZnSO₄ and (NH₄)₂S₂O₃. The work was carried out to investigate the optical and morphological properties of ZnS layers. The deposition temperature and the pH values were respectively 30°C and 1.50. It was observed that optical properties vary with variation in growth voltage. It was observed that bandgap decrease with increase in growth voltage since the higher the growth voltage, the higher the current density. As the deposition temperature increased, the bandgap is seen to decrease. After annealing, the bandgaps are seen to increase and the absorption edges can be seen to have smoothed out. Increase in annealing temperature play a significant role in achieving desired results especially when it is meant for device application. As expected, the layer thickness is seen to increase with increase in deposition temperature.

Keywords: *optical, morphology, electrodeposition, ZnS*



Paper B11 **ICTWESDA 73: Numerical Modelling of the Effect of Temperature and Thickness on the Electrical Properties of Polycrystalline Semi-Conductor Solar Cells [Cdte AndCu(In,Ga)Se₂(Cigs)] Using One Dimensional Device Simulation**

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Abstract

A numerical simulation program SCAPS 1D (solar cell and capacitance simulator) was used in the simulation of CdTe and CIGS solar cells. We concentrated on the effect of temperature and thickness on the electrical properties of CdTe and CIGS solar cells and the agreement between the simulations and measurements was shown and discussed using SCAPS 3.3.00. The influences of temperature and thickness on CdTe and CIGS solar cells were investigated by I-V measurements. The simulated efficiencies for CdTe and CIGS solar cells at 300K were observed to be 16.03% and 16.54% which compare very well with the measured efficiencies 10.72% for CdTe and 15.96% for CIGS solar cell at same temperature. It has been found out that as temperature and thickness increases from (200 – 400)K and (2 – 6) μ m, efficiencies decrease from 18% to 10% for CdTe and 20% to 8% for CIGS from (250 – 400)K and (1 – 5) μ m respectively.

Keywords: *SCAPS 1D, CdTe, Cu(In,Ga)Se₂, Numerical Simulation, Efficiencies η , Comparison of Simulation to Measurement*



Technical Session B:
(1) Thin films, Solar photovoltaic and energy storage

Chair/Moderator: Prof. F. Ezema

Day Two:

Rapporteur: Dr. Kenekukwu Ugwu

Thursday, November 12, 2020

Time: 12:30 - 14:00 PM

Zoom Code Link:

<https://us02web.zoom.us/j/81279877650?pwd=N1VQMVMZGWEJDQkhJNG9KNEtUTXpOZz09>

Paper B12 ICTWESDA 75: Analysis of a concentrated photovoltaic-thermoelectric system under fluctuating weather conditions

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Abstract

This paper presents the performance evaluation of a hybrid photovoltaic-thermoelectric (PV-TE) system operating under transient fluctuating weather conditions. The thermoelectric generator (TEG) is directly attached to the back plate of the PV cell and is used to regulate the cell temperature while increasing its overall efficiency. A three-dimensional finite element model is developed in ANSYS 2020 R1 commercial software and is utilised in studying the temperature, current, voltage and power distribution of the hybrid photovoltaic-thermoelectric system under transient and fluctuating meteorological conditions. Temperature dependent material properties are also considered. The simulation is carried out for 24 h to encompass both day and night operation of the hybrid system. Results indicate that power output obtained from the hybrid PV-TE set up is higher than that harvested from the PV system. Furthermore, the TEG acts as a PV heat sink by converting the waste infrared radiation, unutilised by the PV, to electricity. Hence, the incorporation of TEGs to PV systems is highly encouraged since this will result in better system performance at relatively low cost. The results obtained from this study will provide a suitable reference for the design of hybrid photovoltaic-thermoelectric systems in the future.

Keywords: *Photovoltaic-thermoelectric system, thermoelectric generator, transient study, Finite element method, Performance evaluation, efficiency.*



Paper B13 ICTWESDA 080: Influence of deposition methods on the performance of ZnO based natural dye sensitized solar cells

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Abstract

Solution growth techniques are among the most affordable methods of deposition of nanocrystalline thin films. These methods have also been found useful in the synthesis of some nano-particles such as ZnO photo-anodes for the fabrication of dye sensitized solar cells (DSSCs) thereby further reducing the cost of fabrication of the DSSCs which aims to compete with the conventional silicon solar cells in addition to being more environmentally friendly. Natural Dye sensitized solar cells were fabricated using ZnO photo-anodes synthesized via successive ionic layer and adsorption reaction (SILAR) and Hydrothermal techniques. Natural dye from Baphia nitida plant was used to sensitize the photoanodes. The studies revealed that the deposited ZnO thin films in each case are polycrystalline with hexagonal wurtzite phase and a preferential orientation along the c-axis. The open circuit voltage, current density, fill factor and the overall photocurrent conversion efficiency of the DSSC fabricated using ZnO photo-anode that was deposited by the SILAR method are 322.2 mV, 1.3 mAcm⁻², 0.48 and 0.27% respectively. However, there were overall improvements for the open circuit voltage, current density, fill factor and the overall photocurrent conversion efficiency of the DSSC fabricated using ZnO photo-anode that was deposited by the hydrothermal method, respectively given by 336.4 mV, 1.8 mAcm⁻², 0.52 and 0.45%. Better performance of this cell was attributed to improved electron transport and enhanced natural dye loading of the ZnO nano rods grown by the hydrothermal method.

Keywords: Hydrothermal, SILAR, NDSSC, ZnO, Photoanode



Paper B14 ICTWESDA 083: Embedded Power System for Improved Voltage Profile Of Distribution Network Using Power Factor Equality

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Abstract

Following attention in Renewable Energy Resources (RER), studies in embedding Distributed Generation (DG) to power grids have increased. The advantages of embedding DG in a Distribution Network (DN) are reduction in power loss, voltage profile improvement and system reliability. To maximize overall system efficiency, it is important to determine the optimal DG location. This paper highlights the benefits of DG by using 29-bus radial DN of Onuiyi feeder of Nsukka network, modelled in ETAP software with Newton-Raphson load flow and optimized with Power Factor Equality (PFE) and Point of Minimum Power Loss (PMPL) to demonstrate the benefits of embedding DG.

Keywords: *DG, DN, Integration of photovoltaic, Technical losses, PFE, PMPL and voltage profile*

Technical Session B: Energy efficiency and Management ; Day Two

Paper B15 ICTWESDA 03: An Overview Of Energy Efficiency And Management: A Case Study Of Rural Electrification Agency Building

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Abstract

Sustainable energy management essentially plays a critical role in the socio economic activities of man and in the overall productive processes of a nation; consequently, efficient energy utilization and robust management are key parameters that drive energy sustainability. Energy efficiency in this context can be viewed as a function of technological advancement, owing to the fact that what are regarded as efficient products in the seventies and thereafter have in the contemporary time been replaced by the modern efficient ones. In the industries, obsolete equipment is giving way to more



efficient and automated ones. Architects too have improved considerably in the design of energy efficient buildings, while in the transport sector, energy efficient automobiles that are eco -friendly are gradually emerging. The work will in the general terms discuss energy efficiency and management programmes, and for emphasis, analyzes the results which were obtained during the Walk-through and Diagnostic Energy Audit carried out in the offices of Rural Electrification Agency Building located in FCT. The audit work as presented served as a measure for exposing all the areas of energy wastages and feasible conservation opportunities in the building complex. Energy Audit Devices deployed in the power sources of the building with behavioral and bioclimatic information as collated produced a reliable data that were used in this study and thus gave broad knowledge of Energy Efficiency and Management for our national economy.

Keywords: *Energy Management, Audit, Energy Efficiency, Green House Gas, Sustainability, waste Stream*

Paper B16 ICTWESDA 70: Energy Efficiency and Conservation

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Abstract

Energy efficiency and energy conservation (EEAEC) is the forerunner to an ideal energy solution for sustainable development. EEAEC joins to achieve and maintain optimum energy procurement and utilization in any household or organization. They help to minimize energy costs, wastes as well as environmental ill-effects without affecting the quality of work done in the production process. Energy efficiency means saving energy while keeping the same level of service. It is the ability to capitalize on new technologies and equipment to do the same work with less power. Energy conservation was achieved in like manner when you adopt better ways of doing things using the same amount of available energy to perform more useful work. Energy conservation reduces the need for non-renewable sources of energy. The spin-offs can result in increased environmental quality, national and personal security with higher cost saving that places energy conservation at the top of the sustainable energy portfolio hierarchy in the ranking. This paper, therefore, should be seen as a stimulus to ginger us to adopt every acclaimed energy thrift procedure uniquely in our daily activities, anthropogenic lifestyles, and processes in industries. The paper has tried to examine and demonstrate the technical differences between energy efficiency and energy conservation, thus enabling us to develop an energy audit checklist relevant for home, commercial and industrial applications.

Keywords: *energy management, energy efficiency, energy conservation, sustainable development, energy audit, energy-thrift schemes, sustainable transport.*



Technical Session C: (1) Biofuels

Chair/Moderator: Dr. C. N. Anyanwu

Day One:

Rapporteur: Dr. Anthony Ofomatah

Wednesday, November 11, 2020

Time: 13:00 - 14:40 PM

Zoom Code Link:

<https://us02web.zoom.us/j/84851962445?pwd=SXhrVndJYzM2bVYrUjFXcnFDSnlXdz09>

Paper CI ICTWESDA 07: Unlocking the Future of Bioenergy in Nigeria Using Genetic Modification Framework (GMF) of Switchgrass

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Abstract

The use of biofuel is gradually becoming more attractive universally as convenient substitute for fossil fuels due to the current increase in the demand for clean and renewable energy. This is because of its contribution towards lowering the dependence on crude oil, in view of the current global decline of fuel reserves. Switchgrass (*Panicum virgatum* L.) has been developed into a herbaceous bioenergy crop. The processing of non-edible switchgrass biomass for fuel production will impact on rural and national development without negatively affecting food security. One of the main challenges of the production of biofuel from plant biomass is the technological impediment of breaking down plant biomass (lignin and cellulose in plant cell walls) that can be converted into biofuel. This research work will employ the use of genomic and transgenic aspects of biotechnology, such as callus induction and culture media optimization of native switchgrass, genes and constructs, cloning and sequencing, transformation and characterization analyses to invent a genetic modification framework (GMF) technology that will result in genetically modified switchgrass capable of coproducing cellulase which will culminate to drastic reduction in the cost of production of biofuel and thereby encourage its commercialization.

Keywords: *Bioenergy, Genetic Modification Framework (GMF), cell wall, switchgrass, Panicum virgatum L.*



Paper C2 ICTWESDA 010: Biogas Production And Storage From Pig Dung Co-Digested With Pineapple Peels

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Abstract

Biomethanation potentials of pig dung co-digested with pineapple peels were investigated. Various blends of pig dung with pineapple peels were charged respectively into 50 kg prototype digesters labeled A to C. Digesters D and E were charged with only pineapple peels and pig dung respectively. Proximate and physico-chemical analyses were determined on the slurry using conventional methods. The wastes were subjected to anaerobic digestion for 35 days at mesophilic temperature range of 25 to 37°C. Relative humidity, ambient temperature, pH, slurry temperature and volume of gas were monitored and recorded on daily basis. Biogas yield increased progressively with higher pig dung blend. Onset of gas flammability was observed on the 5th day for blends of pig dung and pineapple peels, as well as for pineapple peels alone while for pig dung alone, it was observed on the 6th day. This was as a result of lower nitrogen contents of pineapple peels blends compared with that of pig dungs alone, a factor which favours early onset of flammability. Biogas generated from the mixture ranged from 65- 71% CH₄, 28 -34% CO₂, and traces of hydrogen sulphide and carbon (II) oxide. The biogas was subsequently stored in a gas cylinder using modified pressure system. This study is aimed at converting wastes such as pig dung and pineapple peels to useful energy and storing the gas produced in cylinders for easy accessibility.

Keywords: *Biogas Production, pig dung, pineapple peels, Gas Flammability, Storage*

Paper C3 ICTWESDA 021: Biodiesel Production from *Irvingia gabonensis* by Transesterification

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Abstract

Biodiesel is a fuel obtained from animal and plant sources. Biodiesel is an alternative fuel to conventional fossil fuel with advantages of environmental friendliness since the emission of greenhouse gases (GHG) will be less than comparable quantity of fossil fuel. Biodiesel feedstocks are easier to get in most places. In this study, oil was extracted from *Irvingia gabonensis* seeds with n-hexane by sonication. The oil was converted into biodiesel (methyl esters) by transesterification using NaOH which was dissolved in



methanol as a homogenous alkaline catalyst. The oil methyl ester, which was the biodiesel was removed from the upper layer, and then washed with hot distilled water to remove the unreacted alcohol, oil and catalyst. The quality of the oil was assessed based on the pH value, iodine value, moisture content, percentage free fatty acid, refractive index, saponification number and specific gravity. The fuel parameters of the methyl ester including viscosity, density, flash point, pour point, fire point, centane number and cloud point were determined and the results obtained were compared with biodiesel standards. It was observed that the fuel properties of the biodiesel were within the quality standards acceptable for use in diesel engines.

Key words: *Biodiesel, Irvingia gabonensis, methyl esters, oil, transesterification*

Paper C4 ICTWESDA 029: The Effect of Elaeis Guineensis Residue On Co₂ And So₂ Emissions From Coal Pellets Combustion

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Abstract

The increase in emission of greenhouse gases generated by fossil fuels such as coal has informed the need for cleaner and renewable sources of energy. Therefore, in order to mitigate the negative effect of continued coal combustion, it is essential to identify more carbon neutral fuels such as biomass. Cofiring of coal with biomass is a viable option when considering the reduction of greenhouse gas emissions during the combustion of coal in coal-fired boilers. Consequently, this study was carried out to determine the effect of elaeis guineensis residue on the combustion emission CO₂ and SO₂ of coal pellets. Samples of coal and elaeis guineensis residue (i.e. palm kernel shell) were collected and pulverized. Pellets were produced mechanically using optimized mixing ratios (i.e. 90%C:10%R, 80%C:20%R, 70%C:30%R, 60%C:40%R and 50%C:50%R). 100%C pellet was also produced. The pellets were thereafter characterized (i.e. proximate and ultimate analyses) in accordance to ASTM Standards. From the results, quantitative analysis of optimized pellets showed that elaeis guineensis (PKS) has potential tendency of reducing percentage combustion CO₂ and SO₂ emissions from the 100%C pellets.

Keyword: *Elaeis guineensis residue, Coal, Optimization, Pellets, Combustion, Emissions*



Paper C5 ICTWESDA 052: Comparative study of calorific values and proximate analysis of biogas from different feedstocks

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Abstract

The waste used in this research paper was Orange and plantain peels with the addition of catalyst (clay). From the experiment carried out, the co-digestion of orange and plantain peels was the first to become flammable. The retention time was 66 days during which the ambient temperature and slurry temperature fluctuated between 22^oC to 42^oC which is within the range of mesophilic temperature. Orange peel, plantain peel and Orange/plantain became combustible on 64th, 55th, and 31st day respectively. Calorific values of the samples were 15,213.85 KJ/Kg, 18,309.35 K J/Kg, and 16761.60 KJ/Kg respectively. Biochemical demands and chemical demand were obtained. The biogas produced was analyzed using biogas analyzer. The methane composition of the biogas produced were 70.7000 % ,82.9955 % and 77.8541 % respectively. The proximate analysis of the samples was done. The Ash content was 0.35% for Orange peel, 0.55% for plantain peel and 0.41% for Orange/plantain. Moisture content was 95.70% for orange, 96.10% for plantain, and 96.00% for Orange/Plantain. Crude fiber has 0.20% for Orange peel, 0.40% for plantain, and 0.30% for Orange/Plantain. Nitrogen was 0.056% for Orange peel, 0.168% for plantain, and 0.126% for Orange/Plantain. Carbon Content was 1.60% for Orange peel, 3.99% for plantain, and 3.19% for Orange/Plantain. Phosphorus was 0.06% for Orange peel, 0.17% for plantain, and 0.13% for Orange/Plantain. Potassium was 0.07% for Orange peel, 0.16% for plantain, and 0.14% for Orange/Plantain. The total viable count of the samples was done.

Keyword: Mesophilic. Combustible. Biochemical. Flammable. Analyzer.



Paper C6 ICTWESDA 054: Heavy metals' identification in bio-slurry from "Adani" powdered rice husk complemented with cow dung and effect of the metals' concentration on biogas yields from digester systems

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Abstract

Effect of selected heavy metals concentration on biogas yield and bio-slurry from powdered rice husk (RH) complemented with graded levels of cow dung (CD) was verified. The waste complements include; 90:10, 80:20, 70:30, 60:40 and 50:50 RH: CD, respectively. The RH and CD alone separately served as the control. Proximate composition, volatile solids, organic carbon, among others, of the undigested wastes was analyzed before biogas production using standard laboratory methods. All wastes were anaerobically fermented at ambient conditions using bio-digesters of same volume (48 L) capacity for a 30 days retention period. Biogas spent sludge/bio-slurry was evaluated for selected heavy metals such as Ni, Cr, Cu, Mn, Pb and Ag. The waste systems yielded total gas volumes as follows: 123, 127, 125, 141, 127, 246 and 291 liters for 90:10; 80:20; 70:30; 60:40 and 50:50 RH: CD, powdered rice husk alone, cow dung alone, respectively, throughout the period. Onsets of flammable gas production of the systems were as follows: 15, 15, 11, 9, 6, 8 and 4 days. Concentrations of the heavy metals of the bio-slurry blends (90:10, 80:20, 70:30, 60:40 and 50:50 RH:CD, respectively) ranged from 4.28-21.37 for Ni; 0.00-4.86 for Cr; 0.00-2.37 for Ag ; 0.00-2.70 for Cu; 0.00-10.42 for Pb; 0.00-9.46 for Mn and 61.14-1,589.65 for Fe mg/kg slurry. Overall results showed that the 50:50 bio-slurry blends did not contain Ag and Cu, 60:40 had no Ag but was highest in total volume of gas production within the period among other blends, 70:30 had no Cr, Pb and Mn, and 80:20 had no Cr and Ag, while 90:10 contained no Cr and Pb.

Keywords: *biogas production, bio-slurry, bio-digester, volume of gas, heavy metals, flammable gas*



Paper C7 ICTWESDA 86: Improving Biogas Yield Using Organic Fraction of Plant and Animal Wastes by Co-digestion

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Abstract

This study presented the effects of co-digestion and catalysts on the performance of biogas production. Poultry dropping and walnut waste were used as feedstock materials while clay, KOH and NaOH were used as catalysts. The experiment was divided into five setups. The retention time was 45 days. The digester temperature floated around 20-44°C while the PH varies from 5.7-8.7. Gas composition, physicochemical properties, calorific value as well as elemental composition of the organic waste were analyzed. The result revealed that the gas produced has high methane content ranging from 66.52 – 73.44% with low CO₂ concentration ranging from 9.97 -16.92%. The total volume of gas was noted to be 135.2l, 115.2l, 82.2l, 162.4l and 115.7l for each sample. The physicochemical properties revealed that the TS varies from 3.04% - 4.15%, while VS varies from 3.27% - 4.49%. The TOC ranges from 3.13% - 3.84% while the nitrogen content ranges within 0.112% - 0.392%, while Crude fibre ranges from 0.70 – 1.79%. Ash content ranges within 1.16 – 2.67% and moisture content varies between 87.77 – 92.34%. The COD and BOD were also obtained. The calorific values of the samples obtained ranges from 15,882 – 22,036KJ/kg. The phosphorus content was between 0.33% and 0.43% while potassium was between 0.29 and 0.42% on average.

Keywords: *Anaerobic Digestion, Co-Digestion, Composition, Physicochemical, Elemental composition*



Technical Session C:

Day One

(2) Energy and environment, Climate change and Energy in education,

Paper C14 ICTWESDA 060: Social Media: An Adult Education Approach For Improving The Environmental Awareness Of Timber Merchants In Udeno, Enugu State

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Abstract

Environmental awareness is very important for resolving the challenges facing the environment. This study assessed the extent to which social media as an adult education approach could improve the environmental awareness of timber merchants. Descriptive survey design was used for the study. The respondents of the study consist of 357 registered timber merchants in the study area. The data collected for the study was analyzed using percentage rating and mean score. A structured questionnaire was used to collect data for the study. The instrument was validated by three experts. Reliability coefficient of 0.85 was obtained for the instrument. The findings, among others, were that, 85% of the timber merchants in Udeno, Enugu State made use of social media sites especially Facebook and Whatsapp; hence, social media provides opportunity for timber merchants to share ideas on environmental issues through online group discussions. The study concluded that social media could be used to promote environmental awareness on the dangers of negative environmental practices such as deforestation and improper dumping of wastes. This enable member of the society to conveniently participate and respond to information posted in relation to environmental issues.

Keywords: *Social media, adult education, environmental awareness, timber merchants, information*



Paper C15 ICTWESDA 065: Renewable Energy And Sustainable Development In Nigeria

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Abstract

Energy is a vital input for social and economic development of any nation. As a result of the generalization of agricultural, industrial and domestic activities the demand for energy has increased remarkably, especially in emergent countries. Nigeria is faced with chronic electricity crisis that has resulted in the crippling of most sectors of the economy. It is estimated that only 40% of Nigerians are connected to the national grid and the connected population are exposed to frequent power outages. Nigeria's electricity grid is mainly powered by large hydropower and depleting hydrocarbon resources. Fossil-based electricity generation contributes not only to increase in carbon footprints, but also exposes the country to changes in price of petroleum resources and political instability from the oil producing region of the country. The country is blessed with abundant Renewable Energy (RE) resources that have not been fully exploited; these renewable resources have the potentials to change the status quo of power generation and consumption in the country. This paper examines the role and challenges of renewable energy in enhancing sustainable development in Nigeria. Such strategies involve energy savings on the demand side, efficiency improvements in the energy production, and replacement of fossil fuels by various sources of renewable energy.

Keywords: *energy, renewable energy, sustainable development, solar energy, hydropower, wind energy*



Paper C16 ICTWESDA 076: Lifelong Learning For Sustainable Community Development: Implication for Renewable Energy Education in Enugu State, Nigeria

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Abstract

The study investigated lifelong learning for sustainable community development: Implication for renewable energy education in Enugu State, Nigeria. Specifically, three research questions and two hypotheses guided the study. The study used descriptive survey research design. The population is made up of 3,960 respondents, comprising of 3,391 adult learners, 552 facilitators and 17 traditional rulers in Enugu State. A sample size of 607 consisting of 358 adult learners, 232 facilitators and 17 traditional rulers were used for the study. Simple random sampling was used to select adult learners and facilitators, while 17 traditional rulers were purposively selected. A structured questionnaire designed by the researchers was the instrument used for data collection. A reliability coefficient of 0.88 was established using Cronbach Alpha. Data collected were analyzed using mean and standard deviation for research questions while ANOVA was used for testing the null hypotheses at 0.05 level of significance. Results showed among others that lifelong learning gave more community members the opportunity to acquire and update themselves with the necessary skills. Analysis of variance of the responses of respondents indicated no significant difference at $P > 0.05$. The paper recommends among others that Government established departments, ministries, agencies and non-governmental organizations should collaborate and make provision for sufficient fund through adult and non-formal education to make learning more flexible and friendly to people who cannot fit-in into the formal system of education due to one problem or the other.

Keywords: *Sustainable development, Lifelong learning, Community development, Sustainable community development, Renewable Energy*



Technical Session C:

(1) Energy and environment, Climate change and Energy in education

Chair/Moderator: Prof. P. Asogwa

Day Two:

Thursday, November 12, 2020

Rapporteur: Dr. Chibueze Nnaji

Time: 12:30 - 14:00 PM

Zoom Code Link:

<https://us02web.zoom.us/j/84851962445?pwd=SXhrVndJYzM2bVYrUjFXcnFDSnlXdz09>

Paper C17 ICTWESDA 077: Reducing The Challenges of Environmental Sustainability Through Adult Education Programmes in Udenu, Enugu State

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Abstract

This paper assessed the extent adult education programmes could help in reducing the challenges of environmental sustainability. The study is descriptive survey. Respondents for the study consist of 92 adult learners and 5 adult education facilitators in the study area. The data collected from the research objectives were analyzed using mean score. A 13 item questionnaire was used to collect data for the study. The instrument was validated by three experts. Cronbach Alpha technique was used to establish the reliability before administrating the instrument to the respondents. Reliability coefficient of 0.81 was obtained. The findings, among others, were that, adult education programmes emphasize the need to balance development with conservation of environmental resources such as forests. Conclusively, it is evident that adult education programmes such as environmental education enhance environmental sustainability as it equips individuals in the society to effectively conserve their environmental resources for the present and future generation.

Key Words: *Environmental Sustainability, Adult Education, Environmental Education, Vocational Education, Deforestation*



Paper C18 ICTWESDA 088: Deployment Of Renewable Energy Technologies For Sustainable Rural Agricultural Development In Nigeria

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Abstract

Renewable energy technology deployment is very critical for sustainable rural agricultural development. This article analyses the impact of renewable energy technologies for sustainable rural agricultural development in Nigeria. The National Centre for Energy Research and Development, University of Nigeria, Nsukka, has developed viable renewable energy technology devices which include solar powered dryers, solar chicken brooders, solar incubators and solar PV system and biogas production system. Applications of these devices for sustainable rural agricultural development and challenges to their deployment were analyzed. Adults in the rural areas in whose hands the agricultural practices are carried out lack knowledge of modern technologies that could lead to boosting rural agriculture. With renewable energy technologies, therefore, sustainable rural agricultural development is possible.

Key Words: *Renewal Energy, Renewal Energy Technology, Rural Agricultural Development, Adult Education*

Paper C19 ICTWESDA 089: Performance analysis of the synthetic storm technique rain attenuation prediction model on Nigerian climate

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Abstract

This study analyzes the performance of the synthetic storm technique (SST) over the Nigerian climate. The location of interest was 9.91°N, 8.88°E. Two months rain rate time-series data measured by a rain gauge located inside the University of Jos, Nigeria was utilized for the purpose of this work. The analysis is based on the time-series seasonal variation of rain statistics. Comparison was made between the SST model and measured values at 12.519 GHz for signal downlink from NIGCOMSAT-1R satellite. From results obtained, we observe peak predicted rain attenuation by SST model was 4.06dB with a minimum of 0dB for the month of June while the peak rain attenuation for July was 6.92dB. It can be observed that the SST predicts closely with measured rainfall values.



However, disparities exist between the calculated attenuation and the measured values for a few rainfall events. The SST model performance was satisfactory for the period under observation.

Keywords: SST; Time series; Rain attenuation; Satellite; NIGCOMSAT-1R

Technical Session C: (2) Biofuels

Day Two

Paper C8 ICTWESDA 081: Perceived Role of Extension Education in Promoting the Use of Biogas for Sustainable Agricultural Development in Nigeria

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Abstract

Biomass technology is a renewable energy source that is significantly used for cooking and heating, which when explored can reduce the use of fossil fuel. This study investigated the perceived role of extension education in promoting biomass technology for sustainable agriculture development in Nigeria. The study adopted the descriptive survey research design. Data were collected from 268 registered members of All Nigeria Farmers Association, Nsukka; and 22 Agriculture extension agents in Nsukka Local Government Area. Researchers-designed questionnaire which was validated by three experts was used for data collection. Mean and standard deviation were used for data analysis. Findings showed that sensitization of farmers on acceptability of use of farm wastes for biogas production; dissemination of information on renewable energy techniques to the farmers and sensitization of farmers on use of farm wastes for biogas production are perceived roles of extension education in promoting the use of farm wastes for renewable energy. Other perceived roles reported by the respondents include motivation of farmers on issues of renewable energy and provision of energy management advice to the farmers. The researchers recommended that efforts should be made to create awareness among the farmers on the use of farm wastes for biogas for renewable energy.

Keywords: biomass, renewable energy, extension education



Paper C9 ICTWESDA 084: Electricity and Biofuel Production from Biomass in Nigeria: Prospects, Challenges and Way Forward

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Abstract

Nigeria currently produces less energy required for uninterrupted electricity supply. This situation has led to an energy crisis that is adversely affecting every sector of the economy. An exploration of energy contributions from different sources could help address the energy crisis. Nigeria has a large quantity of biomass which has high energy potential for supplying her energy needs. This paper aims at promoting the commercial availability of electricity from biomass in Nigeria. The biomass potentials identified include conventional crops, agricultural residues, tertiary residues; forest residues; energy crops; grasses and aquatic weeds including algae. Conversion of biomass to bioenergy can be achieved through anaerobic digestion, gasification, pyrolysis or esterification. Although the prospects are bright, challenges facing bioenergy in Nigeria, include inadequate information on feedstock; uncomprehensive research and development capacity; poor policy formulation and implementation; poor regulatory framework, poor investment climate and poor access to technology. An integrated approach is recommended to include the establishment of Nigerian Biofuel Corporation under a Public-Private Partnership (PPP) arrangement and a Nigerian Network on Bioenergy.

Keywords: *Biomass, bioenergy, potential, availability, technology, energy mix*

Paper C10 ICTWESDA 091: Design and Construction of a Semi-batch Pyrolysis Reactor for the Production of Biofuel

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Abstract

Due to the fast depletion of crude oil wells, increase in greenhouse gas (GHG) emission, energy security challenges, etc. the world through its researchers are in search of sustainable energy sources. Renewable energy sources (RES) have been found to be among the best solutions to the world's energy insecurity and other challenges, but due to Africa's poor sustainable energy policies, the positive effect of renewable energy has not been felt in the continent though it has what it takes to enjoy it. Biofuel being one of the RES, during its production turns waste into wealth. Pyrolysis is an inevitable method for



the production of biofuel, but due to limitations facing the renewable energy technologies (RETs) in Africa (especially the sub-Saharan Africa), constructing a pyrolysis reactor that carries out this process is a challenge to many. A semi-batch reactor was designed (using SOLIDWORKS software) and constructed taking into consideration the process' kinetics, temperature (up to 1000 0C) and feedstock (quality and quantity). The system after being constructed was used to produce bio-oil from cashew nut shell, and polystyrene combined with cashew nut shell. They gave pyrolysis liquid yield of 61.3 % and 64.58 % respectively. This system was designed to be used in a laboratory for research purposes; it can be used in homes if scaled to suit home usage.

Keywords: *Energy policies, Renewable energy, Biofuel, Pyrolysis, Semi-batch reactor.*

Paper C11 **ICTWESDA_092: Integration of perennial grass into energy mix as alternative to fuelwood in select Communities in Ovia North-East LGA of Edo State, Nigeria**

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Abstract

Energy potential of perennial grasses was investigated. Perennial grasses are assorted; well-favored for growth; require moderate soil nutrient with minimum rainfall requirement; and pose less environmental threat than the combustion of fuelwood. *Pennisetumpurpleum*Shumach and *Panicum maximum*Jacq, commonly known as Elephant and Spear grasses, respectively, were selected based on factors such as heating values, physical heights, carbon fixing pathway and availability. Proximate and ultimate analyses were done in bomb calorimeter and ultimate analyzer, respectively, with key results suggesting heating values of 15.17MJ/kg and 14.56MJ/kg, for *Pennisetumpurpleum* Shumach and *Panicum maximum*Jacq, respectively. However, lower energy content than fuelwood suggest that densification is required. Furthermore, survey on integration and acceptability as alternative energy resource was developed and analyzed using Factor analysis. The outcome of the analyses shows that it is cheaper, able to meet soaring energy demands, and provides a way for combating climate change. Thus, there is an urgent need to integrate perennial grasses as energy source into the Nigeria energy mix as viable substitute to fuelwood, to stem loss of forests due to fuelwood harvesting, through evidential crafted policy and implementation, which is very critical in driving green economy and meeting Sustainable Development Goals.

Keywords: *Perennial grass, clean energy, fuelwood, climate change*



Technical Session C: (3) Wind Energy/Technology

Day Two

Paper C12 ICTWESDA 022: Assessment of wind energy potential of Bauchi in North-East, Nigeria

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Abstract

Twenty year (1995-2014) monthly mean wind speed and monthly mean wind direction data of Bauchi location were obtained from the Nigeria Meteorological Agency (NIMET) Lagos for the purpose of this study. The data was measured at 3 m height. In order to evaluate wind characteristics, statistical models such as Weibull and Rayleigh distribution were employed in the assessment of wind energy potential. It was observed that Weibull distribution suited the wind speed data more than Rayleigh. Wind rose plot of the monthly wind direction was plotted to determine the best possible direction to mount wind turbine in Bauchi station. Wind characteristics obtained at 3 m height were extrapolated for higher altitudes.

Key words: *wind speed, wind direction, probability density, Weibull, Rayleigh*

Paper C13 ICTWESDA 085: Assessing the Technical Offshore Wind Energy Potential in Lagos, Nigeria

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Abstract

Looking at the current state of things globally and the greenhouse effect renewable energy sources are no longer a matter of choice. The population of Lagos coupled with the perpetually erratic power supply makes renewable energy the new and sure way to go especially as an alternative supply of electricity. The nation as a whole has a peak generation of 5300MW on average which is only about 30% of its actual needs. The use of renewable energy in Nigeria is growing but so is the population this study seeks to ascertain the possibility of using offshore wind energy as an alternative power supply in Lagos Nigeria. The onshore wind energy resource has been fairly explored but its



counterpart offshore wind energy has not been explored. This study focuses on the technical assessment of offshore wind resources on the Gulf of Guinea around the Lagos Nigeria region. Having analysed wind data from existing literature and analysed offshore wind farm construction the paper presents a technical layout of the number of turbines per the specified area and the potential output using Aerodyn SCD 8.0/168 as a case study. The results show that the annual energy demand of about 96.36TWh in Lagos can be met with the annual generation of about 478TWh for a wind farm at the shore and 500TWh for waters with depth less than 50m.

Keywords: *Offshore, Energy, Wind Energy, Lagos*