

NATIONAL SOLAR ENERGY FORUM (NASEF 2022)

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THEME: ROLE OF GREEN ENERGY ON SUSTAINABLE NATIONAL SECURITY AND ECONOMIC GROWTH

VENUE:

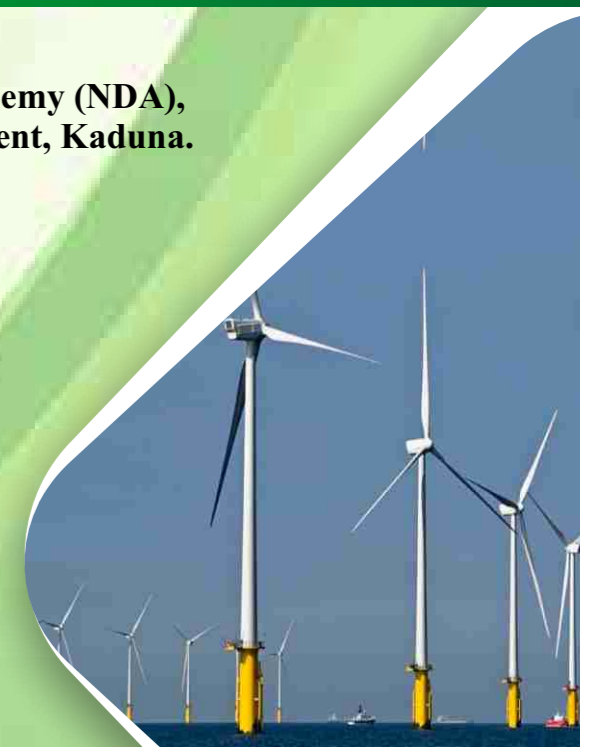
JN Garba Hall, Nigerian Defence Academy (NDA), Postgraduate School, Ribadu Cantonment, Kaduna.

DATE:

29th – 30th August, 2022

PROGRAMME OF EVENTS

BOOK OF ABSTRACTS





PARTNERS/SPONSOR



NATIONAL ANTHEM

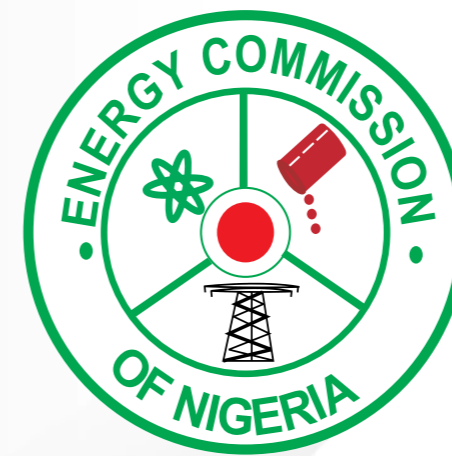
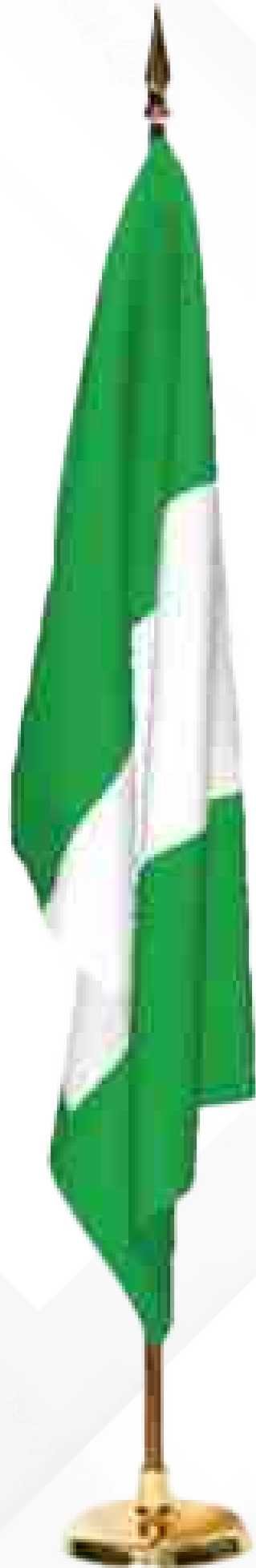
Arise, O Compatriots
Nigeria's call obey
To serve our fatherland
With love and strength and faith
The labour of our heroes past,
shall never be in vain
To serve with heart and might,
One nation bound in freedom, peace and unity

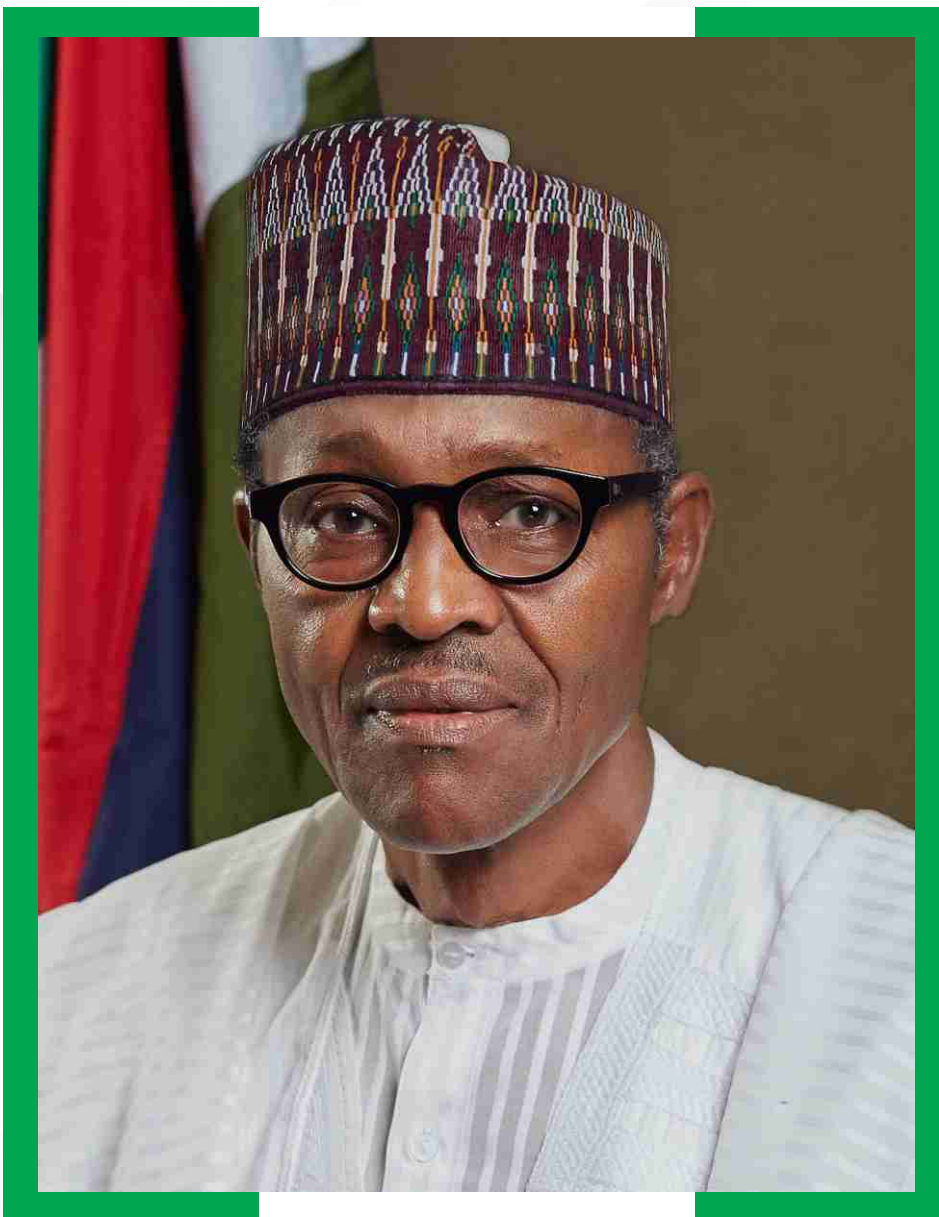
NATIONAL PLEDGE

I pledge to Nigeria my country
To be faithful, loyal and honest
To serve Nigeria with all my strength
To defend her unity and uphold her honour and glory
So help me God

NATIONAL PRAYERS

Oh God of creation,
Direct our noble cause
Guide our leaders right
Help our youth the truth to know
In love and honesty to grow
And living just and true
Great lofty heights attain
To build a nation where peace and justice shall reign





His Excellency
MUHAMMADU BUHARI, GCFR
President, Commander In Chief of the Armed Forces
Federal Republic of Nigeria





CHIEF HOST
HIS EXCELLENCY, MALLAM NASIR AHMED EL-RUFAI,
The Executive Governor
Kaduna State



SPECIAL GUEST OF HONOUR

HIS EXCELLENCY ENGR ABUBAKAR D ALIYU

The Honourable Minister of Power, Federal Ministry of Power



HOST
MAJ GEN IM YUSUF
Commandant, Nigerian Defence Academy Kaduna



KEYNOTE PRESENTER

Ahmad Salihjo Ahmad

Managing Director/CEO, Rural Electrification Agency



GUEST SPEAKER

PROF. ELI JIDERE BALA,

Director General/CEO, Energy Commission of Nigeria, Abuja



PROF. A. S. SAMBO ANNUAL LECTURE SPEAKER

DR. IMAMUDDEN TALBA,

Chairman, Renewable Energy - Energy Efficiency Associations -Alliance



PROF. ISA GARBA,
President,
Solar Energy Society of Nigeria



PROF. A. S. SAMBO

Usmanu Danfodiyo University , Sokoto
Chairman LOC,



PROGRAMME OF EVENTS FOR THE OPENING CEREMONY:

CONFERENCE THEME:

Role of Green Energy Technologies in Sustainable National Economic Growth and Development

Date: 29th – 30th August 2022

Time: 08:00 am

Venue: JN Garba Hall, NDA PG School, Ribadu Cantonment, Kaduna

Date: 29th August, 2022	
TIME	ACTIVITY
08:00am – 08:30am	Opening Ceremony/Registration
08:30am – 09:30am	Tea Break
09:30am – 09:35am	Arrival of Guest and Dignitaries
09:35am – 09:45am	All Guest and delegates seated
09:45am - 09:55am	Arrival of the Chief Host, His Excellency, Mallam Nasir Ahmed El-Rufai , The Executive Governor of Kaduna State
09:55am – 10:00am	Arrival of the Special Guest of Honour, His Excellency Engr Abubakar D Aliyu , The Honourable Minister of Power, Federal Ministry of Power.
10:00am – 10:10am	Welcome address by the Host, Maj Gen IM Yusuf , Commandant, Nigerian Defence Academy Kaduna
10:10am – 10:15am	Remarks by the Chairman LOC, Prof AS Sambo
10:15am – 10:35am	Keynote Address by Ahmad Salihijo Ahmad , Managing Director/CEO, Rural Electrification Agency, Abuja
10:35am – 10:55am	Guest Speaker – Prof Eli Jidere Bala , Director General/CEO, Energy Commission of Nigeria
10:55am – 11:10am	Prof A.S Sambo Annual Lecture – Dr Imamuddeen Talba , Chairman, Renewable Energy–Energy Efficiency Association
11:10am – 11:30am	Goodwill Messages
11:30am – 12:15pm	Award presentations (Awards of Fellow's Awards, Excellent Award Life membership Awards, Advocate's Award, and Animalu's Award)
12:15pm – 12:25am	Address by Chief Host, His Excellency, Mallam Nasir Ahmed El-Rufai , The Executive Governor of Kaduna State
12:25pm – 12:35am	Address by Special Guest of Honour and Declaration of the NASEF 2022 Open, His Excellency Engr Abubakar D Aliyu , The Honourable Minister of Power, Federal Ministry of Power.
12:35pm – 12:45am	Vote of thanks by the President, Solar Energy Society of Nigeria, Prof Isa Garba , The Academy Provost, Nigerian Defence Academy.
12:45pm – 12:50pm	Nationl Anthem
13:00pm -14:00pm	Lunch Break



PROGRAMME OF EVENT FOR THE TECHNICAL SESSION:

CONFERENCE THEME:

Role of Green Energy Technologies in Sustainable National Economic Growth and Development

Date: 29th – 30th August 2022

Time: 08:00 am

Venue: JN Garba Hall, NDA PG School, Ribadu Cantonment, Kaduna

Date: 29th August, 2022	
TIME	ACTIVITY
14:00 - 16:00	<p>Engr. Dr. Abubakar Sadiq Ahmed, Electrical and Electronic Engineering, Federal University of Technology Minna - "Renewable Energy Integration in Nigeria: Technologies, Challenges, and Prospects".</p> <p>Prof. M. S. Haruna, Executive Vice Chairman/Chief Executive, National Agency for Science and Engineering Infrastructure (NASENI) – "The Role of Engineering Infrastructure in the attainment of Sustainable Development and Economic Growth".</p> <p>Prof. Idris Bugaje, Executive Secretary/ Chief Executive, National Board for Technical Education (NBTE) – "The Need for integrating the Green Energy Education Curriculum in Nigerian Technical Institutions for Sustainable Development and Economic Growth".</p> <p>Prof. Olabomi Rasaq Adekunle, Director of Research, National Institute for Policy and Strategic Studies (NIPSS) - "Assessment of the Status of Renewable Energy Utilization and Human Development in Nigeria".</p> <p>Alhaji Aminu Trade, The Founder/Chief Executive, Regional Center for Excellence for Sustainable Energy for Sub-Saharan Africa "Hydrogen Production: Options of Viability and Sustainability for Profit in Nigeria".</p> <p>Question and Answers</p>
PLENARY SESSION II	
Chairman – Prof. A. M. Ashafa, Ag.Vice Chancellor, Kaduna State University, Kaduna.	
16:00 - 18:00	<p>Dr. Muazu Garba, Ag. Director, Sokoto Energy Research Center, Usmanu Danfodio University, Sokoto - "The Role of Research Institutions on the Promotion of Green Energy Technology for Sustainable Development in Nigeria".</p> <p>Engr. Abba Sani Kurawa, MD/CEO, Multigreen Renewables Nig. Ltd. – "Hybrid and Emerging Renewables Energy Technologies Integration of Micro Inverter using AC Coupling in an Offgrid Solar System Design - Charish Enterprise Institute Limited - Case Study".</p>



16:30 - 18:00	<p>Mrs. Olanike Olugboji Daramola, Program Director, Women Initiative for Sustainable Environment – “Gender diversity/ Mainstreaming in the Energy Sector and its Importance in Clean Energy Transition”.</p> <p>Prof. Ifeanyi Solomon Williams, Senior Fellow/HOD Science, Technology and Innovation Studies, National Institute for Policy and Strategic Studies (NIPSS) - “The Status of the Solar Energy Development in Nigeria and it's Policy implications”.</p> <p>Question and Answers</p>
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Date: 30th August, 2022

TECHNICAL SESSION I

TIME	ACTIVITY
08:00 - 11:00	Group 1: Bio-energy and Applications Group 2: Energy and Management Group 3: Solar Energy and Electronic Group 4: Wind Energy and Other Energy Resources
11:15 - 11:45	Tea Break
12:00 - 12:30	Closing Ceremony <ul style="list-style-type: none"> • Presentation of the NASEF 2022 Communique – Dr. I. H. Zarma • LOC Chairman's Vote of Thanks – Prof. A. S. Sambo • Closure
12:30	Departure
12:30 - 13:00	AGM



WELCOME ADDRESS

**by The Host, Commandant, Nigeria Defence Academy,
MAJ GEN, IM YUSUF**

PROTOCOL

1. It is with great pleasure that I stand here on behalf of Nigerian Defence Academy to welcome you all to the 40th National Solar Energy Forum 2022. We particularly welcome the Executive Governor of Kaduna State, His Excellency, Mallam Nasir Ahmed El-Rufai, the Special Guest of Honour, His Excellency, Engr Abubakar D Aliyu, Honourable Minister of Power, the Keynote speaker, Ahmad Salihijo Ahmad, Managing Director/CEO of Rural Electrification Agency and Guest Speaker, Prof Eli Jidere Bala, Director General/CEO, Energy Commission of Nigeria and our co-organizers, Solar Energy Society of Nigeria.

2. Your presence here, despite respective busy schedules, is a demonstration of the commitment you all have to the attainment of sustainable energy development in Nigeria.

3. I'm delighted to assure you that NDA highly appreciates the collaboration with Solar Energy Society of Nigeria in organizing this 40th edition of National Solar Energy Forum (NASEF 2022) because of the fact that the main theme of discussion "Role of Green Energy on Sustainable National Security and Economic Growth" is not only apt, but very relevant to current national and indeed global issues.

4. In our quest to keep both our cadets and post graduate students updated and abreast of developments in renewable energy sector, we have introduced various courses, modules, researches and pilot projects in renewable energy as well as the creation of a special Centre for Renewable Energy Research amongst other efforts. We are also in close contact with other stakeholders such as the Energy Commission of Nigeria (ECN), Rural Electrification Agency (REA) and we are keeping tab on various development strides being recorded in the renewable energy sector.

5. Distinguished Ladies and Gentlemen, this is not to say that we are where we want be both at the Academy level and nationally. There is still much to do for us to be at the position of effective green energy deployment in Nigeria. We need to improve the exploitation, availability, distribution, production and consumption of green energy with great emphasis on lowering the negative environmental impacts. This would enable our country to generate and maintain sustainable energy mix of energy resources that could be deployed for both national security activities and economic growth.

6. It is heartwarming to see tremendous effort that has been put in by various, researchers and stakeholders in the green energy sub sector in Nigeria that have been involved in the process of developing green energy roadmap for the energy sector in Nigeria. It therefore, gives us pleasure (NDA) to host many renowned energy experts in our notable Academy.

7. Of course, there are numerous obstacles to achieving this feat some of which this Forum intends to address. Furthermore, the Forum will advocate localization of current global best practices for effective deployment and utilization of our green energy resources.

8. It is my hope therefore, that at the end of the Forum, a clear blueprint to tackle the aforementioned challenges would emerge.

9. Finally, the Special Guests, Distinguished Ladies and Gentlemen, we once again welcome you and wish you all a rewarding interaction.

Maj Gen IM YUSUF

Commandant,
Nigerian Defence Academy, Kaduna



REMARKS

**by the Chairman Local Organising Committee,
 PROF. A. S. SAMBO**

PROTOCOL

It gives me great honour and pleasure to address this epoch making event of the 40th National Solar Energy Forum NASEF (2022) with the theme “Role of Green Energy on Sustainable National Security and Economic Growth” jointly organized by the Solar Energy Society of Nigeria (SESN) and the Nigerian Defence Academy (NDA) Kaduna, with support from the Rural Electrification Agency (REA) , the Energy Commission of Nigeria (ECN) and the National Agency for Science and Engineering Infrastructure (NASENI) holding place here at the JN Garba Hall of the Nigerian Defence Academy (NDA)'s Postgraduate School, Ribadu Cantonment, Kaduna on 29th and 30th August, 2022.

2. On behalf of the Local Organizing Committee (LOC) NASEF 2022, I want to welcome you all to the beautiful city of Kaduna, which I hope will provide you with the serene environment to share your experiences on how best to utilize the abundant solar and indeed other renewable energy resources in the country for solving our acute energy problems, especially now that the whole world is transiting from fossil fuels to renewable energy sources..

3. NASEF 2022 has the theme “Role of Green Energy on Sustainable National Security and Economic growth” with the overall aim to create a platform for effective networking and collaboration amongst research groups, industry practitioners/technology hubs and the in a manner that is in accord with the global development doctrine of triple helix.

4. The Solar Energy Society of Nigeria (SESN), through its initiatives, is uniquely positioned to ensure that scientific research and innovations create the right impact on national economic growth, enhanced security and sustainable development. With the right strategies and support, the unique knowledge base and skills in Nigeria's institutions, access to funding and leveraging of global interfaces can help to unleash the latent capabilities and drive even greater dimensions in knowledge development and innovation.

5. Mr Chairman, distinguished ladies and gentlemen I will like to stress the renewable energy resources of Nigeria are huge. Taking the two renewable energy resources with the greatest potentials in the country and that is solar and wind energy it is clear that while solar energy can be tapped for electricity generation in 85% of Nigeria wind energy will be most viable in the coastal parts of country as well as at the far north and at Jos and Mambilla Plateaus.

6 For solar energy, taking the commonly available 300 Wp solar panels with about 15% efficiency over 1% of the land area of Nigeria with an average 6 hours of sunshine and an average irradiation of 500 Watts per square metre can produce the following power output:



551,000 MW at 100% Capacity Factor
275,500 MW at 50% Capacity Factor
137,750 MW at 25% Capacity Factor

7. Likewise, wind turbine generators of the Fuhrlander design (250kWp) used over 1% of Nigeria's land with an average wind speed of 6 metres per second can produce the following power outputs:

218,365 MW at 100% Capacity Factor
90,985.5 MW at 50% Capacity Factor
30,328.5 MW at 25% Capacity Factor

8. For hydropower, it is possible that a total of about 20,000 MW can be obtained from both small and large hydropower plants in various parts of the country.

9. In line with the afore-mentioned, I would want to assure all participants that adequate arrangements have been made to ensure a very successful conference and for the welfare of all.

10. I wish to thank the leadership of the Solar Energy Society of Nigeria under the able leadership of our own Professor Isa Garba for the kind consideration of finding us worthy of organizing this very important event. We look forward to more collaborations with the Solar Energy Society of Nigeria in our collective bid to stimulate and encourage research and for the technological and socio-economic development of our dear nation.

11. I would also want to sincerely thank the Commandant and his entire Management of the Nigerian Defence Academy Kaduna for the extraordinary interest and commitment shown on this conference and for providing all the support in ensuring a hitch-free, successful and memorable 40th National Solar Energy Forum (2022).

12. Once again, I wish you all a happy stay in Kaduna and a fruitful deliberation.

Thank you and God bless!

Prof. Abubakar S. Sambo, OON, NPOM, FESN, FAS, FAEng, FNSE
Chairman, Local Organizing Committee
40th National Solar Energy Forum (NASEF' 2022)
29th August, 2022



ADDRESS

**by the President, Solar Energy Society of Nigeria,
PROF. ISA GARBA, FESN**

I am greatly delighted to welcome you all to the Solar Energy Society of Nigeria 40th National Solar Energy Forum (NASEF 2022). The Society has sustained the annual tradition of NASEF as a means of providing platform for interaction between stakeholders in renewable energy technologies (RETs) and development, policy making etc. It is also a forum to access the level of technology and development in renewable energy of which solar energy is the major component. The theme of this year's Forum is Role of Green Energy Technologies in Sustainable National Economic Growth and Development.

The theme is very appropriate as stakeholders will discuss extensively on the role of solar energy in Nigeria economy. It is pertinent to note that in the process of transition towards green energy, it set opportunities to produce enormous benefits for the world by the way of sustaining economic and social development, ensuring access to energy for all, enhancing security of energy, improving the quality of environment by reducing the reliance on fossil fuels and others. Green energy is that energy that does not pollute the environment and is renewable in nature. The energy sources such as sunlight, wind, rain, tides etc can be called as green

energy. This is because these are derived from resources that are readily available on earth and can be naturally replenished and do not even harm the environment. The green energy is important as it replaces the negative effects of fossil fuels with more environmentally friendly alternatives.

Consequently, sustainable development strategies based on green energy can make a significant contribution to the economies of countries that stimulate the accelerated opportunities in this direction.

Distinguished participants, you will all agree with me that lack of power has slowed down Nigeria's development. Our industries, farms and other agricultural enterprises have underperformed because of inadequate and affordable power. It is in view of this, I wish to state that solar energy is essential and will boost agriculture; producing crops, and raising livestock. We all know that solar energy uses the sun's light and heat to generate renewable or 'green' power. The power is mostly harnessed by solar panels or photovoltaic cells where they are arranged professionally to capture sunlight in large fields. Please, I would like to conserve time as I believe we are going have a wonderful brainstorming session on this very important gathering.

At this juncture, I want to thank distinguished members of the society who have in so many ways contributed to the upliftment of the society.

I pray they sustain their good works. I want to register my appreciation to the LOC who have worked tirelessly to make this a success. The Society is very much appreciative of the Commandant, the Host of this NASEF 2022 Forum for all his commitments. Sir, we remain indebted to you.

Your Excellency, Mallam Nasir Ahmed El-Rufai, the Executive Governor of Kaduna State, thank you so much for being there for us as a father and not only that, also for your support and physical presence here. Your Excellency, the Special Guest of honour, Engr Abubarkar D Aliyu, the Honourable Minister of Power, thank you so much for gracing this Forum with your esteem presence.

We are heartily delighted to have you in our midst. Guest speaker, Keynote speaker, ladies and gentlemen, the society is most pleased to have you attend this NASEF 2022 Forum.

We appreciate you so much. Thank you all and God bless.



Prof A.S Sambo Annual Lecture

**by Chairman, Renewable Energy – Energy Efficiency Association-Alliance,
DR IMAMUDDEN TALBA**

TITLE:

Regulatory Quality and Performance: a Panacea to Successful Electricity Sector Reform.

ABSTRACT:

"The goal of Policy and Regulatory reforms in the Nigerian Power Sector is amongst others; to address and resolve the challenges in the Electricity value chain; for the purpose of achieving the Sustainable Development Goals and the commitments made in the National Determined Contribution for Climate change mitigation; that will inevitably lead to National Economic growth".



AWARDEES

RECIPIENTS OF THE FELLOWSHIP OF SOLAR ENERGY SOCIETY OF NIGERIA

- | | | |
|-----|--|-----------------|
| 1. | ENGR. ABUBAKAR D. ALIYU,
Honourable Minister, Federal Ministry of Power. | F-SESN 001-2022 |
| 2. | MAJ GEN IM YUSUF,
Commandant, Nigerian Defence Academy | F-SESN 002-2022 |
| 3. | AHMAD SALIHIJO AHMAD,
Managing Director, Rural Electrification Agency | F-SESN 003-2022 |
| 4. | DR. IMAMUDEED TALBA,
Chairman, Renewable Energy, Energy Efficiency Association -Alliance | F-SESN 004-2022 |
| 5. | PROF. KASIM UTHMAN ISAH,
Department of Physics, Federal University of Technology Minna | F-SESN 005-2022 |
| 6. | ENGR. JIMOH RAUF BADAMOSI,
Managing Director, JRB Solar Limited | F-SESN 006-2022 |
| 7. | DR. SANUSI MOHAMMED OHIARE,
Executive Director, -Rural Electrification Fund, Rural Electrification Agency | F-SESN 007-2022 |
| 8. | PROF. MUSA MOMOH
Department of Physics , Faculty of Physics and Computing Science, Usmanu Danfodiyo University, Sokoto | F-SESN 008-2022 |
| 9. | DR. MAMOUDOU SEYNI MAIGA,
Dean of Faculty, University of Dosso, Niger | F-SESN 009-2022 |
| 10. | ENGR. BARKA SAJOU,
Executive Director -Technical Services, Rural Electrification Agency. | F-SESN 010-2022 |
| 11. | ENGR. TASIU SAAD GIDARI-WUDIL,
President, Nigerian Society of Engineers | F-SESN 011-2022 |
| 12. | MRS HABIBA ALI,
Climate Change and Environmental Consultant | F-SESN 012-2022 |
| 13. | PROF. MOSES NKEM CHENDO,
Former Vice Chancellor, Legacy University | F-SESN 013-2022 |
| 14. | ENGR. ABAKA UMAR JAFAR,
Ag. Director Procurement, Energy Commission of Nigeria | F-SESN 014-2022 |
| 15. | DR. KAISAN MUHAMMAD USMAN,
Deputy Director Engineering, NASENI | F-SESN 015-2022 |
| 16. | DR. MIKAILA ZAKARI YA'U,
Rector Federal Polytechnic Shendam, Plateau State | F-SESN 016-2022 |

**RECIPIENTS OF EXCELLENT AWARD OF SOLAR ENERGY SOCIETY OF NIGERIA**

1. **PROF. IDRIS BUGAJE**,
Executives Secretary, NBTE
2. **DR. ABUBAKAR CHIKA MALAMI, SAN**,
Attorney General and Minister of Justice
3. **PROF. BASHIR GARBA**,
Vice Chancellor, Sokoto State University
4. **PROF. M.S. HARUNA**
Executive Vice Chairman, NASENI
5. **PROF. E. J. BALA**,
Director General, Energy Commission of Nigeria
6. **ENGR. (DR.) ABUBAKAR ISA**,
Managing Director, Satimaiha Nig Ltd

RECIPIENTS OF THE LIFE MEMBERSHIP OF SOLAR ENERGY SOCIETY OF NIGERIA

1. **Prof. Chukwuemaka Casmir Z. Akaolisa**, LM-SESN 056-2022
Dean School of Physical Sciences,
Federal University of Technology, Owerri

RECIPIENTS OF THE ADVOCATE OF SOLAR ENERGY SOCIETY OF NIGERIA

1. **MR. SULEIMAN YUSUF**, SA-SESN 001-2022
Chief Executive Officer, Blue Camel Energy Limited
2. **MR. MATHIAS CHUKWUEMEKA CHINYEREZE**, SA-SESN 002-2022
Solar Energy Training Consultant, Abuja Graduate School
3. **ALH ABDULKARIM KABIR**, SA-SESN 003-2022
Energy Commission of Nigeria
4. **ALHAJI AMINU TRADE**, SA-SESN 004-2022
Founder Regional Center for Sustainable
Energy Development in Sub-Saharan Africa
5. **MR. SALISU ISHAK RABIU**, SA-SESN 005-2022
NNPC Retail Limited

Organisation - Category

5. **JRN Solar Limited** SA-SESN 005-2022
6. **Blue Camel Energy Limited** SA-SESN 006-2022
7. **Women Initiatives for Sustainable Environment (WISE)** SA-SESN 007-2022
8. **PSC SOLAR UK** SA-SESN 008-2022
9. **REEEA-Alliance** SA-SESN 010-2022
10. **A.Y. Global Integrated Consult Ltd, Sokoto** SA-SESN 004-2022

RECIPIENT OF THE Prof. A.O.E. ANIMALU ANNUAL AWARD 2022

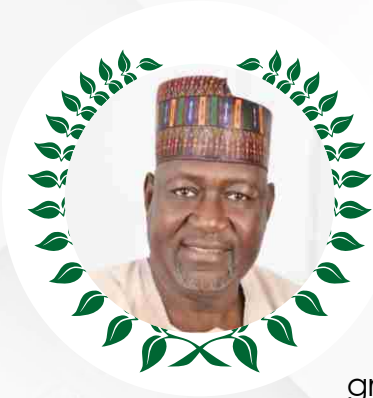
1. **DR. ISMAILA HALIRU ZARMA**
National Programme Officer,
Private Sector Development Japan International Cooperation Agency



CITATION OF THE AWARDEE

ENGR. ABUBAKAR D. ALIYU,

Honourable Minister, Federal Ministry of Power.



Engr. Abubakar D. Aliyu, is the Honourable Minister for Power, an experienced Minister with a demonstrated history of working in the government administration industry. Skilled in Engineering, Team Development, Human Resources, Infrastructure, and Teaching. Strong community and social services professional graduated from University of Maiduguri.

Engr. Aliyu hails from yobe, potiskum Local Government Area. An engineer by profession. Mr Abubakar Aliyu attended Central Primary School Jimeta, where he had his First School Leaving Certificate in 1979. He proceeded to GSSS Monguno in Borno State where he obtained his West African School Certificate in 1984.

Engr. Aliyu later proceeded to Kaduna state Polytechnic where he got a National Diploma (ND) in Civil Engineering in 1988 and HND in High Ways and Transportation Engineering in 1993. In 1999 he obtained his Bachelor of Engineering in Civil and Water Resources Engineering from the University of Maiduguri. He is currently a Fellow in the Nigerian Society of Engineers.

Engr. Abubakar Aliyu had worked as a Technical Officer in Borno State Ministry of Works in 1988 to 1991, he became the Principal Engineer and also Head of Engineering Department in 2004, and Supervising Project Engineers Yobe State Ministry of Housing in 2007. Engr . Aliyu was also the Managing Director, Yobe State Housing and Property Development Corporation in 2009, overseer State Ministry of Health Yobe State, and overseer State Ministry of Commerce Yobe State. He also overseer State Ministry of Integrated Rural Development Yobe State and Deputy Governor Yobe State form 2009 to 2019.

Engr. Aliyu served in various state task force and committees , such as State Task Force On Immunization And Primary Healthcare; State Committee On Resettlement And Rehabilitation Of Internally Displaced Persons ;* State Boundary Committee
* State Environmental Committee; State Sanitation Committee.

Engr. Aliyu received various some of which are; Distinguished Service Award By Thinkers Magazine; Meritorious Service Award By The Task Force On Immunization And PHC'; Best Deputy Governor Of The Decade Award By North East Star Magazine.

Engr. Abubakar D. Aliyu is married and blessed with children.



CITATION OF THE AWARDEE

MAJ GEN IM YUSUF,

Commandant, Nigerian Defence Academy



Maj Gen Ibrahim Manu Yusuf joined the NDA as a member of 37 RC in 1985 and was commissioned into the Nigerian Army Armoured Corps in the year 1990. Since then, he has served meritoriously in various capacities including instruction, staff and command. He has taught at all levels of training in the Nigerian Army and at international level. He was a Directing Staff in the Armed Forces Command and Staff College as well as National Defence College, and Course Director in the Kofi Annan International Peace Training Centre, Accra Ghana. He also held prominent staff appointments including Registrar of the Nigeria Defence Academy, Director Campaign Planning and Chief of Operations at the Army Headquarters Department of Operations, and Executive Director at the Nigerian Army Resource Centre. During his tenure as Deputy Director Campaign Planning, he articulated the Campaign Plan for Operation LAFIYA DOLE and also evolved the blueprint for the identification of BHT members by creating the posters of BHT Wanted List which is still being used by the Nigerian Army.

General Yusuf has a solid command footprint. He commanded in the North East theatre of operation. He commanded the 21 Armoured Brigade and 7 Division Maiduguri. During these periods, he earned a commendation for gallantry in the numerous operations carried out by his Brigade. Following the successful operation conducted by his Division in Sambisa Forest in 2018, he was awarded the Nigerian Army Outstanding Operational Command Medal, making him the first General to earn such an award in the NA. As Force Commander Multinational Joint Task Force, he was conferred with a national award "Knight of the Order of Chad" by the Government of Chad in recognition of his achievements in harnessing the resources of the coalition force to conduct series of successful operations in the Lake Chad Islands under very difficult circumstances. Beyond the mentioned awards, General Yusuf is a recipient of the Grand Service Star, Field Command Medal of Honour, General Operations Medal, Foreign Training Assistance Medal, ECOMOG Medal, Multinational Joint Task Force Medal and Operations ZAMAN LAFIYA, LAFIYA DOLE and YANCIN TAFKI Medals. His military awards also include psc (j) and psc (+). He is a Fellow of the Defence Colleges of Nigeria and Bangladesh as well as a Fellow of the Nigerian Army Resource Centre and Historical Society of Nigeria.

His academic qualifications include a BA (Hons) degree in History and Master of Arts Degree in Defence Studies from Kings College London, amongst other postgraduate degrees. Over the years, he has also attended numerous professional and academic courses at the Naval Postgraduate School Monterrey USA, Norwegian Defence International Centre Norway, Transition International in the Netherlands and Harvard Kennedy School Boston USA. To his credit, he has 6 publications – 3 contributions to book chapters and 3 journal publications. He is a fellow of the Historical Society of Nigeria

He assumed office of the Commandant Nigerian Defence Academy on 8 July 2021. In his leisure time, he enjoys walking, reading and watching movies.



CITATION OF THE AWARDEE



AHMAD SALIHIJO AHMAD,

Managing Director, Rural Electrification Agency

Ahmad Salihijo Ahmad is an energy, environmental specialist who offers more than five years of experience. He also offers expertise and insight into regulatory issues. Currently, Ahmad serves as the MD/CEO with the Rural Electrification Agency of Nigeria, where he leads strategy and planning for electrification efforts across rural regions of the country.

Prior to this role, he worked with a private energy consultancy where he was a member of the Executive Management team. In this role, Ahmad helped with thought leadership and strategic operationalization of various solar energy projects across Nigeria. Other roles that Ahmad has held include Special Adviser to the Honourable Minister of Environment at the Federal Ministry of Environment and Principal Infrastructure Officer at the Infrastructure Concession Regulatory Concession.

Ahmad received a Master of Development Studies from the Nigerian Defence Academy, a Master Diploma from CADD, and a Bachelor's Degree in Electrical Engineering and Management from the University of Leeds. He is also active with the Nigerian Society of Engineers and holds a certification from The Council for the Regulation of Engineering in Nigeria (COREN). Beyond his professional work, Ahmad enjoys reading the Harvard Business Review and follows the latest energy news and reports.



PROF. KASIM UTHMAN ISAH,

Department of Physics,
Federal University of Technology Minna

Abubakar Alkasim bagged his Doctorate degree (PhD.) in Energy Physics from then Modibbo Adama University of Technology (MAUTECH), now Madibbo Adama University (MAU) Yola, Nigeria. He is an Associate Professor in the field of Energy and Environmental Physics in the Department of Physics, (MAU), and currently waiting for the confirmation of his Professorship from external assessors He has been teaching courses and conducting research, and also supervised a good number of undergraduate and postgraduate students. He has been visiting lecturer in both state and federal universities. He has many academic awards and distinctions to his credit. He has many publications in the field of Energy and Environmental Physics and has attended many conferences, seminars and workshops. He is a member of many professional bodies such as Nigerian Institute of Physics (NIP), American Solar Energy Society (ASES), International Organization of Physics (IOP), Solar Energy Society of Nigerian (SESN). He has also served in various committees within and outside the university. He is married with children



CITATION OF THE AWARDEE



DR. IMAMUDEED TALBA,

Chairman, Renewable Energy,
Energy Efficiency Association -Alliance

Highly accomplished lawyer and regulator of 40 Years Post- Call experience and successful track record in Legal, Policy, Regulatory affairs and Strategic Leadership. With 26 years regulatory experience, speciality in Energy policy and exceptionally versed in Leadership, Management and Dispute resolution.

Imamuddeen Talbo started his professional career as a State Counsel with Ministry of Justice, Borno State in 1983. He was appointed a Magistrate; and rose to the office of Chief Magistrate (1989 -1991) and Director Judicial Service Commission (March - August, 1991) Borno State-Judiciff/. He also served as Chief Magistrate/Chief Registrar in Yobe State Judiciary from 1 9911 993.

Mr. Talba had over 13 years' experience in Insurance Regulations (1 994 -2007) where he served as the pioneer Secretary and Legal Advisor to the National Insurance Supervisory Board (as it then was , then NAICOM in 1997). During his career at NAICOM he headed the legal division and was also secretary and adviser to the Board, he chaired the review of the Insurance Laws, drafted and developed Insurance rules and regulations, supervised the liquidation and receivership of failed Insurance companies, monitored compliance and performance of the insurance licensees, served in the committees of the recapitalization of the Insurance Industry and the Consumer Complains Bureau. He also served as a Board Member of the Economic and Financial Crimes Commission from 2005 -2007, as a representative of NAICOM.

Mr. Talba had another 12 years working experience as a Regulator in the Electricity Sector; with an excellent understanding of Regulatory Policy and Reforms of the electricity industry, Economic regulations, Regulatory compliance and performance monitory, licencing, legal support and market dispute resolution. In cognisance of his regulatory experience, he was appointed as pioneer Secretary to the Nigerian Electricity Regulatory Commission (NERC) in 2007 to establish the secretariat and assist in developing regulatory rules and processes for the electricity sector. In the course of his service with NERC, he served as Head (Director) (Renewable Energy Research and Development Division 2010 -2013), Head (Consumer Affairs Division 2013 201 6) and Head (Legal, licencing and Compliance Division 201 6 -2019).

In 2009, when the Commissioners were suspended, Mr. Talba was appointed the Administrator/Chief Executive to the Commission and served in that capacity for 22 months (FEB 2009 - DEC 2010). He is currently the Chairman of Steering Committee of the Renewable Energy and Energy Efficiency Associations- Alliance (the Umbrella body of all Renewable Energy and Energy Efficiency Associations in Nigeria) a Member of the Board of Transmission Company of Nigeria; and also the Principal Partner of Talba Chambers (a firm of Legal and Regulatory Consultants).

**CITATION OF THE AWARDEE****DR. SANUSI MOHAMMED OHIARE,**

Executive Director, -Rural Electrification Fund,
Rural Electrification Agency



Dr. Sanusi Mohammed Ohiare, Executive Director in charge of Rural Electrification Funds, obtained a Bachelor's degree in Economics with Second Class Honours, Upper Division, from the University of Jos in 2006. He attended the Centre for Energy, Petroleum, Mineral Law and Policy, University of Dundee, Scotland, from where he obtained a Master's degree in Energy Studies, with specialization in Energy Finance, in 2011. He holds a PhD in Rural Energy Development from the Institute for Energy and Sustainable Development, De Montfort University, Leicester, England, in 2014. He is said to be the only Nigerian with specialization in that area.

Prior to joining REA, Ohiare had worked with the German International Cooperation Agency (GIZ) as National Advisor on Rural Electrification, under the Nigerian Energy Support Programme, co-founded by the European Union and the German Government. In that capacity, he provided technical support to the REA and the Nigerian Electricity Regulatory Commission in the areas of data management and systems planning for rural electrification support for the development of mini-grids pilot projects. He also coordinated the programme in the northern states.

Ohiare has worked with the Nigerian Bulk Electricity Trading Plc; Sustainable, Policy and Innovative Development Research (SPIDER) Solutions; Federal Capital Territory Administration, Abuja, and various private companies in different capacities. He was a member of the Presidential Committee that reviewed the Rural Electrification Strategy and Implementation Plan document for the country in 2013. He was also a member of the team that drafted the mini-grid regulations of 2016.

He is a member of the International Association of Energy Economics (IAEE); Lagos Oil Club; Society for Petroleum Engineers and the Energy Institute of the United Kingdom



CITATION OF THE AWARDEE



PROF. MUSA MOMOH,

Department of Physics ,
Faculty of Physics and Computing Science,
Usmanu Danfodiyo University, Sokoto

Musa Momoh was born in Igarra, Edo state, to the family of late Chief Saliu Momoh, the Attah-Ibaya of Igarra. He attended Moslem School for his primary school education. Between 1968-1972, he attended St. Paul Grammar school where he obtained the West African school Certificate (WAEC). Between 1975 and 1980, he proceeded to the University of Benin where he was awarded a Bachelor of Science degree Applied Physics . After obtaining a Second Class Upper degree, he undertook the mandatory one-year National Youth Service with Federal Polytechnic, Yola, Gongola State. He secured employment with College of Education Benin City (1981-1982) and University of Sokoto, now Usmanu Danfodiyo University (UDUS) (1982-date). He went to the University of Manchester Institute of Science and Technology (UMIST) where he obtained his Master of Science degree in Power Electronics System. (1982-1984).

He came back home to Nigeria to continue academic work as a lecturer at the Usmanu Danfodiyo University, Sokoto. In 1995, he began attending the Ahmadu Bello University, graduating with a Ph.D degree in Physics in 2000.

He was appointed as the Head of department of physics in 2000, a position he had for 16 years (2000-2016). He became a professor of Applied physics in 2003.

Musa has served as President of Science Association of Nigeria, SAN(2008-2010), Executive Member, Nigerian Institute of Physics (2003-2006), Chairman, Technical Committee for NASEF 2011, Solar Africa 2012, 2017, etc. He is also a fellow of SAN and NIP.

Momoh is married and has four children. He is a member of several professional bodies including Solar Energy Society of Nigeria, Science Association of Nigeria, Nigerian Institute of Physics, etc.



JIMOH RAUF BADAMOSI

Managing Director, JRB Solar Limited

He holds HND in Public Administration from Federal Polytechnic, Nassarawa and has undergone extensive courses in the design and construction of inverters, UOS, security alarms and other electrical circuit devices.

Going forward, Mr. Jimoh exhibits extensive knowledge in the design and installation of various kinds of domestic and industrial solar power systems.

He manages the overall operations of JRB Solar Investment, including product development, marketing, communications, and logistics.

Also, he develops and approves strategies to meet investor, consumer, and employee needs. Indeed, he is a visionary leader who successfully supervised the transition of JRB Solar Investment Ltd from a mere idea into a resounding reality.

Under his leadership, the company has acquired strategic partnership with AnjiDasol Science and Technology and 4plus Belgium.



CITATION OF THE AWARDEE



ENGR. BARKA SAJOU,

Executive Director Technical Services,
Rural Electrification Agency

He holds a Bachelor's degree in Electrical and Electronics Engineering from the University of Maiduguri; a Master's degree in Electrical Power Engineering, from the University of Greenwich, United Kingdom and a Post Graduate Diploma in Grid Integration and Distributed Renewable Energy from the University of Zaragoza, Spain.

Sajou has worked on various projects which include the Green Bond of the federal government, as a lead off-grid power specialist; Power Infrastructure Advisor under the Nigeria Infrastructure Advisory Facility led by the DFID and a transaction advisor for the development of SHS, mini-grids and independent power plants (IPPs). Before he joined REA, he was the Senior Manager, Strategy and Corporate Planning at the Abuja Electricity Distribution Company Plc. In that position, he led product innovation, strategy and corporate development, as well as project development for decentralized energy solutions.

Sajou joined REA with about 10 years' experience in electrification planning, power infrastructure finance, project development, power reforms and operations.



PROF. MOSES NKEM CHENDO,

Former Vice Chancellor,
Legacy University

Prof. Moses Nkem Chendo is a Nigerian from Umudioka in Dunukofia Local Government Area of Anambra State. He obtained his B.Sc (Chemistry) from the University of Benin, MSc and PhD in Industrial Chemistry from Nnamdi Azikiwe University. He is a pioneer staff in the Pure and Industrial Chemistry Department of Chukwuemeka Odumegwu Ojukwu University where he has served variously as Head of Department, Dean Student Affairs, Director Academic Planning, University Orator, Member of the Governing Council, and presently Dean School of Postgraduate Studies.

Moses Chendo is the pioneer Vice Chancellor of Legacy University, and has also served Chemical Society of Nigeria (CSN) as Chairman Anambra Chapter, National Publicity Secretary, Deputy Vice President South East, Representative at the Federation of African Societies of Chemistry and presently, the President and Chairman of Council. Chendo is a Professional Teacher, Chartered Chemist, Fellow of ICCON and CSN and Member Teachers Registration Council of Nigeria.



CITATION OF THE AWARDEE



ENGR TASIU SAAD GIDARI-WUDIL,

President, Nigerian Society of Engineers

ENGR. TASIU SAAD GIDARI-WUDIL (ENGR. WUDIL), FNSE, SMIEEEE, FNIEEEE, MNIM

Engr. Tasiu Saad Gidari –Wudil (Engr. Wudil), FNSE, SMIEEEE, FNIEEEE was born on the 12th September, 1962 at Wudil, in Kano State. His early educational career saw him through the Wudil Central Primary School, Government Technical College, Wudil, Science Secondary School Dawakin Kudu where he wrote and got eight credits at the West African Examination in 1983. He later got admission into the Federal University of Technology (now ATBU), Bauchi to study Electrical and Electronics Engineering in 1985. Engr. Wudil holds a Master of Engineering in Electrical Engineering (Power & Machines) and Bachelor of Engineering in Electrical Engineering (Power & Machines) from Abubakar Tafawa Balewa University, Bauchi. Currently, Engr. Gidari-Wudil is a PhD student at the Abubakar Tafawa Balewa University Bauchi.

WORKING EXPERIENCE:

Engr. Gidari-Wudil worked with the Kano State Science and Technical Schools Management Board as Electrical Instructor at the Government Technical College, Wudil. He also served as Engineer 1 (Electrical) at the Ministry of Education, Kano. He got a job with the Bayero University Computer Centre as Computer Maintenance Engineer but later joined the defunct National Electric Power Authority (NEPA). Engr. Gidari-Wudil is now an Assistant General Manager with the Nigerian Electricity Regulatory Commission.

NSE ACTIVITIES

Engr. Gidari-Wudil is a true NSE man with passion for the development of young engineers, and protection of the dignity of the Nigerian engineer. He has served at various levels in Jos, Bauchi and Maitama Branches. He served on various boards and in committees at the NSE National level. He has been on COREN and NBTE accreditation teams.

Engr. Gidari-Wudil was overwhelmingly elected as Vice President of NSE at Uyo in 2016. He superintended the Engineering Bureau Service Department and Board (Engineering Manpower Bureau, Cost Indices and Infrastructural Score Card Committee, Accreditation Committee). He was the pivot of the implementation of the Computer Based Test for NSE corporate examination. He also championed the creation of the Energy Audit Study Group. The EBS Board under his leadership introduced the Engineering Product Endorsement Scheme which is yet to be approved by Council. He has excellently represented the NSE President on several occasions and chaired Council meeting for some moment holding brief for the President.

In 2018 he was re-elected as Vice President, for 2019, by yet another majority of the Nigerian engineers. He was assigned to supervise the Engineering Regulation, Legislation and Liaison Board.



CITATION OF THE AWARDEE



MRS HABIBA ALI,

Climate Change and Environmental Consultant

Mrs. Habiba Ahmed Ali is renowned expert in the fields of Project Management, Climate Change, Energy and Environment, Clean Development Mechanism. Environmental Finance development in Nigeria. Mrs Habiba has over 17 years post B.sc and 12 years post MBA development experience in Nigeria with trainings from Europe. She has been with the renewable energy industry since 2005. She started by Working with Developmental Association for Renewable Energies (DARE) as a co-founder and National Coordinator. Where she worked on the CDM project Efficient Cook Stoves for Nigeria, The Solar Lamps Assembly and sales training programme, Solar Dryers for Healthy foods project and a host of others. With the knowledge and experience gathered, Habiba branched out to handle the commercial aspects of the renewable energy industry by launching Sosai. Sosai Renewable Energies offers efficient, reliable and sustainable products for example solar lamps, solar home systems and water filters to the people of mostly the rural and peri urban communities of Northern Nigeria. She possesses a Bachelor's degree in Accounting, A master's in Banking and Finance and currently at Dissertation level of PhD in Management (Finance). She has also acquired trainings in Energy and Environment like:

- Energy for Sustainable Development: University of Lund Sweden.
- Gender in Energy and Environment: Energia
- Formulating proposals for CDM Projects: University of Twente, Netherlands
- Entrepreneurial Management: Enterprise Development center Lagos.

A Vital Voices Grow Fellow, A Cherie Blaire Mentee 2016, Mentor 2017, a World Bank Womenx fellow and a Cherie Blaire Road to Business Growth graduate.

Through Sosai, Habiba is a member of the Manufacturers Association of Nigeria and holds the office of Kaduna north regional coordinator. She is currently the Interim Vice President of Renewable Energies Association of Nigeria. A member of the Partnership for Clean Indoor Air, Global Alliance for Clean Cook stoves, Nigerian Alliance for Clean Cook Stoves and the Nigerian Energy Network.

Currently active as the Managing Director/ CEO Sosai Renewable Energies Company Nigeria, Sosai together with its Partners C-Quest LLC are implementing a nationwide POA for improved cook stoves in Nigeria. Sosai is currently empowering communities and businesses with solar technologies ranging from roof top solar, Solar home systems, 10Kw Micro Grids for communities, Solar Dryers and Integrated Energy Centers.



CITATION OF THE AWARDEE



ENGR. ABAKA UMAR JAFAR,

Ag. Director Procurement,
Energy Commission of Nigeria

Engr. Abaka Jafar Umar was born on 7th June 1969 in Wukari, Taraba State. He is the currently an acting Director Procurement at the Energy Commission of Nigeria. He holds Master Degree in Energy Studies from Federal University of Agriculture Makurdi, Benue, State in 2015 and First Degree in Electrical & Electronic Engineering from University of Maiduguri in 1996.

Engr. Abaka attended the following training programme both International and National;

TRAINING ATTENDED:

- Training on capacity building for procurement -2011
- Procurement and management of engineering projects - 2014
- Training on Procurement planning, policy and project implementation – 2015
- Training on budget 2017, process simplified and implantation strategy -2017
- Training on Procurement Conversion in Digital Bridge Institute (BPP) -2019
- National Training Workshop for Capacity Building on Energy Demand and supply Projections, by ECN, 18th -20th November, 2008
- Training on Solar Photovoltaic Systems in Renewable Energy Academy, Berlin-Germany
- Training on Solar Photovoltaic System Design, and Installation- Japan by JICA-2013
- Training Course in Solar Energy Utilization at Yachiyo Engineering Co Ltd, Kyocera Corporation, Sharp and EECTRIC Power Development Co. Ltd Japan, JICA 2005
- International Summer School and Training on Solar Energy University of Agriculture Abeokuta Nigeria, 2006
- Research Methods, Survey Methodology and Data Management Ibadan 2004
- Training on Advance Solar and Backup Power, by XANTREX, African Energy and Deka, October 2007.
- Training on Sustainable Energy Development for Sub-Saharan Africa on the Use of IAEA's Mode for Energy Supply Strategy Alternative and their General Environmental Impacts (MESSAGE) by International Atomic Energy Agency, Vienna, and October 2006.
- Training on Computer Aided Design (CAD) and Details Project Report (DPR) of Small Hydro Power Scheme by UNIDO Regional Centre for Small Hydro Power, November 2005.
- Training on Maintenance and Installation of Solar PV Systems, by UNESCO, June 2008
- Training on Capacity Building on Small Hydro Power, by UNIDO, May 2004.

Engr. Abaka has membership with following Professional assignments and organisations;

1. Member –Nigerian Institution of Electrical and Electronics Engineers (NIEEE)
2. Member – Council for Regulation of Engineering (COREN)
3. Member – Nigerian Society of Engineers (NSE)
4. Institute of Corporate of Administration of Nigeria



CITATION OF THE AWARDEE



DR. KAISAN MUHAMMAD USMAN,

Deputy Director Engineering, NASENI

A. EDUCATIONAL /PROFESSIONAL QUALIFICATIONS WITH DATES

- I. PhD Mechanical Engineering, May, 2017
Ahmadu Bello University, Zaria, Nigeria
- II. M.Sc., Mechanical Engineering, March, 2014
Ahmadu Bello University, Zaria, Nigeria
- III. B.Eng., Mechanical Engineering, October, 2006
Ahmadu Bello University, Zaria, Nigeria

B. JOB EXPERIENCES

- I. Deputy Director, December, 2022-Present
Technical Services, National Agency for Science and Engineering Infrastructure, Abuja
- II. Deputy Director, May, 2021-Dec., 2022
Equipment Maintenance and Development Center, Ahmadu Bello University, Zaria
- III. Senior Lecturer, October, 2019 -Present
Mechanical Engineering, Ahmadu Bello University, Zaria, Nigeria
- IV. Lecturer I, April, 2016- Oct., 2019
Mechanical Engineering, Ahmadu Bello University, Zaria, Nigeria
- V. Scientific Officer, March, 2010- April, 2016
Energy Management Training and Manpower Devt. Energy Commission of Nigeria
- VI. Research Fellow, June, 2014, May, 2015
Industries, National Center for energy Efficiency and Conservation, Uni-Lag, Lagos
- VII. Standards Engineer, Sept., 2009, March, 2010
Mechanical, Standards Organisation of Nigeria, 21 Osuntokun Avenue, Bodija, Ibadan
- VIII. Engineering Management Trainee, Nov., 2008, Sept., 2009
Mechanical Engineering, Ashaka Cement PLC, Bajoga, Gombe State

C. PUBLICATIONS

Journal Articles (65) – Conference Proceedings (35) - Book Chapters (10) -Patents (4)

D. PROFESSIONAL AFFILIATIONS

- COREN Registered Engineer (R20,861) Council for the Regulation of Engg. in Nigeria
- Fellow, African Society for Engineering Management (FSEM)
- Member, Nigerian Society of Engineers, 58,633
- Member, International Association of Engineers (IAENG) (Number, 120697)
- Member, Automotive Engineers Institute (Mo222)
- Member, World Society for Sustainable Energy Technologies
- Member, National Association of Evaluators
- Member, Association of Nigerian Inventors
- Member, Nigerian Young Academy (MNYA)



CITATION OF THE AWARDEE



DR. MIKAILA ZAKARI YA'U,

Rector Federal Polytechnic Shendam, Plateau State

Dr. MIKAILA, Zakari Ya'u was born on 4th July, 1964 in Bashar, Wase Local Government Area of Plateau State. He attended LGED Central Primary School Bashar where he obtained his First School Leaving Certificate in 1979. He attended Government Secondary School Wamba for his junior secondary school education and Government Technical College Bukuru for his senior secondary school education.

For his university education, Dr. Mikaila studied Mechanical Engineering in the famous Ahmadu Bello University Zaria, the University of Agriculture, Makurdi and the Federal University of Technology, Minna for his first, second and third degrees respectively.

The working career of Dr. Mikaila is very successful, he worked in the Plateau State Polytechnic, Barkin Ladi for eighteen (18) years where he served in different capacities: lecturer, examination officer, project coordinator, Head, Mechanical Engineering Department and Dean, School of Engineering. He also worked with NASCO House Hold Products LTD, Jos for one (1) as a Plant Manager. He joined the service of the Energy Commission of Nigeria in 2010 where he served for eleven (11) years. He left the Commission on Leave of Absence as an Acting Director, Renewable Energy Department to take up an appointment as the Rector, Federal Polytechnic Nyak Shendam, Plateau State in 2021.

Dr. Mikaila is married with six (6) children



DR. MAMOUDOU SEYNI MAIGA,

Dean of Faculty,
University of Dosso, Niger

Dr. Mamoudou Seyni Maiga is the Acting Head at the Centre on Energy Efficiency - ANASOL Partnership University of Dosso, Niger. He holds PhD in Economics and management of the Sustainable Energy from the South Western University of Finance & Economics in 2010 and MSc in Energy and Environmental Economics and Policy from the Technical University of Lisbon, College of Economics and Management in 2005. Dr. Maiga has been in charge of the development of energy efficiency implementation projects at local level in developing countries and emerging economies. She also supported the management of the Sustainable Energy for All Accelerators coordination activities in Niger.

Dr. Maiga was the Project Officer, National Energy Agency, Niger and was charged with the responsibility of co-ordination and technical and financial development of energy related projects. He also, served as Senior Expert on Energy Efficiency at the Energy Charter Secretariat (Intergovernmental Organisation), Niamey and was tasked with responsibility of co-ordinating the process of identifying and monitoring progress made by countries in implementing various energy and environmental obligations as well as co-ordinate implementation of reviews of energy efficiency policies and programmes and facilitate access of countries to relevant information on policies, methodologies and models for energy policies and clean technologies in Niger.



**BOOK
OF
ABSTRACT**



TECHNICAL SESSION			
TIME	ACTIVITY	Chairman/Deputy Chairman of Session /Rapporteurs	VENUE
8:00 - 11:30	Group 1: Bioenergy and Applications	Chairman: Prof. Samaila Umaru Deputy Chairman: Engr. Yusuf Ganda Rapporteurs: 1. Mr. Nafiu Tijjani 2. Alh. Abdulkarim Kabir	NASEF-ROOM 01
	Group 2: Energy and Management	Chairman: Prof. B. G. Danshehu Deputy Chairman: Dr. S. A. Baki Rapporteurs: 1. Mr. Abbas I. Musa 2. Mr. Ismaila Pindiga	NASEF-ROOM 02
	Group 3: Solar Energy and Electronic	Chairman: Prof. Musa Garba Deputy Chairman: Dr. Kaisam Usman Rapporteurs: 1. Mr. Mohammed Goni 2. Dr. A. F. Akande	NASEF-ROOM 03
	Group 4: Wind Energy and Other Energy Resources	Chairman: Prof. Kasim Uthman Isa Deputy Chairman: Dr. Aminu Isa Rapporteurs: 1. Mr. Alhassan Gumel 2. Engr. Rikoto Ismaila	NASEF-ROOM 04
11:30 - 11:45	Tea Break /Networking of Guests and Delegates		



GROUP 1: BIOENERGY AND APPLICATIONS

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
1.	Production And Characterisation Of Pyro-oil Through The Pyrolysis Of Waste-tyres	<p>*¹Lamido S. I., ²Habib M., & ³Pindiga I. S.</p> <p>^{1,2}Department of Petrochemical and Gas Processing Engineering, Kaduna Polytechnic.</p> <p>³Department of Electrical and Electronics Engineering, Kaduna Polytechnic.</p> <p>Corresponding Email: i.lamido@kadunapolytechnic.edu.ng</p>	BA-001
2.	Estimation of Calorific Value of Five Biomass Species From Their Elemental Composition Using Minitab Soft Ware Tool	<p>¹Rikoto I.I., ²Garba I., ²Adamu A.A., ¹Ganda Y.M. ¹Muazu A. M., ³Yakubu A.I, & ⁴Usman M.Z</p> <p>¹Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto</p> <p>²Department of Mechanical Engineering, Bayero University Kano</p> <p>³A.Y Global Integrated Consult Ltd Arkilla Express way Sokoto</p> <p>³National Board for Technology Incubation, Kebbi, Area Office,</p> <p>Corresponding Author: rikoto2003@gmail.com, ismail.isah@udusok.edu.ng Phone: +2348038498566</p>	BA-002
3.	Efficient Bread Baking Oven Using Fewer Firewood Sticks	<p>*¹Musa M. J, ²Salihu O. Y, ¹Kabir A. A, & ³Salawu H</p> <p>¹Dept. of Electronics and Telecommunications Engineering, Ahmadu Bello University, Zaria, Nigeria</p> <p>²Center for Renewable Energy Sustainable Technology and Development, (CRESTAD), Kaduna, Nigeria</p> <p>³Dept. of Electrical Engineering, Kaduna Polytechnic, Kaduna, Nigeria</p> <p>*Corresponding Email: mmjibrin@abu.edu.ng; s.otuoze@kadunapolytechnic.edu.ng; kabrahmed@abu.edu.ng; oipesalau@gmail.com</p>	BA-003



GROUP 1: BIOENERGY AND APPLICATIONS

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
4.	Thermochemical Conversion and Evaluation of Biomass for Production of Green Fuels	<p>¹Rikoto, I.I., ²Garba I.,²Adamu. A.A, ²Yola. I.A., ²M.T Jimoh ¹Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto ²Department of Mechanical Engineering, Bayero University, Kano Corresponding Author: rikoto2003@gmail.com, ismail.isah@udusok.edu.ng Phone: +2348038498566</p>	BA-004
5.	Sustainable Production of Bioethanol From Maize Husk By Simultaneous Saccharification And Fermentation Using <i>acremonium Butyri</i> and <i>Zymomonas Mobilis</i>	<p>^{*1}Bello A. Y., ²Jumare F. I., ¹Hussein R. A. & ¹Haruna Z. A ¹Department of Basic Science and General Studies, Federal College of Forestry Mechanization Afaka, Kaduna, Nigeria. ²Department of Microbiology, Sokoto State University, Sokoto, Nigeria. Corresponding author's Email: abdullahi.belloyusufgwdsok@gmail.com</p>	BA-005
6.	Characterization of Torrefied <i>Calotropis Procera</i> Stem As A Feedstocks For Gasification	<p>^{*1}Tukur U.G., ¹, ² Okoh E.V.C, & ³Umar S. ¹Sokoto Energy Research Centre, Usmanu Danfodiyo University Sokoto, Nigeria ²Department of Pure and Applied Chemistry, Usmanu Danfodiyo University Sokoto, Nigeria ³Department of physics, Kebbi State University of Science and Technology, Aleiro *Corresponding Email:</p>	BA-006



GROUP 1: BIOENERGY AND APPLICATIONS

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
7.	An Overview of Air Pollutants: It Effects on Environment and Health	<p>*¹Aliyu A. S ., ²Abubakar H., & ³Abdullahi M. D. ¹ & ³Centre for Renewable Energy Sustainable Technology and Development (CRESTAD), Kaduna Polytechnic, Kaduna, Nigeria ²Department of Energy Efficiency and Conservation, Centre for Renewable Energy Sustainable Technology and Development (CRESTAD), Kaduna Polytechnic, Kaduna, Nigeria *Corresponding E-mail: asaliyu9090@yahoo.com Phone: +2348028343404</p>	BA-007
8.	A Smart Solid Waste Monitoring System For Environmental Sustainability	<p>*¹Ismail Z. O., ²Lawal D. S , ³Salihu Y. O., & ⁴Hassan A. A. ¹Department of Electrical and Electronics Engineering, Kaduna Polytechnic. Kaduna ²Department of Electrical and Electronics Engineering, Nigerian Defence Academy. Kaduna ³Department of Computer Engineering, Kaduna Polytechnic. Kaduna ⁴Department of Electrical and Electronics Engineering, Kaduna Polytechnic. Kaduna *Corresponding Email: zismail41@yahoo.com</p>	BA-008



GROUP 1: BIOENERGY AND APPLICATIONS

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
9.	Optimization of Biogas Production For Laboratory Scale Experiments	<p>*¹Mohammad A., ¹Zuru A. A., ¹Muhammad C., ²Mu'azu M., & ³Ibrahim B. ¹Department of Pure and Applied Chemistry, Usmanu Danfodiyo University Sokoto ²Department of Mechanical Engineering, Usmanu Danfodiyo University Sokoto ³National Biotechnology Development Agency, Abuja. *Corresponding Email; t jachmad@hotmail.com</p>	BA-009
10.	Treatment Of Waste Water From Upper Niger River Basin Fish Pond With Moringa Oleifera Seeds Under Laboratory Conditions In Minna, Niger State	<p>*Ayanwale A. V., Babakasim M. & Oluwafemi O. J Hydrobiology and Fisheries Unit, Department of Animal Biology, Federal University of Technology, Minna *Corresponding Email: a.adesola@futminna.edu.ng; Phone: +2348036532471</p>	BA-010
11.	Determination of Best Ratio for Optimal Biogas Yield from the Co-digestion of Cow Dung and Chicken Droppings Under Ambient Condition	<p>*Basirat Kikelomo Odunola, & Wunuken Carlos Solomon Department of Mechanical Engineering Faculty of Engineering and Technology, Nigerian Defence Academy, Afaka, Kaduna-Nigeria. *Corresponding Email: bkodunola@nda.edu.ng; Mobile Number: 08153004551</p>	BA-011



GROUP 1: BIOENERGY AND APPLICATIONS

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
12.	Comparative Studies of Single and Cascaded Rocket Firewood Burning Stoves Based On Energy Analysis Method	<p>¹Lawal S., ²Abubakar H. N., & ³Mati A. A. ¹Directorate of Physical Planning and Development, Umaru Musa Yar'adua University, Katsina, Nigeria. ²Centre for Renewable Energy Research and Development, Umaru Musa Yar'adua University, Katsina, Nigeria ³Centre for Nuclear Energy Research, Ahmadu Bello University Zaria, Nigeria *Corresponding Email: abubakar.haruna@umyu.edu.ng; Tel: 08056000617</p>	BA-012
13.	Modelling and Defect study of Sn-based HTM-free Perovskite Solar Cell using SCAPS Software	<p>¹Danladi, E., ²Adekanye, O. O., ³Oni, E. M., and ⁴Michael, U. S. ¹Department of Physics, Federal University of Health Sciences, Otukpo, Benue State, Nigeria ²Department of Physics, Airforce Institute of Technology, Kaduna, Nigeria ³Department of Electrical and Electronics Engineering, Nigerian Defence Academy, Kaduna, Nigeria ⁴Department of Physics, Nigerian Defence Academy, Kaduna, Nigeria *Correspondence: Email Address: danladielibako@gmail.com Phone number: +2348063307256</p>	BA-013
14.	Effect of Film Thickness of a Dye-Sensitized Solar Cells Deposited Using Screen Printing Technique	<p>Samaila Buda^{1*}, Ibrahim Danmalam^{1,}, Kabir ahmed Dabai^{1,}, and Nuhu Sani Jega^{2,} ¹Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto ²Adamu Augie College of Education Argungu, Kebbi state *budasamaila@gmail.com</p>	BA-014



GROUP 1: BIOENERGY AND APPLICATIONS

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
15.	Utilization of Carbon Nanotubes in Perovskite Solar cell for Enhanced Performance	¹ Michael, U. S., ¹ Onimisi, M. Y., ² Danladi, E., and ³ Oni, E. M. ¹ Department of Physics, Nigerian Defence Academy, Kaduna, Nigeria. ² Department of Physics, Federal University of Health Sciences, Otukpo, Benue State, Nigeria. ³ Department of Electrical and Electronics Engineering, Nigerian Defence Academy, Kaduna, Nigeria. *Correspondence: Email: udesmik@gmail.com Phone number: +2347030498215	BA-015
16.	Design Of Hybrid Solar Air Conditioning System Based On The Weather And Environmental Conditions Of Nigeria	Alkali Saifullahi Auwalu ^{1*} , Khalid K. Dandago ² , Ibrahim Mahmud Khilishi ³ ¹ Energy Systems Engineering Department, Cyprus International University, Cyprus. ² Aerospace Engineering Department, Air Force Institute of Technology, Kaduna, Nigeria. ³ Department of Education Technical, Kano State Polytechnic, Kano, Nigeria. *Corresponding Author Email: saalkali99@gmail.com Contact Phone Number: 08077775777	BA-016



GROUP 2: ENERGY AND MANAGEMENT

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
1.	Green Energy: The Panacea to Reversing Desertification and Poverty in Nigeria	* ¹ Maiwada N. A., ² El-Ladan A. H & ³ Abdullahi U.S ¹ Department of Geography, Umaru Musa Yar'adua University, Katsina, Nigeria ² Ibrahim Shehu Shema Centre for Renewable Energy and Research, Umaru Musa Yar'adua University, Katsina, Nigeria ³ Havage Engineering Services Limited, Kaduna, Nigeria *Corresponding E-mail: nuramaiwada@yahoo.com, Phone: 08037372928	EE-001
2.	Optimization of The Industrial Use of Renewable Energy For Sustainable And Cost Effective Rural Electrification	* ¹ Njoku C.O, ¹ Uche E.U, ² Gambo V.A, & ³ Yekini B.Y ¹ Department of Mechanical Engineering, Air Force Institute of Technology, Kaduna ² Department of Mechanical Engineering, Ahmadu Bello University, Zaria ³ Department of Mechatronics Engineering, Air Force Institute of Technology, Kaduna *Corresponding Email: christianonye521@gmail.com, eaumie@gmail.com 08034315747	EE-002
3.	Green Energy Sustainability as a Tool To Economic Growth In Nigeria	* ¹ Mamuda M., ² Maishanu S. M. & ³ Khalil I. A ¹ Department of Mechanical Engineering, Usmanu Danfodiyo University Sokoto ² Department of Plant Science, Usmanu Danfodiyo University Sokoto ³ Sultan Muhammadu Maccido Institute for Qur'an and General Studies Sokoto Corresponding Author: mamuda.muhammad@udusok.edu.ng	EE-003



GROUP 2: ENERGY AND MANAGEMENT

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
4.	Renewable Energy Consumption Reduce Unemployment In Nigeria: Evidence From Econometrics Analysis	¹ Bawalle A. A. & ² Zarma I. H. ¹ Centre for Management Development, Nigeria ² Science, Technology & Innovation (ST&I) and Digital Transformation (DX), Japan International Cooperation Agency (JICA), Nigeria Office *Corresponding Email: aleeukabo@gmail.com; ZARMA-Ismaila@jica.go.jp Phone: +2348034887166	EE-004
5.	Energy Security and Sustainable Rural Transformation In Nigeria	Chigasa C. U.; *Chibueze E. N.; Chidiebere E. A; Ezinne F O.; Gerald A.; & Izuchukwu F. O. National Centre for Energy Research and Development, University of Nigeria, Nsukka. *Corresponding author: E-mail: chibueze.nnaji@unn.edu.ng	EE-005
6.	Assessment of the Status of Renewable Energy Utilization and Human Development in Nigeria	Olabomi R. A. National Institute for Policy and Strategic Studies (NIPSS), Kuru, Nigeria Corresponding Email: rasaanolabomi@yahoo.com	EE-006
7.	Linking Renewable Energy Technologies Acceptance and Effective Transition to Green Energy: Evidence from Rural Nigeria for Policy Making	¹ Naseer BabangidaMuazu & ² Bauna Faith Koyan ^{1,2} Centre for Energy and Environmental Strategy Research, Kaduna State University *Corresponding Email: nmbabangida69@gmail.com	EE-007
8.	Green Buildings as a Vehicle Towards Achieving Sustainable Development Goals In Nigeria	*Mu'azu A. I. Department of Architecture, Baze University, Abuja *Corresponding Email: Abbas.muazu@bazeuniversity.edu.ng; Phone: 0802 795 6333	EE-008



GROUP 2: ENERGY AND MANAGEMENT

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
9.	An Appraisal of The Impact of Privatization Of The Electricity Sector In Nigeria	* ¹ Musa A. I. & ² Zarma I. H. ^{1,2} Energy Commission of Nigeria, Abuja *Corresponding Email: bundu02@yahoo.com	EE-009
10.	Nigeria's Energy Transition Pathway: The Role of Technology, Investment, Business Strategies and Policy	* ¹ Sambo A. S., ² Zarma I. H., & ³ Dioha I. J. ¹ Faculty of Engineering and Environmental Design, Usmanu Danfodiyo University, Sokoto ² Africa Centre of Excellence for Sustainable Power and Energy Development (ACE-SPED), University of Nigeria, Nsukka ³ Admiralty University of Nigeria *Corresponding Email: ismailzarma@yahoo.com	EE-010
11.	Green Energy Development in Nigeria: Law, Regulation, Trends and Opportunities	* ¹ Sambo A. S., ² Bala E. J., ² Zarma I. H., & ³ Dioha I. J. ¹ Usmanu Danfodiyo University, Sokoto ² Energy Commission of Nigeria ³ Admiralty University of Nigeria *Corresponding Email: ismailzarma@yahoo.com	EE-011
12.	Green Energy as a Factor For Security and Economic Development: Prospects For Nigeria	*Lawan S., Aliyu S. & Danjumma I.M. Department of Electrical/Electronic Engineering, Nigerian Defence Academy, Kaduna *Corresponding Email: slawal@nda.edu.ng	EE-012
13.	Meticulous Shift to Green Energy	*Muhammad Y. & Yusuf U G Usmanu Danfodiyo University Sokoto *Corresponding Email: yousshuf@gmail.com; Phone no.:08176880413	EE-013



GROUP 2: ENERGY AND MANAGEMENT

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
14.	Renewable Energy Mixroles In Achieving Sustainable Development Goals In Nigeria	<p>*¹Utazi N. D.,^L. ¹Soretire K. & ^{1,2}Umaru, S. ¹Mechanical Engineering Department, Air Force Institute of Technology Kaduna, Nigeria ²Department of Mechanical Engineering, Ahmadu Bello University Zaria, Nigeria *Corresponding Emails: bnumar@yahoo.com; Phone::+2348053392760</p>	EE-014
15.	The Impact Of Information and Communications Technology on Productivity Of Customer Service For Kaduna Electric Company	<p>*¹Labbo A. , ¹Yobo P., & ¹Ekpemi S. ¹Department of Business Administration, Air Force Institute of Technology Kaduna, Nigeria *Corresponding Emails: aminazuru8890@gmail.com; Telephone Number:08067300859</p>	EE-015
16.	Promising Potentials of Agrivoltaic Systems for the Development of Nigeria Green Economy	<p>*Muhammad Bello Garba Department of Technical Education, Shehu Shagari College of Education, Sokoto *Corresponding Email: engrbgmuh@gmail.com; Tel. +234 806 940 5869</p>	EE-016
17.	The Influence of Certain Factors on Photovoltaic ModulePerformance	<p>N Achara, SU Mohammed, W Solomon Department of Mechanical Engineering, Nigerian Defence Academy, Kaduna Email: ekoamuzu@gmail.com, mobile: 08107095701</p>	EE-017



GROUP 3: SOLAR ENERGY AND ELECTRONIC

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
1.	Effect of Sputtered Silver Thin Film Thickness Towards Morphological And Optical Properties Of Black Silicon Fabricated By Two-step Silver-assisted Wet Chemical Etching For Solar Cells.	* ₁ Auwal Abdulkadir & ₂ Aliyu Kabiru Isiyaku ₁ Department of Physics, Umaru Musa Yar'adua University, Katsina, Nigeria. ₂ Department of Physics, Kaduna State University, Kaduna, Nigeria. *Corresponding Email: auwal.abdulkadir@umyu.edu.ng +2348066845094	SEE-001
2.	Experimental Study of Flow Over Roughed Crump Weir Using Soft-computing Techniques	Sani Yakubu Khalifa ₁ Department of Water Resources and Environmental Engineering Ahmadu Bello University Zaria, Kaduna state, Nigeria. Khalees2k1@gmail.com	SEE-002
3.	Impact Of Micro Textures Sizes Towards Light Absorption Enhancement In Hybrid Micro/nano Textured Black Silicon For Photovoltaics	* ₁ Auwal Abdulkadir & ₂ Aliyu Kabiru Isiyaku ₁ Department of Physics, Umaru Musa Yar'adua University, Katsina, Nigeria. ₂ Department of Physics, Kaduna State University, Kaduna State, Nigeria. *Corresponding Email: auwal.abdulkadir@umyu.edu.ng, Phone: +2348066845094	SEE-003
4.	Biopic Solar Air-conditioner in Mechanize Agriculture for Sustainable Development	_{1,2} Sani U. K. & ₃ Zingying L ₁ National Board for Technology Incubation, Federal Ministry of Science Technology and Innovation, Abuja. ₂ Mechatronic Engineering Department, Nigerian Defense Academy Kaduna ₃ Institute for the Development of Energy for African Sustainability (IDEAS), Johannesburg, South Africa Corresponding Email: ubasani265@gmail.com; uba.sani2020@nda.edu.ng Phone:+234 706 500 8838	SEE-004



GROUP 3: SOLAR ENERGY AND ELECTRONIC

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
5.	Design of an Alternative Solar Power for a Residential Building at Naibawa Area, Kano	¹ Rikoto I. I., ² Usman I. I., ³ Ikpa T.M., ¹ Ganda Y.M., ⁴ Yakubu A.I., & ¹ Umar N. ¹ Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto, Nigeria ² Department of Mechanical Engineering, Bayero University, Kano, Nigeria ³ TOKOMIT Nigeria. Ltd Abuja ⁴ A.Y. Global Integrated Consult Ltd, Sokoto Corresponding Email: rikoto2003@gmail.com, Tel: +2348038498566	SEE-005
6.	Load Analysis of Sokoto Guest Inn Ltd For Solar Photovoltaic System Design and Economic Analysis Of The System	¹ Dabai K. A., ² Argungu G. M., ^{1,2} Buda S. & ² Umar H. S. ¹ Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto ² Department of Physics, Usmanu Danfodiyo University, Sokoto *Corresponding Email: kabir.ahmed@udusok.edu.ng	SEE-006
7.	Installation of Solar Carport for the Provision of Car Shade and Lighting of Staff Quarters in Delta	*Dioha, I. J. & Chidozie E. Renewable Energy Unit, Admiralty University of Nigeria, Ibusa, Delta State. *Corresponding Email: dioha-energy@adun.edu.ng	SEE-007
8.	Experimental Analysis of Fixed and Dual axis Solar Tracker using Analytical Solar Angle Parameters of Kano City, Nigeria	¹ Muhammad J. Y.; ² Gele M. A.; ³ Kadawa I. A.; ¹ Anas B; ³ Kamal A. A. ¹ Department of Mechanical Engineering, Nigerian Army University, Biu, Nigeria ² Sokoto Energy Research Centre, Usmanu Danfodiyo University Sokoto, Nigeria ³ Department of Electrical and Electronics Engineering, Nigerian Army University Biu, Nigeria *Email Addresses: jambcyfm@gmail.com	SEE-008



GROUP 3: SOLAR ENERGY AND ELECTRONIC

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
9.	Heat Spreading Enhancement Capability of BAIN Nanocomposite at Harsh Ambient on White-based High-Power LED	* ^{1,2} Hamza El-ladan A. ¹ Centre for Renewable Energy and Research, Umaru Musa Yaradua University (UMYU), Katsina ² Nano Optoelectronics Research Laboratory, School of Physics, Universiti Sains Malaysia (USM), 11800 Minden, Pulau Pinang, Malaysia *Corresponding Email: abdulkarim.hamza@umyu.edu.ng Phone: 08065525224	SEE-009
10.	Position Control Of a Solar Tracking System Using a Proportional-integral (pi) Controller And Sliding Mode Control (smc)	* ¹ Beli A. I., ² Zaiyanu N., ³ Bashir S. U. ¹ Electrical & Electronics Engineering Department, Kaduna Polytechnic ² Department of Electrical & Electronics Engineering Technology, Nuhu Bamalli Polytechnic, Zaria. ³ Department of Electrical & Electronics Engineering Technology, Federal Polytechnic Damaturu. *Corresponding Email: a.beli@kadunapolytechnic.edu.ng ,	SEE-010
11.	Effects of Aluminum Dopants on ZnO Nanoparticles for NDSSC Applications	* ^{1,3} Offiah S. U., ² Orizu G. E., ³ Ugwuoke P. E., & ³ Ezema F. I. ¹ National Centre for Energy Research and Development, University of Nigeria Nsukka, ² Department of Physics and Industrial Physics, Nnamdi Azikiwe University Awka ³ Department of Physics and Astronomy, University of Nigeria Nsukka *Corresponding Email: offiahsolomon@gmail.com	SEE-011



GROUP 3: SOLAR ENERGY AND ELECTRONIC

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
12.	A Brief Review of Progress in Electron Transport Layers in Perovskite Solar Cells	^{*1,2} Yusuf A.S., ² Anderson T. M, & ³ Prasad K. ¹ Department of Physics, Federal University of Technology, Minna, Nigeria. ² Department of Physics and Astronomy, Auckland University of Technology, New Zealand. ³ Department of Electrical and Electronics, Auckland University of Technology, New Zealand. *Corresponding Email: ayusuf@futminna.edu.ng	SEE-012
13.	Parametric Design Considerations Of Hybrid Solar Photovoltaic – Diesel System	^{*1,2} Mawoli M., ³ Sambo, A.S., ^{1,2} Dabai, K.A., ¹ Ganda Y.M. & ¹ Rikoto, I.I. ¹ Sokoto Energy Research Centre, Usmanu Danfodiyo University Sokoto ² Department of Electrical & Electronic Engineering, Usmanu Danfodiyo University Sokoto ³ Faculty of Engineering and Environmental Design, Usmanu Danfodiyo University Sokoto *Corresponding Email: mawoli.mohammed@udusok.edu.ng	SEE-013
14.	An Off Grid Photovoltaic Solar System Design: A Case Study of Kaduna Polytechnic	^{*1} Hamisu Usman, ² Aminu Hamisu Kuraand, & ² Muhammad Mustapha Saleh ¹ Department of Electrical and Electronic Engineering, Kaduna Polytechnic, Kaduna ² Department of Electrical Technology, Federal College of Education (Technical) Gusau, Zamfara state *Corresponding Email: hamisuusman@kadunapolytechnic.edu.ng;	SEE-014



GROUP 3: SOLAR ENERGY AND ELECTRONIC

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
15.	A Review: Perovskite in Tandem Solar Cell	* ₁ Muhammad B M., ₂ Isah K. U., ₂ Abdulkareem A. S., & ₂ Ibrahim S. O. ₁ Department of Physics, Federal Polytechnic Bide, ₂ Department of Physics, Federal University of Technology, Minna *Corresponding Email: bakeko4711@gmail.com	SEE-015
16.	Energy Audit And Solar Pv System Analysis Of a Residential Building: A Case Study Of 3 Bedroom Apartments At Agric Quarters Kaduna	* ₁ Labbo A., ₂ Utazi N. D., ₂ Soretire L. K., & ₁ Yobo P. ₁ Department of Business Administration, Air Force Institute of Technology Kaduna, Nigeria ₂ Department of Mechanical Engineering, Air Force Institute of Technology Kaduna, Nigeria *Corresponding Email: aminazuru8890@gmail.com; Telephone Number:08067300859	SEE-016
17.	A Review on Dye Sensitized Solar Cells (DSSCs): Present Status And Future Prospects	* ₁ Abubakar A. A., ₁ Isah K. U., ₁ Kimpa M. I., ₁ Ibrahim S. O., & ₁ Yusuf A. S. ₁ Department of Physics, School of Physical Sciences, Federal University of Technology Minna. *Corresponding Email: aa.ahmad@futminna.edu.ng;	SEE-017
18.	Assessment and Cost Implication for the Design of a Standalone Alternative Solar Power for Sultan Bello Jummat Mosques, Sokoto	* ₁ Rikoto I. I., ₁ Dabai K. A., ₁ Yusuf N., ₂ Labbo A. & ₃ Abubakar I. L. ₁ Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto ₂ Dept. of Business Administration, Air Force Institute Technology. Kaduna ₃ Department of Electrical Engineering, Waziri Umaru Polytechnic Birnin Kebbi *Corresponding Author: rikoto2003@gmail.com; Tel: 08038498566	SEE-018



GROUP 3: SOLAR ENERGY AND ELECTRONIC

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
19.	Investigating The Absorption Of Solar Radiation By Dust And Glass and Their Effects on Pv Solar Panels in Kaduna Metropolis	*Mohammed Mannir Aliyu Physics Department, Kaduna State University, KASU, Kaduna *Corresponding Email: mannir2003@yahoo.com	SEE-019
20	Optoelectronic Properties of Nitrogen doped S_b2S_3 for solar Cell Application: A G_0W_0 calculation	Abdullahi Lawal* and Ibrahim D Yusuf Department of Physics, Federal College of Education Zaria, P.M.B 1041, Zaria, Kaduna State Nigeria	SEE-020

GROUP 4: WIND ENERGY AND OTHER ENERGY RESOURCES

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
1.	Economic Analysis of Wind Generated Electricity from Three Selected Sites in Nigeria	¹ Samuel M., ² Muhammad S.U., & ³ Solomon W.C. ^{1,2,3} Dept of Mechanical Engineering, Nigerian Defence Academy, Kaduna *Corresponding Email: marydibal267@gmail.com; sumammed@nda.edu.ng; scwunuken@nda.edu.ng	WEOER-001
2.	An Overview of the Exploitation of Renewable Energy Resources in Nigeria	¹ Julius A. Y.; ² Zarma I. H.; & ³ Garba I. ¹ Energy Commission of Nigeria HQTRS, Abuja ² Africa Centre of Excellence for Sustainable Power and Energy Development (ACE-SPED), University of Nigeria, Nsukka ³ Nigeria Defence Academy (NDA) Kaduna *Corresponding email: juliusagaka2001@gmail.com and ismailzarma@gmail.com	WEOER-002
3.	Geothermal Gradients in Rafin Rewa Hot Spring, Lere Local Government Area Of Kaduna State	¹ Ezra D., ² Nehemiah A. & ³ Nuhu M. G. ¹ Department of General Studies, NuhuBamalli Polytechnic, Zaria, Kaduna, Nigeria. ² Department of Agricultural and Bio-Environmental Engineering, NuhuBamalli Polytechnic, Zaria, Kaduna, Nigeria. ³ Department of Mechanical Engineering, NuhuBamalli Polytechnic, Zaria, Kaduna, Nigeria. *Corresponding Email: ezradauda2014@gmail.com Phone: (08050575522)	WEOER-003



GROUP 4: WIND ENERGY AND OTHER ENERGY RESOURCES

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
4.	Analytical Investigation of Variations for Day-Lengths and Length of Objects' Shadow at Various Seasons of the Year	*Dabai K. A. & Buda S. Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto *Corresponding Email: kabir.ahmed@udusok.edu.ng	WEOER-004
5.	Studies of the Monthly Average Global Solar Radiation of Sokoto State	* ₁ Alor K P, ₁ Nwokoye A O C & ₂ Offiah S U ₁ Physics and Industrial Physics, Nnamdi Azikiwe University Awka, Anambra, Nigeria ₂ National Centre for Energy Research and Development, University of Nigeria Nsukka *Corresponding Email: nazaekpere1977@gmail.com, offiahsolomon@gmail.com, Phone: 08062152391	WEOER-005
6.	Status Of Life Cycle Assessment (LCA) of Solar Systems In Nigeria	* ₁ Baba M. T., ₂ Adamu A. A., & ₂ Yola I. A. ₁ Department of Mechanical Engineering, Federal Polytechnic Mubi Adamawa State ₂ Department of Mechanical Engineering, Bayero University Kano *Corresponding Email: muhammadtankobaba@gmail.com Phone: 08037259060; 08025194104	WEOER-006
7.	Geothermal Energy Development and its Potential as Clean Energy for Electricity Generation and other Applications	* _{1,2} Eke Mkpamdi N ₁ Department of Mechanical Engineering, University of Nigeria, Nsukka ₂ Africa Centre of Excellence for Sustainable Power and Energy Development(ACE-SPED) *Corresponding Email: mkpamd.eke@unn.edu.ng, Phone +2348037304156	WEOER-007



GROUP 4: WIND ENERGY AND OTHER ENERGY RESOURCES

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
8.	Green Hydrogen Energy Development in Nigeria: A case study of H2_Atlas Nigeria Tool.	¹ Zarma I. H., ² Ugwuoke P. E., & ³ Okhimamhe A. A. ¹ Energy Commission of Nigeria, Abuja ² University of Nigeria, Nsukka, ³ West African Centre for Climate Change and Adapted Land Use (WASCAL), FUT Minna, *Corresponding Email: ismailzarma@gmail.com	WEOER-008
9.	Analysis of Energy Use Intensity in Institutional Buildings using Building Information Modelling Tool	¹ Pindiga I. Y., ² Garba I., ² Muhammad S. U., & ³ Zarmai M. T. ¹ Department of Electrical Engineering, Kaduna Polytechnic, Kaduna ² Department of Mechanical Engineering, Nigerian Defence Academy, Kaduna ³ Department of Mechanical Engineering, University of Abuja *Corresponding Author's e-mail: ismailayusufpindiga@gmail.com.	WEOER-009
10.	Comparative Analysis Between Linear Model and Weibull Model for Analysis of Wind Energy Conversion Systems	*Dabai K. A. & Buda S. Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto *Corresponding Email: kabir.ahmed@udusok.edu.ng	WEOER-010
11.	Energetic and Exergetic Performance Evaluation of High Pressure Heaters of a Steam Power Plant using Modeling and Simulation Techniques	¹ Abubakar H., ² Adisa A. B., & ³ Ejilah R. I. ¹ Department of Energy Efficiency and Conservation, Centre for Renewable Energy Sustainable Technology and Development (CRESTAD), Kaduna Polytechnic, Kaduna, Nigeria ^{2 & 3} Mechanical/Production Engineering Department, Abubakar Tafawa Balewa University, Bauchi, Nigeria *Corresponding E-mail: harounasadeeq@yahoo.com Phone: +2348036009948	WEOER-011



GROUP 4: WIND ENERGY AND OTHER ENERGY RESOURCES

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
12.	Cloud Cover Based Hourly Solar Radiation Prediction Model for Distributed Generation: A Nigerian Prospective at Nigerian Defence Academy Afaka Kaduna State Nigeria	*Sabo A..& Jae I. A. Department of Electrical and Electronic Engineering, Nigerian Defence Academy,Kaduna, Nigeria. Corresponding Email: s.aliyu@nda.edu.ng; iliyasujae@nda.edu.ng	WEOER-012
13.	University Putra Malaysia Pilot Solar Photovoltaic Plant: Case Study and Implementation Proposal at Nigerian Defence Academy Afaka Kaduna State Nigeria	*Sabo A., Jae I.A, Lawan S., Danjuma I.M, & Ladodo A.R Department of Electrical and Electronic Engineering, Nigerian Defence Academy Kaduna, Nigeria. Corresponding Authors: s.aliyu@nda.edu.ng; iliyasujae@nda.edu.ng;	WEOER-013
14.	Investigating The Possibility of Hybridizing Solar and Energy Resources For Domestic Needs In Two Cities in Nigeria	*Muhammad S. U., Solomon W. C., Samuel M. & Achara N. Department of Mechanical Engineering, Nigerian Defence Academy. Kaduna. *Corresponding Email: sumammed@nda.edu.ng;	WEOER-014
15.	Comparison of An Active Solar Water Heating System Calculated Design Parameters and Dynamic Simulation Results Using T*sol Software	¹ Sirajo Alhassan, ¹ Isah Garba, ² Badamasi Haruna, ² Dauda Garba, ² Anas Abdullahi Muhammad, & ³ Jamilu Ya'u Muhammad ¹ Department of Mechanical Engineering, Faculty of Engineering, Bayero University, Kano ² Department of Welding and Fabrication Technology, Kano State Polytechnic Kano, Nigeria ³ Department of Mechanical Engineering, Nigerian Army University, Biu, Borno State, Nigeria *Corresponding Email: fatysira@gmail.com; GSM: 08032031756	WEOER-015



GROUP 4: WIND ENERGY AND OTHER ENERGY RESOURCES

S/N	PAPER TITLE	Authors Name, Address & email	Abstract Code No
16.	Promoting Nuclear Energy Generation in Nigeria for Long-Time Development	¹ Kabir A.; ¹ Dalhat B A.; ¹ Cecilia O.; & ¹ Muhammad A. ¹ Nuclear Energy, Energy Commission of Nigeria, *Corresponding Email: aakabeer9@gmail.com;	WEOER-016
17.	Effect of Solar Regenerated Solid Desiccant Dehumidifying Pad on Indoor Relative Humidity in Direct Evaporative Cooling	¹ Ahmadu T. O., ¹ Ndagi H., ² Ibrahim T. K., & ¹ Sanusi Y. S. ¹ Department of Mechanical Engineering, Ahmadu Bello University, Zaria. ² Department of Chemical Engineering, Federal University, Wukari, Taraba. *Corresponding author: email: talibahmadu@gmail.com phone: +2348023824226	WEOER-017

ABSTRACTS

Group 1: Bioenergy and Applications

BA-001

PRODUCTION AND CHARACTERISATION OF PYRO-OIL THROUGH THE PYROLYSIS OF WASTE-TYRES

¹Lamido S. I., ²Habib M., & ³Pindiga I. S.

^{1,2}Department of Petrochemical and Gas Processing Engineering, Kaduna Polytechnic.

³Department of Electrical and Electronics Engineering, Kaduna Polytechnic.

*Corresponding Email: i.lamido@kadunapolytechnic.edu.ng

Abstracts:

Waste tyres are one of the major causes of environmental pollution, their non-biodegradability nature contributes to hazardous adverse effect they have on the environment. An estimated of 1.5 billion tyres are discarded annually all over the world. In this research, waste tyres were pyrolysed in a fixed bed pyrolyser reactor at 350- 450 °C to produce pyro oil as the main desired product. The effect of time of extraction, quantity of gas consumed and quantity of catalyst on percentage oil yield were investigated. The oil yield obtained from the process was found to be 31.1%. The pyro oil properties include: a viscosity of 2.08 cSt, density of 924 kg/m³, flash point of 65 °C, pour point of -13°C, cetane number of 63.19 and calorific value of 37.68 MJ/kg.

Keywords: Waste tyres, Pyrolyser, Pyrolysis, Pyro oil, Calorific value.



BA-002

ESTIMATION OF CALORIFIC VALUE OF FIVE BIOMASS SPECIES FROM THEIR ELEMENTAL COMPOSITION USING MINITAB SOFTWARE TOOL

¹Rikoto I.I., ²Garba I., ²Adamu A.A., ¹Ganda Y.M., ¹Muazu A. M., ³Yakubu A.I., & ⁴Usman M.Z
¹Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto
²Department of Mechanical Engineering, Bayero University Kano
³A.Y Global Integrated Consult Ltd Arkilla Express way Sokoto
³National Board for Technology Incubation, Kebbi, Area Office,
 Corresponding Author: rikoto2003@gmail.com, ismail.isah@udusok.edu.ng
 Phone: +2348038498566

Abstracts:

Calorific value is one of the important parameter for evaluating the fuel properties of biomass for its cooking energy potentials. Bomb calorimeters used in determination of calorific value of materials are very expensive and time consuming. The calorific value of biomass is very crucial in the design of thermochemical conversion system. In this study the elemental composition of five biomass species (Carbon Hydrogen, Nitrogen, Oxygen and Sulphur) was used to develop a correlation for estimating the caloric value of selected biomass using multiple regression analysis in Minitab environment. Minitab is a statistical software tool for the analysis of results that involved multiple regressions. The result of the analysis indicates a linear relationship in the variables. The calorific value is also referred to as higher heating value. Regression analysis has revealed that: HVV versus C: $HVV = 19.15 - 0.02610 C$; HVV versus H: $HVV = 19.52 - 0.2705 H$; HVV versus N: $HVV = 17.63 - 0.0939 N$; HVV versus O: $HVV = 16.94 + 0.01925 O$; HVV versus S: $HVV = 17.43 + 0.245 S$. The model equation generated was found to be the correlation based on the elemental composition to have a linear relationship and can conveniently estimate the higher heating value of five biomass species. The new correlation developed from the elemental composition of five biomass has a coefficient of determination (R^2) 0.995, indicating that the model obtained has 99.5% correct prediction of HHV, thus confirming the validity and applicability of the equation for estimating the calorific value for the selected woody biomass.

Keywords: Caloric Value, Biomass, Elemental Composition, Minitab software

BA-003

EFFICIENT BREAD BAKING OVEN USING FEWER FIREWOOD STICKS

^{*1}Musa M. J., ²Salihu O. Y., ¹Kabir A. A., & ³Salawu H
¹Dept. of Electronics and Telecommunications Engineering,
 Ahmadu Bello University, Zaria, Nigeria
²Center for Renewable Energy Sustainable Technology and Development, (CRESTAD),
 Kaduna, Nigeria
³Dept. of Electrical Engineering, Kaduna Polytechnic, Kaduna, Nigeria
 *Corresponding Email: mmjibrin@abu.edu.ng; s.otuoze@kadunapolytechnic.edu.ng;
 kabirahmed@abu.edu.ng; oipesalau@gmail.com

Abstracts:

Bread baking is a huge business, which generates capital. A lot of baking ovens make use of firewood or diesel fuel. Due to the problem of desert encroachment due to frequent falling of trees and cost of production using diesel fuel, the gain in bread production is on the decline. This paper aims at introducing a rocket oven, which will use very few sticks of firewood to generate the required heat needed for the bread oven as compared to



the traditional oven, which require a whole tree to start up. Materials (bricks, sand, cement and water) are used for the brick structure, (pumice, grog, and clay) are used for the double wall heat insulation, while assorted metals of different sizes and shapes are used for the metal box chamber. The internal bread setting chamber was constructed using wire mesh. Silicone gel was used to seal off any possible leakage, to ensure proper heat retention and energy management. The oven was compared with the traditional oven, and diesel fuel oven an improvement in fewer sticks of firewood of 80% where recorded, time to start loading bread was improve with 91.67% and total combustion was achieve against the traditional oven. An improvement in cost of the proposed heating source as compared with diesel fuel oven of 8 kW/10 kVA running power capacity is 90.91%. The introduction of the proposed rocket oven was significantly huge as compared to the conventional local oven and diesel fuel oven. Hence, the rocket oven is an ideal oven for maximum gain.

Keywords: Baking, combustion, firewood, oven

BA-004

THERMOCHEMICAL CONVERSION AND EVALUATION OF BIOMASS FOR PRODUCTION OF GREEN FUELS

¹Rikoto, I.I., ²Garba I., ²Adamu. A.A, ²Yola. I.A., ²M.T Jimoh

¹Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto

²Department of Mechanical Engineering, Bayero University, Kano

Corresponding Author: rikoto2003@gmail.com, ismail.isah@udusok.edu.ng

Phone: +2348038498566

Abstracts:

Global interest on the search for greener fuels sources is gaining tremendous momentum essentially to bridge the gap between fuel supply and demand as well as safeguard the environment . The deregulation of kerosene and recent hike in cooking gas has increased the demand for fuel wood and charcoal as an alternative cooking fuel. This paper attempt to high light and evaluates available option for biomass conversion through the application of heat. The non-availability of suitable cost-effective technologies for conversion of biomass residues for household cooking has resulted in gross underutilization and neglect of biomass residues as a potential energy source. Some biomass conversion techniques are limited to selectivity of biomass and generate several residues that are not environmentally friendly. Thermochemical conversion entails the application of heat in conversion of biomass in to useful fuels. Thermochemical conversion of biomass has shown potential to provide greener energy for numerous applications in both domestic and industrial sector for the production of synthetic fuels and chemicals.. The technologies under thermo chemical conversion include direct combustion, Gasification, pyrolysis Torrefaction and liquefaction. Evaluation of biomass for its energy potentials can be done through the determination of its proximate composition, ultimate composition and higher heating values. Proximate analysis provides percentage composition of biomass in terms of gross component such as moisture content, (M), Volatile matter, (V), Ash, (ASH), and Fixed Carbon, (FC). Ultimate analysis refers to determination of the elemental composition of biomass in terms of its fuel properties, the elements consist of carbon, hydrogen, nitrogen, oxygen and sulphur. The heating value



of biomass materials was defined as its energy content. It is a very important parameter for the design of thermochemical conversion system.

Keywords: Thermochemical, Conversion Fuels, Biomass, Energy

BA-005

SUSTAINABLE PRODUCTION BIOETHANOL FROM MAIZE HUSK BY SIMULTANEOUS SACCHARIFICATION AND FERMENTATION USING ACROMONIUM BUTYRI AND ZYMOMONAS MOBILIS

*₁Bello A. Y., ₂Jumare F. I., ₁Hussein R. A. & ₁Haruna Z. A

₁Department of Basic Science and General Studies,

Federal College of Forestry Mechanization Afaka, Kaduna, Nigeria.

₂Department of Microbiology, Sokoto State University, Sokoto, Nigeria.

Corresponding author's Email: abdullahi.belloyusufgwsok@gmail.com

Abstracts:

A green bio-energy from bio-polymeric resource with potentials in maintaining ecological balance brings about search for elements and technics to ease biofuel production. Bioethanol was determined using maize husk by simultaneous saccharification and fermentation. Test organisms include fungi and bacteria. The fungi *A. butyri* was isolated and identified from dead plant matter roots of *Piliostigma reticulatum* using sabouraud dextrose agar (SDA) and compared with their cultural and morphological characteristics of those known and reported taxa. The bacteria used were obtained from the department of microbiology, Udusok, Nigeria. Proximate compositions of maize husk include protein (6.9%), Ash (5.02%), Moisture (7.6%), Fat (17.0%), Fibre (3.25%) and Carbohydrate (65.52%). The maize husk was pretreated using dilute acid solution. After dilute acid pretreated maize husk, the sample were inoculated with 10⁷ fungal spore cells of *A. butyric* for hydrolysis, incubated at 30°C on rotary shaker for 72hrs. The bacteria *Z. mobilis* 1×10⁸ cells were subsequently inoculated for fermentation for the next 48hrs at same flask. In each duplicate experiment, samples were analysed for reducing sugar and bioethanol quantity up to 120hrs. The highest mean of reducing sugar was between 72 (3.865±0.077) and 96hrs (3.865±0.063). Bioethanol was determined quantitatively using potassium dichromate. About 1% of Standard ethanol concentration was obtained. The diluted 1% was re-diluted again and obtained 0, 0.2, 0.4, 0.6 and 0.8. These concentrations added with potassium dichromate reagent were used for development of standard ethanol curve using UV-VIS spectrophotometer 588nm. About 2.5ml was mixed with 1ml potassium dichromate and absorbance was also taken at 588nm using spectrophotometer. The quantity of bioethanol in the presence of *A. butyri* and *A. butyri* + *Z. mobilis* was peak at 72hrs (0.98%) and 120hrs (1.65) respectively. Successive increase across different period in the quantity of bioethanol was observed. Therefore, *A. butyri* is potential agent that can both hydrolyze and ferment sugars. Maize husk is a vital waste with potential sugars that can be used to produce bioethanol.

Keywords: Bioethanol, Maize husk, Hydolysis and Fermentation



BA-006

CHARACTERIZATION OF TORREFIED *Calotropis procera* STEM AS A FEEDSTOCKS FOR GASIFICATION

¹Tukur U.G., ^{1,2}Okoh E.V.C, & ³Umar S.

¹Sokoto Energy Research Centre, Usmanu Danfodiyo University Sokoto, Nigeria

²Department of Pure and Applied Chemistry, Usmanu Danfodiyo University Sokoto, Nigeria

³Department of physics, Kebbi State University of Science and Technology, Aleiro

*Corresponding Email: tukurgwadangaji@gmail.com

Abstracts:

Research on biomass resources as an alternative fuel is crucial for energy security and environmental sustainability, the aim of this research is to evaluate the effect of torrefaction on fuel properties of *Calotropis procera* stem (CPS). Torrefaction is a thermal treatment method for upgrading biomass fuel properties. 500g of *Calotropis procera* stem was Torrefied at optimal torrefaction setting of 207OC for temperature, 15minute for retention time, 5OC/mins for heating rate and 4cm for particle size. The fuel properties of raw and Torrefied sample was comparatively evaluated by determinations of ultimate and proximate composition, oxygen-carbon ratio, hydrogen-carbon ratio and high heating value of the samples. The fuel properties of the two samples are significantly different ($p < 0.05$). The fuel properties of the Torrefied sample has been improved by increasing the amount of atomic carbon from 41.98-78.91% while decreasing the amount of atomic hydrogen and oxygen from 5.7-2.85% and 49.32-16.41% respectively, the nitrogen and sulfur content also decreased from 2.29-1.62% and 0.59-0.21% respectively. As a result of changes in chemical composition due to the release of volatiles, the moisture content and volatile matter content decreased from 8.24-3.42% and 63.32-57.36% while the fixed carbon content and ash content increased from 25.29-32.97% and 3.15-6.25% respectively, therefore, *Calotropis procera* stem has been Torrefied at low temperature and the Torrefied material results in favorable fuel characteristic for biomass gasification.

Keywords: Biomass, Torrefaction, *Calotropis procera*, Thermal treatment, Gasification

BA-007

AN OVERVIEW OF AIR POLLUTANTS: IT EFFECTS ON ENVIRONMENT AND HEALTH

¹Aliyu A. S., ²Abubakar H., & ³Abdullahi M. D.

¹ & ³Centre for Renewable Energy Sustainable Technology and Development (CRESTAD), Kaduna Polytechnic, Kaduna, Nigeria

²Department of Energy Efficiency and Conservation,

Centre for Renewable Energy Sustainable Technology and Development (CRESTAD), Kaduna Polytechnic, Kaduna, Nigeria

*Corresponding E-mail: asaliyu9090@yahoo.com Phone: +2348028343404

Abstracts:

An atmosphere faces many difficult problems that are brought about by human activities. Accordingly, air pollution is one of the major health problems confronting humans today with certainly high rate of atmospheric pollution, especially in the densely populated urban cities. Consequently, accumulation of pollutants in the atmosphere in large quantities and of longer duration poses harm to human health. Prevalent diseases



resulting from exposure to these pollutants include pertussis, pulmonary tuberculosis, cerebral spinal meningitis (CSM), pneumonia, measles, chronic bronchitis, and upper respiratory tract infection (URTI). This paper focuses on the human health effects of primary air pollutants with the objective of reviewing the various sources, chemical composition and emission of these pollutants. A review of these pollutants is presented, which led to the conclusion that human environment being the basis for any economic, social and cultural development, needs to be maintained in a good state to ensure a high level of social performance which could potentially provide an achievable proposal for economic growth, and environmental sustainability.

Keywords: Atmosphere, Health, Pollution, Sustainability

BA-008

A SMART SOLID WASTE MONITORING SYSTEM FOR ENVIRONMENTAL SUSTAINABILITY

^{*1}Ismail Z. O., ²Lawal D. S , ³Salihu Y. O., & ⁴Hassan A. A.

¹Department of Electrical and Electronics Engineering, Kaduna Polytechnic. Kaduna

²Department of Electrical and Electronics Engineering,
Nigerian Defence Academy. Kaduna

³Department of Computer Engineering, Kaduna Polytechnic. Kaduna

⁴Department of Electrical and Electronics Engineering, Kaduna Polytechnic. Kaduna

*Corresponding Email: zismail41@yahoo.com

Abstracts:

This paper is aimed at providing a smarter way to collect and monitor solid wastes. Solid waste management is one of the most challenging environmental issues that pose a threat to both individuals and government at large. Wastes are not properly disposed; streets are seen with over flow of garbage in bins and these results in environmental degradation causing a lot of health hazards. There are no proper infrastructures put in place to monitor the status of these bins. In order to control this, a smart solid waste monitoring system has been designed and implemented. The system consists of sensors to measure the weight and level of the wastes inside the bin such that if the threshold of both the weight and height of bin is reached, information is sent to the required authority through an internet gateway. Each bin is equipped with an IoT module made up of an ATmega328 Micro controller which receives signal from the sensors (ultrasonic and load cell sensors). This information is communicated to the administrators via an internet gateway. Truck drivers are equipped with android devices used to monitor the information related to the waste bin for different selected locations. It is only the bins whose notification is received on his device that will be cleared, hence saving him the cost of going to locations where bins are not full. This way the administrator can monitor the statuses of the bins. Through this the collection of garbage can be managed efficiently.

Key Words: ATmega328, ultrasonic, IoT, load cell.



BA-009

OPTIMIZATION OF BIOGAS PRODUCTION FOR LABORATORY SCALE EXPERIMENTS

*¹Mohammad A., ¹Zuru A. A., ¹Muhammad C., ²Mu'azu M., & ³Ibrahim B.

¹Department of Pure and Applied Chemistry, Usmanu Danfodiyo University Sokoto

²Department of Mechanical Engineering, Usmanu Danfodiyo University Sokoto

³National Biotechnology Development Agency, Abuja.

*Corresponding Email; tjachmad@hotmail.com

Abstracts:

This research presents the study carried out on the production of biogas using different substrates. Co-digestion of animal waste and crop residue using 10 digesters with their replicates were prepared according to the statistical tool mini tab experimental design. The Correlation co-efficient of these digesters showed 0.894976 or 89% positive relation. The cumulative yield of biogas measured for 56days for cow dung (A), camel dung (B) and maize silk (C) mono substrates are 463g, 309g and 55g respectively. Co-digestion of di-substrates have individual cumulative yield of AB 458g, AC 57g and BC 74g while tri-substrates have ABC 366g, A*BC 356g, AB*C 439g and ABC* 83g. The result reveals cow dung performs better among the mono substrates whereas mixer of cow dung and camel dung had the optimal yield of co-digestion of di-substrates while substrate AB*C had the highest production among co-digestion of tri-substrates. Proximate and Physico-chemical analysis of moisture, ash, total solids, volatile solids were determined. They were further analyzed for their total carbon, total nitrogen, phosphorous, potassium, and carbon to nitrogen ratiocontents according to the standard procedures. Biogas yield can be enhanced by co-digestion of crop residues and animal dung only after careful selection .

Keywords: Substrates, Minitab, Biogas, Co-digestion

BA-010

TREATMENT OF WASTE WATER FROM UPPER NIGER RIVER BASIN FISH POND WITH MORINGA OLEIFERA SEEDS UNDER LABORATORY CONDITIONS IN MINNA, NIGER STATE

*Ayanwale A. V., Babakasim M. & Oluwafemi O. J

Hydrobiology and Fisheries Unit, Department of Animal Biology,

Federal University of Technology, Minna

*Corresponding Email: a.adesola@futminna.edu.ng;

Phone: +2348036532471

Abstracts:

Water treatment involves a number of combined processes based on the quality of the water source, amount of microbial load, the cost and availability of chemicals in achieving the desired level of treatment. Waste water collected from Upper Niger River Basin Fish Pond in Minna was evaluated with Moringa oleifera seeds (0.1, 0.2 and 0.3g) replicated thrice in a complete randomized design. The physiochemical parameters of wastewater and water treated with M. oleifera seeds were determined based on standard experimental procedures. The results of physiochemical parameters of waste



water and water treated with *M.oleifera* seeds: pH (7.23), (EC)Electrical conductivity (350 μ s/cm), (TDS)Total dissolved solids, (130mg/l) and alkalinity (48mg/l) were all within the acceptable limits of WHO, but temperature (28oC) and turbidity (13NTU) were above WHO limits. The pH (7.23 \pm 0.02) of the water treated with 0.1g of *M.oleiferaseeds* and EC (509.33 \pm 36.23 μ s/cm) at 0.3g were significantly higher ($P < 0.05$) during the experiment. Water temperature of the treated water was not affected by *M.oleifera* seeds but TDS (618.67 \pm 2.02Mg/l) of treated water at 0.1g and alkalinity (163.33 \pm 8.74 mg/l) at 0.3g were significantly higher ($p < 0.05$) during the experiment. However, there was significant reduction ($P < 0.05$) in turbidity (5.33 \pm 0.33 NTU) at 0.3g of *M. oleifera* seeds after treatment of waste water. Treatment of waste water with *M.oleifera* seeds at 0.3g reduced the turbidity of waste water from the fish pond. Therefore, more research is recommended on the effects of *M. oleifera* seeds on waste water clarity and other natural sources for potential coagulation ability.

Keywords: Waste water, Moring oleifera seeds, Physicochemical parameters and Minna

BA-011

DETERMINATION OF BEST RATIO FOR OPTIMAL BIOGAS YIELD FROM THE CO-DIGESTION OF COW DUNG AND CHICKEN DROPPINGS UNDER AMBIENT CONDITION

*Basirat Kikelomo Odunola, & Wunuken Carlos Solomon

Department of Mechanical Engineering Faculty of Engineering and Technology,
Nigerian Defence Academy, Afaka, Kaduna-Nigeria.

*Corresponding Email: bkodunola@nda.edu.ng; Mobile Number: 08153004551;

Abstracts:

The investigation is on the use of animal wastes to generate biogas for use as an alternative to fossil fuel. Biogas was generated from the codigestion of cow dung and chicken droppings and the results obtained documented in the work. Laboratory scaled bio-digesters were designed and constructed using old plastic bottles 1.5 litre in size and 5 in number. The digesters were incorporated with biogas upgradation device. Five different ratios of blends, (CCH100, CCH75, CCH50, CCH25 and CCH0) were prepared and charged into the digesters. The experiment was carried out under ambient temperature between 19oC-28.1oC. The gases generated from the different ratio of blends were analyzed and graphically presented. It was found from the results that the blend with ratio CCH100amb had the highest methane yield of 82.59% at ambient temperature between 19oC-28.1oC, while in all the codigested blends CCH75amb had the highest methane yield of 80.14% at ambient temperature between 19oC-28.1oC. The results also showed total elimination of moisture content and Hydrogen Sulphide in the gas generated. Codigestion of several blends of chicken and cow dung was investigated and it was found from the study that the blend CCH75amb had the optimum methane yield.

Keywords: Biogas Yield, Co-digestion, Cow Dung, Chicken Droppings



COMPARATIVE STUDIES OF SINGLE AND CASCADED ROCKET FIREWOOD BURNING STOVES BASED ON ENERGY ANALYSIS METHOD

¹Lawal S. *²Abubakar H. N., & ³Mati A. A.

¹Directorate of Physical Planning and Development,
Umaru Musa Yar'adua University, Katsina, Nigeria.

²Centre for Renewable Energy Research and Development,
Umaru Musa Yar'adua University, Katsina, Nigeria

³Centre for Nuclear Energy Research,
Ahmadu Bello University Zaria, Nigeria

*Corresponding Email: abubakar.haruna@umyu.edu.ng;
Tel: 08056000617

Abstracts:

In Nigeria, the total wood removals from forests in 2005 amounted to 86,626,797 m³. The amounts of fuel wood consumed from forests in the year 2005 were 72,710,935 m³. As at 2018, emissions from Nigeria's kitchens contributed to about 55 million tons of CO₂e. A huge amount of these emissions are from large scale cooking in our boarding secondary schools, commercial restaurants and large households. The traditional three stone stoves being used in these quarters are inefficient. This work presents the comparative thermal and exergy efficiency analysis of single and cascaded three pot firewood energy saving stoves. The 70cm diameter pot stoves were constructed using 2mm thick steel metal with inner linings filled with ash as insulating material. The cook stoves were tested using standard water boiling and cooking test methods. It was shown from the analysis of the result that; the single pot and cascaded-pot rocket stove were estimated to have thermal and exergy efficiencies of 24.45%, and 12.52%, respectively. A single-pot and cascaded - pot cook stove can save about 897 kg and 950 kg of fuel wood per annum, respectively. The result shows that Carbon emissions of single and cascaded cook stove are estimated to be reduced by about 1886kg and 1990 kg per annum respectively

Keywords: cascaded rocket stove, thermal and exergy efficiencies



BA-013

MODELLING AND DEFECT STUDY OF Sn-BASED HTM-FREE PEROVSKITE SOLAR CELL USING SCAPS SOFTWARE

¹Danladi, E., ²Adekanye, O. O., ³Oni, E. M., and ⁴Michael, U. S.

¹Department of Physics, Federal University of Health Sciences, Otukpo, Benue State, Nigeria

²Department of Physics, Airforce Institute of Technology, Kaduna, Nigeria

³Department of Electrical and Electronics Engineering, Nigerian Defence Academy, Kaduna, Nigeria

⁴Department of Physics, Nigerian Defence Academy, Kaduna, Nigeria

*Correspondence: Email Address: danladielibako@gmail.com

Phone number: +2348063307256

Abstracts:

Perovskite Solar Cells (PSCs) developed based on Tin (Sn) have attracted a lot of research attention due to their non-toxic nature and low cost. In this paper, a numerical simulation of Hole Transport Material (HTM)-free PSCs based on methyl ammonium tin triiodide ($\text{CH}_3\text{NH}_3\text{SnI}_3$) was carried out using a One Dimensional Solar Cell Capacitance Simulator (SCAPS-1D) software. The effects of interface defect density and absorber layer thickness was investigated systematically. The device before optimization gave a Power Conversion Efficiency (PCE) of 8.35 %, Fill Factor (FF) of 51.93 %, Short circuit current density (J_{sc}) of 26.36 mAcm^{-2} and Open circuit voltage (V_{oc}) of 0.610 V. Upon variation of the interface defect density and absorber layer, while keeping other parameters constant, an optimum interface defect density of 1012 cm^{-2} and absorber thickness of 0.5 μm were obtained. Upon simulating with the optimized data, the final device gave a PCE of 14.38 %, FF of 68.01 %, J_{sc} of 22.67 mAcm^{-2} and V_{oc} of 0.933 V. When the optimized metric parameters are compared with the unoptimized ones, an improved performance of ~ 72.22 % in PCE, ~ 30.96 % in FF, and ~ 52.95 % in V_{oc} were obtained. The results obtained are somewhat encouraging and has paved the path for developing cost effective, non-toxic and comparable state of the art high efficient perovskite solar cells.

Keywords: Perovskite Solar Cells, Interface defect, HTM-free, Tin based Perovskite

BA-014

EFFECT OF FILM THICKNESS OF A DYE-SENSITIZED SOLAR CELLS DEPOSITED USING SCREEN PRINTING TECHNIQUE

Samaila Buda^{1*}, Ibrahim Danmalam^{1,,}, Kabir ahmed Dabai^{1,}, and Nuhu Sani Jega^{2,}

¹Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto

²Adamu Augie College of Education Argungu, Kebbi state

*budasamaila@gmail.com

Abstracts:

A single-layer N719 sensitized nanocrystalline TiO_2 films have been successfully deposited on FTO-coated glass substrates using the screen-printing technique with four different thicknesses (10, 12, 14 and 18 μm) and used as simple and low cost photoanodes for dye-sensitized solar cells (DSSCs). The thickness was controlled by adjusting the distance between the screen-printing mesh and the FTO-coated substrate using the two height



control bolts. The films were deposited using one-time screen-printing method. So that the multiple screen-printing and annealing cycles can be reduced. Furthermore, the cell fabrication time was reduced as well as the problem of recombination at the interfacial layers between the TiO₂ films was avoided. The thickness of the TiO₂ films was measured by the surface profilometer. The prepared photoanode samples were characterized using FESEM, EDX, AFM, and UV-VIS-NIR spectroscopies. The ruthenium dye soaking time was optimized at 48 hours. The photovoltaic parameters such as short circuit current density (I_{sc}), open-circuit voltage (V_{oc}), fill factor (FF) and power conversion efficiency (η) were measured for fabricated cells at room temperature under one sunlight 100 mW/cm² illumination using the solar simulator. The effect of the thickness of the TiO₂ film on the fabricated DSSCs performance parameters was studied. DSSC devices with average thickness 12 μ m achieved the highest conversion efficiency of 5.13% with ($J_{sc} = 12.12$ mA/cm²), and ($V_{oc} = 0.69$ V). The obtained results revealed that the amount of the adsorbed dye increases with the increase in the TiO₂ film thickness and thus improve photogenerated current. However, exceeding the optimum photoanode thickness results in decline in the photogenerated current and the overall efficiency due to back electrons recombination and the lower photoanode transmittance.

Keywords: Photoanode, Screen-printing Photogenerated current, Dye-sensitized solar cell

BA-015

UTILIZATION OF CARBON NANOTUBES IN PEROVSKITE SOLAR CELL FOR ENHANCED PERFORMANCE

¹Michael, U. S., ¹Onimisi, M. Y., ²Danladi, E., and ³Oni, E. M.

¹Department of Physics, Nigerian Defence Academy, Kaduna, Nigeria.

²Department of Physics, Federal University of Health Sciences,
Otukpo, Benue State, Nigeria.

³Department of Electrical and Electronics Engineering,
Nigerian Defence Academy, Kaduna, Nigeria.

*Correspondence: Email: udesmik@gmail.com

Phone number: +2347030498215

Abstracts:

Perovskite solar cells (PSCs) based on carbon nanotubes have attracted huge research interest in the academic community and are expected to achieve swift commercialization in recent time. In This research work, the effect of applying multi-walled carbon nanotubes (MWCNTs) as counter electrode on the photovoltaic performance of perovskite solar cells was investigated. UV-Vis spectrophotometry, Scanning Electron Microscopy, Surface Profilometer, Raman Spectroscopy and Solar Simulator were used to characterize and study the properties of the prepared cells sample. The reference cell (without MWCNTs) demonstrated a PCE, J_{sc} , V_{oc} and FF of 2.82 %, 7.64 mAcm⁻², 0.88 V, and 42.00 % respectively. When MWCNTs was incorporated, we observed a PCE of 4.30 %, J_{sc} of 8.47 mAcm⁻², V_{oc} of 0.85 V and FF of 60.00 %. The MWCNTs modified device shows an enhancement of 52.48 % in PCE, 10.86 % in J_{sc} , and 42.86 % in FF over the unmodified device. This enhancement could be attributed to the high surface interaction of the carbon nanotubes molecules and reduced contact resistance between individual nanotubes.

Keywords: Perovskite Solar Cell, Carbon Nanotubes, Contact resistance, Counter electrode



DESIGN OF HYBRID SOLAR AIR CONDITIONING SYSTEM BASED ON THE WEATHER AND ENVIRONMENTAL CONDITIONS OF NIGERIA.

Alkali Saifullahi Auwalu^{1*}, Khalid K. Dandago², Ibrahim Mahmud Khilishi³

¹Energy Systems Engineering Department, Cyprus International University, Cyprus.

²Aerospace Engineering Department, Air Force Institute of Technology, Kaduna, Nigeria.

³Department of Education Technical, Kano State Polytechnic, Kano, Nigeria.

*Corresponding Author Email: saalkali99@gmail.com

Contact Phone Number and 08077775777 &

Abstracts:

Producing air conditioning from solar energy technology has emerged as a feasible option that could meet the cooling load demand of buildings within few hours during maximum solar irradiation. This research presents the design of a hybrid solar air conditioning system; the system comprises of conventional direct expansion air conditioning system components combined with a solar collector (evacuated tube) as additional heat source, which is installed after the compressor to reduce the power consumption of the compressor. The objective of the research is to design the system with high Coefficient of performance (COP) / Energy Efficiency Ratio (EER) that would incur less energy consumption of the compressor by harnessing the abundant solar energy in Nigeria. The refrigeration capacity of the system is assumed as 20KW, a capacity enough to satisfy the requirements of a small building. Refrigerants R134a and R410a are used as refrigeration materials. The EER was found to be 4.11 and 4.10 for the refrigerant R134a and R410a, respectively, at sub cooled 12 and 10°C. Furthermore, energy saving in a year was found to be 9.12% and 8.79% for the refrigerant R134a and R410a, respectively. Also, CO₂ emission was decreased by 148.29kg/yr and 213.54kg/yr for the refrigerant R134a and R410a, respectively, when compared with the vapor compression refrigeration cycle system without solar assistance.

Keywords: Solar energy, Hybrid Solar Air conditioning, Conventional Air conditioner, Refrigerant, Renewable energy.

**Group 2: Energy and Management****EE-001****GREEN ENERGY: THE PANACEA TO REVERSING DESERTIFICATION AND POVERTY IN NIGERIA**¹Maiwada N. A., ²El-Ladan A. H & ³Abdullahi U.S

1 Department of Geography,

Umaru Musa Yar'adua University, Katsina, Nigeria

² Ibrahim Shehu Shema Centre for Renewable Energy and Research,

Umaru Musa Yar'adua University, Katsina, Nigeria

³ Havage Engineering Services Limited, Kaduna, Nigeria

*Corresponding E-mail: nuramaiwada@yahoo.com, Phone: 08037372928

Abstracts:

This paper provides an overview of green energy as an alternative approach in promoting sustainable energy supply for reversing desertification and poverty in Nigeria. It addresses the nexus between green energy, desertification and poverty in terms of the mechanism of sustainable development. It further highlights the danger that wood biomass in Nigeria is facing the threat of depletion due to fuelwood extraction. This fuelwood-poverty drives the land into desertification thus putting the livelihoods of millions of people at risk of poverty, hunger and insecurity. Strategic green energy projects and programmes should be prioritized at all levels of government to strengthen the resilience of the people in tackling the twin problems of desertification and poverty in Nigeria. Rural dwellers in the vulnerable dryland areas of northern Nigeria that are significantly affected by desertification should be recognized and be given the capacity and incentive to poster land rehabilitation projects. The adoption of sustainable green energy systems which is a myriad of energy technologies for cooking, lighting and pumping water can move the country out of its current energy crisis while still ensuring rural development. This way, there will be significant reduction in the levels of poverty, human migration, conflicts and insecurity in Nigeria.

Keywords: energy crisis, desertification, poverty, sustainable development.

EE-002**OPTIMIZATION OF THE INDUSTRIAL USE OF RENEWABLE ENERGY FOR SUSTAINABLE AND COST EFFECTIVE RURAL ELECTRIFICATION**¹Njoku C.O, ¹Uche E.U, ²Gambo V.A, & ³Yekini B.Y¹Department of Mechanical Engineering, Air Force Institute of Technology, Kaduna²Department of Mechanical Engineering, Ahmadu Bello University, Zaria³Department of Mechatronics Engineering, Air Force Institute of Technology, Kaduna

*Corresponding Email: christianonye521@gmail.com, eaumie@gmail.com

08034315747

Abstracts:

The benefits associated with the utilization of renewable energy sources such as improved electricity access, economic development and energy sustainability can never be over-emphasized. Nigeria being a developing country with an acute electricity problem is blessed with



renewable energy resources. There is an inequitable access of rural communities to electricity services in the country as demand supersedes the generation. The provision of feasible electricity to the rural dwellers is hampered by some inefficiency bedeviling the allocation of energy resources coupled with the near depletion of fossil fuels. Due to capital intensive nature of renewable energy sources; most of these energy sources remain unexploited in Nigeria. This study aims at developing a general framework that can be utilized in Nigeria to minimize the total cost of installing renewable energy technologies while satisfying some predetermined constraints which include demand and supply, renewable energy potentials. The extent of renewable energy resources is described and existing government policies are articulated. Various policies, that could possibly incentivize the realization of wider renewable energy applications in rural Nigeria, are proposed. The challenges and future prospects of renewable energy are also discussed. In this work, three scenarios are presented namely prospective off-grid which accesses electricity level below 50%, on-grid which accesses electricity level above 50% and all-off-grid which finds the optimal cost of installing off-grid renewable energies. The results show that the total installation costs of the first and second scenarios are \$97.46 and \$114.03 billion respectively while that of the third scenario is found to be \$244.33 billion. Further analysis of the results obtained reveal that the combination of the off-grid and on-grid installations has the minimum installation cost and it is to be adopted especially in the rural and remote areas. Hence, the dissemination of decentralized renewable energy resources will not only improve the wellbeing of rural Nigerian communities, but also enhance Nigeria's energy and economic prospects for potential global investment.

Keywords: Rural electrification, Cost, Renewable Energy sources, Nigeria

EE-003

GREEN ENERGY SUSTAINABILITY AS A TOOL TO ECONOMIC GROWTH IN NIGERIA

¹Mamuda M., ²Maishanu S. M. & ³Khalil I. A

¹Department of Mechanical Engineering, Usmanu Danfodiyo University Sokoto

²Department of Plant Science, Usmanu Danfodiyo University Sokoto

³Sultan Muhammadu Maccido Institute for Qur'an and General Studies Sokoto

Corresponding Author: mamuda.muhammad@udusok.edu.ng

Abstracts:

This study examines green energy sustainability as a tool to economic growth in Nigeria. Accessibility to hygienic modern energy services is an enormous challenge facing the African continent as a whole because energy is fundamental for socio-economic development and poverty eradication. At present, almost 60% to 70% of the Nigerian population does not have access to electricity. Present power crisis in Nigeria will persist unless the government diversifies the energy sources in domestic, commercial, and industrial sectors to adopt new available green energy technologies to complement the conventional one. This will reduce energy wastages and save cost. This study critically examines some energy policies interventions, which can contribute to the sustainable economic, environmental, and social development in Nigeria. In conclusion, this study revealed that the green economy holds lots of opportunities. Recommendations to enable Nigeria transit into green economy includes that institutional capacity is needed to integrate environmental policies with economic policies.

Keywords: Sustainability, Green energy, Economic growth



EE-004

RENEWABLE ENERGY CONSUMPTION REDUCE UNEMPLOYMENT IN NIGERIA: EVIDENCE FROM ECONOMETRICS ANALYSIS

¹Bawalle A. A. & ²Zarma I. H.

¹Centre for Management Development, Nigeria

²Science, Technology & Innovation (ST&I) and Digital Transformation (DX),
Japan International Cooperation Agency (JICA), Nigeria Office

*Corresponding Email: aleeukabo@gmail.com; ZARMA-Ismaila@jica.go.jp

Phone: +2348034887166

Abstracts:

Renewable energy consumption in both advanced and developing economy is increasingly getting momentum; this is largely owing to its little or zero Green House Gas Emission. Global transition in energy consumption and desire to actualize SDG goal 7 has provided additional impetus research and investment in green energy. Many researches have explicitly documented how energy sufficiency promotes economic growth. Unarguably, energy deficit in Nigeria is hindrance economic growth particularly in rural area which further heightened the level of unproductiveness and economic inequality between urban and rural household. Though, the evaluation of renewable energy and economic growth nexus has received significant researchers' attention, little emphasis has placed on understudying the correlation between renewable energy consumption and unemployment nexus. This study was designed to empirically study the link between renewable energy consumption and unemployment rate in Nigeria. At the time when unemployment number is at frightening level, the research is particularly important for fiscal and monetary authority in Nigeria. In this study, the short- and long-term relationships between energy consumption and unemployment rate will be examined using empirical data for the period 1999 – 2021. Auto Regressive Distributed Lag (ARDL) and Granger causality tests are used. The finding indicated positive short- and long run association between energy consumptions and employment in Nigeria, also, Granger causality test reveals bidirectional causality between energy consumption and employment.

Keywords: Renewable Energy, ARDL, Unemployment Rate, Granger-causality

EE-005

ENERGY SECURITY AND SUSTAINABLE RURAL TRANSFORMATION IN NIGERIA

Chigasa C. U.; *Chibueze E. N.; Chidiebere E. A.; Ezinne F O.; Gerald A.; & Izuchukwu F. O.
National Centre for Energy Research and Development, University of Nigeria, Nsukka.

*Corresponding author: E-mail: chibueze.nnaji@unn.edu.ng

Abstracts:

This paper focuses on Nigeria's energy access posture, reviewing its impact on rural transformation with reference to rural education. There is a plethora of evidence in literature on the role of energy security in socio-economic transformation. Analysis of secondary data through relevant statistics showed that energy security would promote rural livelihoods, income and improved access to educational opportunities; these translating to rural social transformation. Thus, the paper recommends energy diversification through decentralized sources and particularly focusing on off-grid renewable projects to achieve energy security and sustainable rural transformation in Nigeria.

Keywords: Energy access posture, Rural transformation, Rural education, Energy security, Rural livelihoods, Educational opportunities, Energy diversification, Nigeria



EE-006

ASSESSMENT OF THE STATUS OF RENEWABLE ENERGY UTILIZATION AND HUMAN DEVELOPMENT IN NIGERIA

Olabomi R. A.

National Institute for Policy and Strategic Studies (NIPSS), Kuru, Nigeria

Corresponding Email:rasaqolabomi@yahoo.com

Abstracts:

Provision of clean and sustainable energy, which is the 7th goal of the United Nations Sustainable Development agenda, is interconnected with other goals and it plays a vital role in the socio-economic development of the country and its citizens. With a relatively high potential for a number of renewable energy (RE) such as solar, biomass, and small hydropower, Nigeria is expected to be in the forefront in the provision of clean and sustainable energy via the RE utilization with resultant influences on the socio-economic development and livelihood of the citizens. Meanwhile, among the prominent RE sources with high potentials in Nigeria, only solar energy is given a significant prominence while biomass for instance, is mostly used in its crude form thereby creating indoor pollution and increased desertification. A number of policies and plans have been put in place including the National Renewable Energy and Energy Efficiency Policy (NREEEP) and the recent National Development Plan (NDP) 2021 – 2025. These are in attempt to improve the lives of the population via provision of affordable and renewable energy for socio-economic development. These, if implemented would facilitate the achievement of clean sustainable energy (the 7th sustainable development goal of the United Nations). However, lack of appropriate implementation strategies and poor renewable energy infrastructure have hampered the utilization of the RE and the socio-economic development with its toll on the livelihood of the citizens. This paper discusses the renewable energy utilization via various technological innovations, and its percentage contribution to Nigeria's energy mix with focus on solar energy, small hydropower, and biomass. The paper equally examines the applicability of the existing framework in support of increased renewable energy utilization towards improved socio-economic development.

Keywords: Renewable energy sources; Energy efficiency; Energy mix; Socio-economic development; Sustainable development goals

EE-007

LINKING RENEWABLE ENERGY TECHNOLOGIES ACCEPTANCE AND EFFECTIVE TRANSITION TO GREEN ENERGY: EVIDENCE FROM RURAL NIGERIA FOR POLICY MAKING

¹Naseer BabangidaMuazu & ²Bauna Faith Koyan

^{1,2}Centre for Energy and Environmental Strategy Research,
Kaduna State University

*Corresponding Email: nmbabangida69@gmail.com

Abstracts:

Recent trends in energy use in many developing countries are showing a failure of household's transition to green energy "ascending the energy ladder" despite Climate Change Policies that were designed by the United Nations Framework Convention on Climate Change (UNFCCC) and Paris agreement to serve as a global blueprint for the sustainable development, climate change mitigation and utilization of energy resources such as hydro, biomass, solar, and wind to provide green energy for both household and industrial activities. It is against this backdrop that an



empirical investigation was conducted to establish whether or not there exists a linkage between renewable energy technologies acceptance and effective transition to green energy in Nigeria. Both theoretical and empirical literature suggests that households in developing countries often choose their energy type based on certain factors. We take this assumption to test, using Kauru LGA, Kaduna State as our reference point. 382 respondents were purposefully selected across the 10 wards of the LGA. Descriptive and inferential statistics were used for the analysis. The results revealed that economic and demographic variables namely, family size, income, educational level of the households, and price of renewable energy play a significant role in their transition to green energy. Furthermore, the study has established a strong fuel stacking behavior among the households, and the majority of them are conversant with renewable energy technologies. The findings of the study have important implications for energy planning and climate change policy. We recommend private sector participation with strict government regulations in green energy supply as a way of reducing environmental degradation.

Keywords: RET, Acceptance, Transition, Policymaking

EE-008

GREEN BUILDINGS AS A VEHICLE TOWARDS ACHIEVING SUSTAINABLE DEVELOPMENT GOALS IN NIGERIA

*Mu'azu A. I.

Department of Architecture, Baze University, Abuja

*Corresponding Email: Abbas.muazu@bazeuniversity.edu.ng;

Phone: 0802 795 6333

Abstracts:

In this paper, an attempt to exude the synergetic roles between two topical issues in Nigeria; Housing and Energy, towards achieving the country's SDGs via desktop reviews is presented. The paper highlights the predominant focus on the supply side of energy as a means to ameliorate the endemic energy deficit. Conversely, the country is racing to bridge the housing deficit which is estimated to be over 17million units. However, it is estimated that households consume the highest share of electricity in Nigeria. This suggests a rapid and continuous increase in supply of housing will lead to asustained increase in energy demand despite all measures to bridge the energy supply deficit. The paper demonstrates that, adaptation of green buildings as a measure from the demand-side approach (which ensures rational and efficient energy use, appropriate deployment of renewable energy technology) in current and future housing developments has the potential to reduce the pressure on energy supply infrastructure while also enable achieving SDGs 7 and 11 (affordable and clean energy, sustainable cities and communities) amongst others.

Keywords: Green buildings, Energy consumption, Housing, Nigeria



EE-009

AN APPRAISAL OF THE IMPACT OF PRIVATIZATION OF THE ELECTRICITY SECTOR IN NIGERIA

¹Musa A. I. & ²Zarma I. H.

^{1,2}Energy Commission of Nigeria, Abuja

*Corresponding Email: bundu02@yahoo.com

Abstracts:

With a population of about 200 million, Nigeria produces a meagre 5GW of electricity from the national grid. This is just one third of the minimum required electricity for the development of the country. Since returning to democratic rule in 1999, Nigeria had adopted privatizing the electricity sector in order to improve its efficiency and to ensure energy security. The aim of this Study was to appraise this privatization in regard to its objectives and targets. It discovered that despite a process adjudged to be largely successful, the erratic power supply still persists. The reasons include insufficient gas supply, absence of a cost-reflective tariff, inefficient transmission system, lack of investment planning and procurement framework, weak governance and inadequate enforcement of contracts by regulatory bodies and lack of diversification to other energy sources such as renewables. Given the centrality of electricity to sustainable socio-economic development, it is urged that Decision Makers resolutely implement appropriate interventions, as recommended herein, towards resolving the identified lingering problems. This would assure adequate supply of electricity to the populace while at the same time consolidating the Nation's march towards a much desired energy security.

EE-010

NIGERIA'S ENERGY TRANSITION PATHWAY: THE ROLE OF TECHNOLOGY, INVESTMENT, BUSINESS STRATEGIES AND POLICY.

¹Sambo A. S., ²Zarma I. H., & ³Dioha I. J.

¹Faculty of Engineering and Environmental Design,
Usmanu Danfodiyo University, Sokoto

² Africa Centre of Excellence for Sustainable Power and Energy Development
(ACE-SPED), University of Nigeria, Nsukka

³Admiralty University of Nigeria

*Corresponding Email: ismailzarma@yahoo.com

Abstracts:

The adoption of energy transition strategies and policies are designed to move the global energy sector away from fossil fuels towards zero-carbon energies by 2050 as determined by the Paris Agreement. There is universal acceptance of the need to transition in order to reduce energy related CO₂ emissions and limit climate change. However, there also needs to be recognition that whilst aggressive energy transition programmes are being pursued in developed countries and by the international oil companies, many developing countries, and especially those with hydrocarbon-dependent economies such as Nigeria, require a more gradual and flexible approach to energy transition. Nigeria is pursuing energy transition in order to promote economic growth and is gradually investing in renewable energies, primarily solar, in order to reduce carbon emissions whilst continuing to exploit hydrocarbon resources, especially natural gas – the energy transition fuel for Nigeria. Energy transition will continue to impact the ability of Nigeria and oil and gas companies to attract capital as banks and investors prioritise environmental, social and governance ("ESG") factors and move away from funding hydrocarbon projects. Accordingly, the Federal Government (FG) of Nigeria has indicated a strong political will to embark on 'energy transition that with focus on technology, investment, business strategies and policy as its pathways.

Keywords: Nigeria, Energy, Transition and Pathways

**EE-011**

GREEN ENERGY DEVELOPMENT IN NIGERIA: LAW, REGULATION, TRENDS AND OPPORTUNITIES

*¹Sambo A. S.,²Bala E. J., ²Zarma I. H., & ³Dioha I. J.

¹Usmanu Danfodiyo University, Sokoto

²Energy Commission of Nigeria

³Admiralty University of Nigeria

*Corresponding Email: ismailzarma@yahoo.com

Abstracts:

Nigeria has 12,500 megawatts of installed generation capacity, being largely dependent on natural gas, at 87.5 per cent of the on-grid energy supply mix. This position is rather unsurprising given the nation's vast gas resources and the relative cost-efficiency of gas-fired power generation. Due to perennial challenges with grid infrastructure and other well-documented constraints to reliable power supply, a large proportion of the economy is reliant on off-grid, captive energy generation, which is for the most part, powered by petrol and diesel. As the harmful effects of pollution and greenhouse gas emissions become clearer and the need for sustainable development takes on a more central role in the global energy conversation, there seem to be a consensus among key players across the world that it is imperative to shift focus towards renewable energy (and other clean energy sources) to drive economic growth, not least in developing countries such as Nigeria, where the need for investment is greatest. This global paradigm shift, along with various policy initiatives by governments to incentivise renewable energy development and financing has led to an unprecedented growth in renewable energy (especially solar and wind) projects in many countries. Even for a country like Nigeria, where renewable energy has always featured in the energy mix (hydropower accounts for about 12.5 per cent of its on-grid energy), the current trend provides an opportunity to promote and attract sustainable investment in its energy sector.

Keywords: Green energy, Development, Regulations and Policies

EE-012

GREEN ENERGY AS A FACTOR FOR SECURITY AND ECONOMIC DEVELOPMENT: PROSPECTS FOR NIGERIA

*Lawan S., Aliyu S. & Danjuma I.M.

Department of Electrical/Electronic Engineering,

Nigerian Defence Academy, Kaduna

*Corresponding Email: slawal@nda.edu.ng

Abstracts:

All over the world, green energy has become a great instrument of power generation, confidence security building, and sustainable nation growth. In some countries green energy yields an added value as a veritable instrument of economic development. This study on the use of green energy as a strategic instrument of sustainable national security and economic development. The study draws strength from responsible green energy consumption, access to clean and affordable energy and climate change action. The study set out with five objectives viz: to examine the relationship between green energy and economic development, study the ways and extent to which green energy has contributed to economic development in Nigeria, explore the problems confronting the use of green energy as a strategic instrument of economic development in Nigeria, examine the prospects of applying green energy for economic development in Nigeria



and formulate strategies for transforming green energy into an effective tool of economic development in Nigeria. Data for the research were gathered from primary and secondary sources, and analysed descriptively. The analysis of the collected data gave rise to a number of interesting findings. The study found that there is a strong relationship between green energy and economic development. It also found that green energy has made some useful contributions to Nigeria's economic development, though far below expectations. However, numerous problems were found to be confronting green energy in Nigeria which retarded its use as an effective tool of economic development. For example, there is an absence of national policy gearing green energy to national economic development. Inadequate funding, corruption and poor green energy administration further retard the use of green energy for national development purposes. The study also found that green energy has very bright prospects to act as a catalyst for economic development in Nigeria. These findings have policy implications and have led to some recommendations. The paper therefore recommended that the nation's green energy policy be amended to gear it towards making green energy a strategic instrument of national economic development. Secondly, adequate funds need to be mobilized for green energy from public and private sectors. Thirdly, big time investors, both domestic and foreign have to be mobilized and motivated into investing in green energy to move green energy forward and transform it into a tool of Nigeria's economic development. Fourthly, corruption as well as poor administration must be reduced to the barest minimum in the green energy aspects of national life in Nigeria. It is believed that these recommendations, if implemented, would allow green energy to be used as an instrument of combating insecurity and economic development in Nigeria.

Keywords: Green Energy, Insecurity, Economic Development, Renewable Energy, wireless communication

EE-013

METICULOUS SHIFT TO GREEN ENERGY

*Muhammad Y. & Yusuf U G

Usmanu Danfodiyo University Sokoto

*Corresponding Email: yousshuf@gmail.com;

Phone no.:08176880413

Abstracts:

There is an unequivocal need to diligently create a master plan to reinvent the fabric of sustainable green energy in Nigeria amidst global call for the eviction of combustibles as well as other green house gases. It is therefore paramount to make a bold step, yet- a subtle one in the creation of mini-grids that generate power utilizing sustainable means such as: sun, wind, water etc. to power public places which includes: Universities, Hospitals, Industries, Ministries and the likes. The method utilized in preparing this particular work is from an intuitive point of view as well as observational perspective. Using Usmanu Danfodiyo University as a case study, a mini-grid was recently put in place to cater for some of the power requirement thereby cutting cost on monthly basis and more importantly, doing away with a percentage of carbon emission which will have occurred using the conventional means. There is a strong positive correlation in the strive to possess such sustainable mini-grid system across the country. This study implies that with increase in rise of this initiative, a more possible way of achieving the sustainable transition in a less demanding way is possible within the shortest time possible.

Keywords: sustainable, mini-grid, energy

**EE-014**

RENEWABLE ENERGY MIXROLES IN ACHIEVING SUSTAINABLE DEVELOPMENT GOALS IN NIGERIA

¹Utazi N. D.,¹L. ¹Soretire K. & ^{1,2}Umaru, S.
¹Mechanical Engineering Department,
Air Force Institute of Technology Kaduna, Nigeria
²Department of Mechanical Engineering,
Ahmadu Bello University Zaria, Nigeria
*Corresponding Emails: bnumar@yahoo.com;
Phone::+2348053392760

Abstracts:

Nigeria is currently faced with acute electricity problems, which is hindering its development despite the availability of renewable and non-renewable energy resources in the country. Their abundance provides the country with a wide range of options for harnessing and incorporating them into its energy mix. On the heels of a global shift away from fossil fuels as a result of their connection to global warming and climate change. Affordable and clean energy is one of the seventeen sustainable development goals (SDGs) that are crucial in the majority of Africa's countries, including Nigeria. SDG 7 is inextricably linked to the other goals because it is critical for socio-economic growth. Energy sustainability requires a paradigm shift in the production, use, and regulation of energy resources, stimulating and facilitating the transition to a more effective and efficient energy system. This article discusses the importance of incorporating renewable energy into Nigeria's energy mix to address the country's energy needs and achieve the United Nations' Sustainable Development Goals. As a country, a wide range of energy sources is needed for safety and security reasons. A strong energy mix in Nigeria will give everyone in the country power.

Keywords: Renewable, Energy, Sustainable Development, Carbon Emission

EE-015

THE IMPACT OF INFORMATION AND COMMUNICATIONS TECHNOLOGY ON PRODUCTIVITY OF CUSTOMER SERVICE FOR KADUNA ELECTRIC COMPANY

¹Labbo A. , ¹Yobo P., & ¹Ekpemi S.
¹Department of Business Administration,
Air Force Institute of Technology Kaduna, Nigeria
*Corresponding Emails: aminazuru8890@gmail.com;
Telephone Number:08067300859

Abstracts:

The impact of Information and Communications Technology (ICT) on the productivity of an electricity distribution firm using the three most viable variables of productivity; Efficiency, Reliability, and Profitability was calculated. Assessment of the impact of ICT on the productivity of customer service unit of the Kaduna Electric was done using data pertinent to the research from carefully designed questionnaires. Data were analyzed using statistical tools such as; inferential statistics, percentage and chi-square test. Thus, unveil that amidst electric power distribution system functions of the firm, customer



services is also benefits in ICT deployment. Nonetheless, the overall productivity variables of Efficiency, Reliability, and Profitability evaluated by primary inferential statistics got scores of 4.135, 4.12 and 3.94 as average mean of respondent, on a scale of 1 to 5, with a success benchmark of 2.5 above, dawn the credence of ICT impact on productivity. However, the tests for hypothesis investigating the dependence of productivity variables on ICT deployment has strengthen this finale, with its affirmation that, Customer service functional operations embracing ICT deployment has significant influence on productivity variables, and thus, Customer service productivity by an extend of 81.3%, defined on an average percentile scale of 100%.

Keywords: Customer service, ICT, Productivity

EE-016

PROMISING POTENTIALS OF AGRIVOLTAIC SYSTEMS FOR THE DEVELOPMENT OF NIGERIA GREEN ECONOMY

*Muhammad Bello Garba
Department of Technical Education,
Shehu Shagari College of Education, Sokoto
*Corresponding Email: engrbgmuh@gmail.com;
Tel. +234 806 940 5869

Abstracts:

Renewable energy generation in Nigeria has proved to be essential for both domestic and industrial uses. Most of the renewable energy generation in Nigeria comes from photovoltaic (PV) installation. The PV installation requires land space of about two (2) hectares for every one megawatt (MW) electricity generation. Food and energy are very essential requirements for every human being, and thus a novel concept of co-developing the same area of land for both PV-based electricity generation and farming production, referred to as agrivoltaic system (AVS) or agrophotovoltaic (APV) is gaining popularity in many countries of the world. The paper tries to discuss the potential role of AV in enhancing and improving the livelihood of Nigerian farmers and could become the engines of a sustainable Nigerian economy. The paper further discusses advantages of AVS to farmers such as possibility to collect and store rainwater from the top surface of PV panels in AVS which could used to provide supplemental irrigation the crops to be grown inthe AVS as well as to clean the deposited dust from top surface of PV panels apart from electricity generation, while improving the Land Equivalent Ratio (LER) thereby enhancing green economy. Finally, The paper recommends that adoption of AVS by Nigeria government and individuals in agricultural industry would become a strategy to pursue green economy which is capable of aligning income and employment generation with poverty eradication and natural capital conservation. It could also be used as means to secure land tenure as well as enhance energy-food security, socio-economic feasibility, and livelihoods of the country.

Keywords: agrivoltaic; photovoltaic; green economy; land equivalent ratio



THE INFLUENCE OF CERTAIN FACTORS ON PHOTOVOLTAIC MODULE PERFORMANCE

N Achara, SU Mohammed, W Solomon
Department of Mechanical Engineering,
Nigerian Defence Academy, Kaduna
Email: ekoamuzu@gmail.com,
Mobile: 08107095701

Abstracts:

In the energy resource sector, it is unsustainable to ignore depleting nature of conventional fossil fuels and the associated environmental degradation. This menace can only be resolved by replacement with non-polluting renewable resources such as the photovoltaic. Solar energy appears to have a great potential as it is available globally and has near zero carbon footprint. However, the energy harvested from a photovoltaic module is affected by many factors including module active surface orientation, angle of tilt, module surface temperature, ambient temperature and contaminants. Contaminants could be bird droppings or dust. Dust is a major problem in sub-Saharan Africa. Dust can reduce the transmittance of the module cover and also can create partial shading. Two monocrystalline modules have been designed and built for the purpose of studying the effect of a number of factors on the performance of the photovoltaic system. The experimental investigation have been carried out on both modules under the same ambient conditions. It has been found that for a given dust size, the cell surface temperature decreases with increasing area density or dust loading (kg/m^2). When particle size is the variable and the loading is kept constant, the cell surface temperature increases with increasing particle size. This behaviour is attributed to the wider interstitial spaces of the larger particle sizes that expose uniformly larger area of the module surface to insolation. The experiments have shown that the generated voltage is hardly affected by the dust loading but the generated current and power decrease with increasing dust loading. Again, for a constant dust loading, the power generated increases with increasing dust particle size. Additionally, it has been found that voltage generation is affected by changes in module surface temperature, a function of the ambient temperature. It is thought that low module surface temperature aids the preservation of the orderliness of electron activities hence improved voltage generation.

Keywords: *Insolation, transmittance, module, monocrystalline*



Group 3: Solar Energy and Electronic

SEE-001

EFFECT OF SPUTTERED SILVER THIN FILM THICKNESS TOWARDS MORPHOLOGICAL AND OPTICAL PROPERTIES OF BLACK SILICON FABRICATED BY TWO-STEP SILVER-ASSISTED WET CHEMICAL ETCHING FOR SOLAR CELLS

¹Auwal Abdulkadir & ²Aliyu Kabiru Isiyaku

¹Department of Physics, Umaru Musa Yar'adua University, Katsina, Nigeria.

²Department of Physics, Kaduna State University, Kaduna, Nigeria.

*Corresponding Email: auwal.abdulkadir@umyu.edu.ng
+2348066845094

Abstracts:

Effect of sputtered silver (Ag) thin film thickness towards morphological and optical properties of black silicon (b-Si) fabricated by two-step silver-assisted wet chemical etching for solar cells is investigated. The method involves low temperature annealing of crystalline silicon (c-Si) coated with Ag thin films of 10 nm, 15 nm, and 25 nm. This is followed by an etching in a solution of HF:H₂O₂:DI H₂O (1:5:10 volume ratio) at room temperature for 70 s. Dense and spherical Ag Nps with an average diameter of 203 ± 17.8 nm and surface coverage of about 72.5% are achieved on a sample with Ag film thickness of 15 nm prior to annealing. After the etching, the average nanopores' height of ~420 nm with an average diameter of ~200 nm owing to denser Ag NPs on the c-Si surface before the etching are obtained. Optical absorption enhancement due to low weight average reflection (WAR) within wavelength region of 300–1100 nm is observed on the b-Si wafers. Sample with 15 nm of Ag thin film prior to annealing, demonstrates WAR of 7.7% compared 40.0% of the reference planar c-Si. The low WAR is due to the efficient light coupling effect of the b-Si nanopores. The fabricated b-Si nanopores can be used in b-Si solar cells for enhanced optical absorption and high photocurrent in the future.

Keywords: Silver film thickness, two-step silver assisted etching, black silicon, absorption

SEE-002

EXPERIMENTAL STUDY OF FLOW OVER ROUGHED CRUMP WEIR USING SOFT-COMPUTING TECHNIQUES

Sani Yakubu Khalifa

¹Department of Water Resources and Environmental Engineering
Ahmadu Bello University Zaria, Kaduna state, Nigeria.

Abstracts:

The flow characteristics changes with varying geometry of hydraulic weir and how the weir is inclined to the direction of flow in a channel. In this way, several studies have investigated the performance weirs experimental with paying much attention on the accurate prediction of discharge coefficient. Thus, the main objective of this study is to employ artificial intelligence (AI) techniques to predict discharge coefficient (Cd) of crump weir models. Hence, the precision and use of seven data-driven models including Bayesian neural network (BNN), multiple linear regression (MLR), multi-layer perceptron neural network (MLPNN), genetic algorithm (GA), support



vector machine (SVM), Radial Basis Function (RBF) and curve fitting neural network (CFNN) were examined for estimating of the Cd. To achieve this, experiments were conducted on eighteen crump weir models of different apex angles 80°, 90°, 100°, 110°, 120° and 130°. The upstream angles of the weir models were set in decreasing order of 85°, 70°, 55°, 40°, 25° and 10°. While the downstream angles were increased as 15°, 20°, 25°, 30°, 35° and 40° respectively. 360 laboratory test results were used, 70% for training, 15% for testing and 15% for validation. And statistical parameters of coefficient of determination (R^2), root-mean-square error (RMSE), mean absolute error (MAE), were employed as the criteria for the comparison of the models' performance. Results showed good agreements between the observed and estimated values using the AI-based models. However, among these models, the CFNN managed to estimate the Cd of the weir with the highest precision and accuracy than the rest of the models with ($RMSE=0.1635 \times 10^{-4}$, $R^2=0.9981$). Also, it was found that the most efficient crump was weir model 17 for having the least Cd of 1.14914 and least percentage error of 12.97412, which has been optimized using GA with Cd value of 1.14815.

Keywords: Crump Weir, Discharge Coefficient, Channel, Experiments, Artificial Intelligence

SEE-003

IMPACT OF MICRO TEXTURES SIZES TOWARDS LIGHT ABSORPTION ENHANCEMENT IN HYBRID MICRO/NANO TEXTURED BLACK SILICON FOR PHOTOVOLTAICS

¹Auwal Abdulkadir & ²Aliyu Kabiru Isiyaku

¹Department of Physics, Umaru Musa Yar'adua University, Katsina, Nigeria.

²Department of Physics, Kaduna State University, Kaduna State, Nigeria.

*Corresponding Email: auwal.abdulkadir@umyu.edu.ng,

Phone: +2348066845094

Abstracts:

This paper reports an investigation on impacts of micro textures' sizes towards enhancing broadband light absorption in hybrid micro/nanotextured crystalline silicon (c-Si) for application in photovoltaics. Microscale pyramids are fabricated using sodium hydroxide (NaOH) solution. The NaOH etching is performed at different durations between 25-40 min. Nanowires on pyramids are formed using one-step silver-assisted wet chemical etching (one-step AgNO₃-based MACE). After 30 min of NaOH etching, pyramids with 3-7 μm heights (3-10 μm widths) are formed. The pyramids suppress broad band reflection of the c-Si through an enhanced scattering. After the one-step AgNO₃-based MACE, nanowires with about 300-800 nm heights (40-50 nm widths) are obtained on the pyramids. After the nanowires formation on pyramids, weighted average reflection (WAR) for all samples is significantly suppressed, due to enhanced light trapping by the nanowires and increased light scattering from the base pyramids. The sample with 30 min NaOH etching, and 80 s one-step AgNO₃-based MACE demonstrates WAR of 9.0%, being the lowest broadband reflection achieved in this work. This corresponds to potential short-circuit current density ($J_{sc}(\max)$) of 38.9 mA/cm², or 14.1% enhancement compared to the $J_{sc}(\max)$ of the pyramids without nanowires (34.1 mA/cm²).

Keywords: Alkaline texturing, one-step silver-assisted wet etching, hybrid textures, absorption



BIOPIC SOLAR AIR-CONDITIONER IN MECHANIZE AGRICULTURE FOR SUSTAINABLE DEVELOPMENT

^{1,2}Sani U. K. & ³Zingying L

¹National Board for Technology Incubation,

Federal Ministry of Science Technology and Innovation, Abuja.

²Mechatronic Engineering Department, Nigerian Defense Academy Kaduna

³Institute for the Development of Energy for African Sustainability (IDEAS),
Johannesburg, South Africa

Corresponding Email: ubasani265@gmail.com; uba.sani2020@nda.edu.ng

Phone:+234 706 500 8838

Abstracts:

This article provided a biopic solar air-conditioner suitable for use in mechanize agriculture at rural and unreliable grid supply areas. This is where the popular vapor compression refrigeration cycle is reviewed, adhesive joints introduced and robotics applied on air-conditioner system operations. R134a or R1234yf and solar photovoltaic are utilized refrigerant and power source to reduce the respective chlorofluorocarbons discharge and carbon dioxide emissions. Method adopted includes design calculation, determination of system power consumption and CO₂ emission reduction, refrigeration cycle analysis, modeling, simulation, fabrication and performance test. The result exhibited a cooling system using a DC pump not compressor that operated at coefficient of performance (11.1) much higher than that of compressor system (2.1). Because the components of inverter air-conditioning systems are removed so as the cost of the products. Further reductions of refrigerant fluid and emissions are also indicated which therefore significantly reduced the rate of CO₂ and CFC emission to the atmosphere. The pilot project is located at Government Technical College Kano and Patent is applied through NOTAP. Hence, the project targets ways to resolve current climate change and power cost dilemma by delivering efficient and climate friendly cooling for agriculture through rapidly phasing down hydrofluorocarbons in the cooling sector and the report tells us there are many actions we can take to get cooling right as enshrined in the Kigali Amendment to Montreal Protocol. Other Proven policies of importance such as minimum energy performance standards, National Climate Act and the integration of efficient cooling into enhanced Nationally Determined Contributions of the Paris Agreement, as African nations need to invest in post COVID-19 recovery.

Keywords: Adhesives, Biopic, Emission, Robotics

**SEE-005**

DESIGN OF AN ALTERNATIVE SOLAR POWER FOR A RESIDENTIAL BUILDING AT NAIBAWA AREA, KANO

¹Rikoto I. I., ²Usman I. I., ³Ikpa T.M., ¹Ganda Y.M., ⁴Yakubu A.I., & ¹Umar N.
¹Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto, Nigeria
²Department of Mechanical Engineering, Bayero University, Kano, Nigeria
³TOKOMIT Nigeria. Ltd Abuja
⁴A.Y. Global Integrated Consult Ltd, Sokoto
Corresponding Email: rikoto2003@gmail.com,
Tel: +2348038498566

Abstracts:

Frequent collapse of the national grid, poor quality electricity supply by the national grid, high cost of diesel fuel for running heavy duty generators and global search for green energy has necessitated the need for a switch to solar power as an alternative energy. This paper report on the detail design of a 12,5kW solar photovoltaic power for a residential building at Naibawa area in Kano state. Based on the load assessment of the building, the estimated power for the building is 5.015kW with the total energy demand of 39.670kWh. Considering the appliances that are to be powered based on a preliminary load analysis. A 15kVA/48V Inverter, 34 pcs of 350W/12V module, 16pcs of 2000Ah/12V batteries and 2pcs of 80A/48V MPPT charge controller, and 16mm² and 24mm² flexible copper wire for the balance of the system component was recommended. The design system is expected to power a 200W refrigerator, 3 Air conditions of 1.5Hp, 1 plasma TV of 200W, 50 LED lightening bulbs of 10W, 6pcs of 40W low energy consumption fans and a water pump of 1hp. The designed is expected to provide an alternative to the grid electricity for a minimum of 18hours if run concurrently and 24hrs non concurrently operation.

Keywords: Design, Solar power, Residential building, Naibawa

SEE-006

LOAD ANALYSIS OF SOKOTO GUEST INN LTD FOR SOLAR PHOTOVOLTAIC SYSTEM DESIGN AND ECONOMIC ANALYSIS OF THE SYSTEM

^{*1}Dabai K. A., ²Argungu G. M., ^{1,2}Buda S. & ²Umar H. S.
¹Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto
²Department of Physics, Usmanu Danfodiyo University, Sokoto
*Corresponding Email: kabir.ahmed@udusok.edu.ng

Abstracts:

This work analysed all the electrical appliances of Sokoto Guest Inn Ltd (13.126oN, 5.204oE) for design of solar photovoltaic system. The location composed of four different apartments: A Reception, 8 Channels, 6 Royal Suits, and 2 Halls. The load analysis of the location gives power requirements of 49.6kW, 30.6kW, 8.2kW, and 29.6kW with corresponding energy consumption of 319.4kWh, 132.6kWh, 36.0kWh, and 180.8kWh for the Reception, a Channel, a Royal Suit, and a Hall respectively. Daily average solar radiation data was obtained from Nigeria Metrological Agency (NIMET) which ranges from 17.0MJ/m² (i.e., 4.72kWh/m²) to 25.58MJ/m² (i.e., 7.10kWh/m²) with an average value of 21.83MJ/m² (i.e., 6.06kWh/m²). The Load sizing of the appliances gives: 5 pieces, 3 pieces, 1 piece, and 3 pieces of 15kVA inverter; 540 pieces, 224 pieces, 61 pieces, and 306 pieces of 150 Watt peak modules; 184 pieces, 77 pieces, 21 pieces, and 104 pieces of 12V, 200Ah deep cycle battery for the Reception, a Channel, a Royal Suit, and a Hall respectively. Economic analyses of the systems were carried out given the Levelised Cost of Energy of 63.17, 56.91, 71.61, and 58.78 NGN/kWh for the Reception, a Channel, a Royal Suit, and a Hall respectively. The cost of energy obtained is slightly higher than the present cost of grid, but the PV system is available all the time and more reliable as compared to the grid.

Keywords: Load Analysis, Solar PV, System Design, LCOE



SEE-007

INSTALLATION OF SOLAR CARPORT FOR THE PROVISION OF CAR SHADE AND LIGHTING OF STAFF QUARTERS IN DELTA

*Dioha, I. J. & Chidozie E.

Renewable Energy Unit, Admiralty University of Nigeria, Ibusa, Delta State.

*Corresponding Email: dioha-energy@adun.edu.ng

Abstracts:

A study of a 3.5kW solar carport for the provision of car shade and lighting of staff quarters in the Admiralty University of Nigeria, Delta State has been conducted. The energy audit of the staff quarters showed that 120kWh of energy is consumed for the lighting. This study is focused on efficient lighting of the staff quarters and the provision of a carport for the university. Energy-saving lamps (LEDs) are suggested to reduce the staff quarter's lighting energy consumption from 120kWh to 51.4kWh. Cars exposed to the atmosphere without shade are prone to atmospheric, thermal, and oxidative degradation as well as degradation caused by ultraviolet radiation (UV). The adverse condition that the cars are exposed to, at different seasons of the year will reduce the life span of the car. The estimated average cost for the installation of the 3.5kW solar photovoltaic car park is nine thousand six hundred and ninety-five dollars (\$9,695:00).

Keywords: Solar Car Park, Energy Efficiency, LED, Staff Quarters, Degradation

SEE-008

EXPERIMENTAL ANALYSIS OF FIXED AND DUAL AXIS SOLAR TRACKER USING ANALYTICAL SOLAR ANGLE PARAMETERS OF KANO CITY, NIGERIA

*₁Muhammad J. Y.; ₂Gele M. A.; ₃Kadawa I. A.; ₁Anas B; ₃Kamal A. A.

₁Department of Mechanical Engineering, Nigerian Army University, Biu, Nigeria

₂Sokoto Energy Research Centre, Usmanu Danfodiyo University Sokoto, Nigeria

₃Department of Electrical and Electronics Engineering,

Nigerian Army University Biu, Nigeria

*Email Addresses: jambcyfm@gmail.com

Abstracts:

Developing Countries are always battling with power fluctuation with rapid increase in energy demand and they depended on power generated by the fossil fuels. This source of energy is always depleting since its non-renewable and not environmentally friendly, therefore, renewable energy sources should be replacement of fossil fuel in order to control pollution and global warming. This study tends to compare the performance of manually control dual-axis tracking and fixed solar PV module using available altitude and azimuth angles of Kano city, Nigeria. The result of the experimental study revealed that average percentage power output gain for a dual-axis tracking system was 53.5% as compared to the fixed solar PV module. Finally, it was recommended to design an automatic control tracking system using microprocessor or fuzzy logic using solar condition of Kano, Nigeria as future study.

Keywords: Efficiency, Fossil fuel, Modules, Power output, Voltage



SEE-009

HEAT SPREADING ENHANCEMENT CAPABILITY OF BALN NANOCOMPOSITE AT HARSH AMBIENT ON WHITE-BASED HIGH-POWER LED

^{1,2}Hamza El-ladan A.

¹Centre for Renewable Energy and Research,
Umaru Musa Yaradua University (UMYU), Katsina

²Nano Optoelectronics Research Laboratory,
School of Physics, Universiti Sains Malaysia (USM),
11800 Minden, Pulau Pinang, Malaysia

*Corresponding Email: abdukarim.hamza@umyu.edu.ng
Phone: 08065525224

Abstracts:

Using the T3Star method and cumulative structure-function analysis, the thermal performance of high-power white LED mounted on bare aluminium substrate and solid thermal interface material (BAIN composite) coated substrates are evaluated, at three different bond line thickness, harsh ambient temperatures of $\sim 55^{\circ}\text{C}$ with higher driving current $\sim 700\text{ mA}$. The recorded total thermal resistances of the bare substrate is found to be in $\sim 12\text{K/W}$ while the coated substrates were found to be in $\sim (7.9 - 11.43\text{K/W})$, the evaluated junction temperature of the LED-based on the coated substrates is improved to about 20% over that of the bare substrate. The de-rating curve for the LED to operate safely without getting de-rated based on the developed STIM and higher ambient temperature is plotted, while the presence of the developed material is confirmed by XRD and FTIR analysis.

Keywords: Solid Thermal Interface Material; Light Emitting Diode; Thermal Resistance; Junction Temperature

SEE-010

POSITION CONTROL OF A SOLAR TRACKING SYSTEM USING A PROPORTIONAL-INTEGRAL (PI) CONTROLLER AND SLIDING MODE CONTROL (SMC)

¹Beli A. I., ²Zaiyanu N., ³Bashir S. U.

¹Electrical & Electronics Engineering Department, Kaduna Polytechnic

²Department of Electrical & Electronics Engineering Technology,
Nuhu Bamalli Polytechnic, Zaria.

³Department of Electrical & Electronics Engineering Technology,
Federal Polytechnic Damaturu.

*Corresponding Email: a.beli@kadunapolytechnic.edu.ng,

Abstracts:

Photovoltaic solar power offers many advantages in the generation of electricity. The challenge in getting the maximum benefit of collecting solar power is to ensure that a photovoltaic solar panel or a complete PV array is correctly orientated and positioned with regard to the direct sunlight coming from the sun at all times of the day because the more surface area that is exposed to direct sunlight, the more output the photovoltaic panel will produce. This paper reports the position control of the solar panel to track the direction of the sun throughout the daytime. DC motor is used to actuate the process. A comparative study is conducted in MATLAB/Simulink using a Proportional-Integral (PI) controller and a second-order sliding mode control (SMC) and the simulation results are presented to show the performance of the techniques in position control of the DC motor.

Keywords: DC motor; Solar Tracking; Position control; Second order sliding mode; PI control



SEE-011

EFFECTS OF ALUMINUM DOPANTS ON ZnO NANOPARTICLES FOR NDSSC APPLICATIONS

^{*1,3}Offiah S. U, ²Orizu G. E, ³Ugwuoke P. E, & ³Ezema F. I.

¹National Centre for Energy Research and Development,
University of Nigeria Nsukka,

²Department of Physics and Industrial Physics,
Nnamdi Azikiwe University Awka

³Department of Physics and Astronomy, University of Nigeria Nsukka

*Corresponding Email: offiahsolomon@gmail.com

Abstracts:

A low-cost simple successive ionic layer adsorption and reaction (SILAR) method was used to synthesize Al-doped and pristine nanostructured zinc oxide thin films using Zinc chloride and ammonia as major precursors. The study was carried out by depositing 3% Aluminum doped ZnO on the FTO substrate to be used as photoanode. The natural red dye extracted from the Camwood plant was used as a sensitizer together with the photoanode to fabricate a dye-sensitized solar cell. The optical and structural properties of the pure and extrinsic ZnO thin films were also studied by characterizing the samples. The study of the photovoltaic properties (like the short circuit current, open circuit voltage, field-factor, shunt, and series resistances) of the pure and extrinsic ZnO film also carried out indicated that Al-doped ZnO prepared cell outperformed the pristine ZnO prepared dye-sensitized solar cell except for the field-factor. All other photoconversion efficiency studies also pointed to the fact that the Al-doped ZnO photo-electrode gives a better result when compared with the undoped ZnO photoanode. The cheap and availability of the constituent nanostructured materials for natural dye-sensitized ZnO nano-rods prepared solar cells in conjunction with locally available red dye extracted from *Baphia nitida* plant makes it a promising material for DSSCs production.

Keywords: Nanostructure, SILAR, NDSSC, Aluminium, dye

SEE-012

A BRIEF REVIEW OF PROGRESS IN ELECTRON TRANSPORT LAYERS IN PEROVSKITE SOLAR CELLS.

^{*1,2}Yusuf A.S., ²Anderson T. M, & ³Prasad K.

¹Department of Physics, Federal University of Technology, Minna, Nigeria.

²Department of Physics and Astronomy,
Auckland University of Technology, New Zealand.

³Department of Electrical and Electronics, Auckland University of Technology,
New Zealand.

*Corresponding Email: ayusuf@futminna.edu.ng

Abstracts:

The energy industry is currently very interested in designing and developing next-generation photovoltaic systems using organic-inorganic perovskite hybrid solar cells. They represent the most promising materials for high Power Conversion Efficiency (PCE), low-cost solar cells. They can also come up with answers to the global dilemma and the current energy requirements of civilization. Over the past few years, the power conversion efficiency of perovskite solar cells (PSCs) has rapidly increased, going from 3.8 to 24.2 %. The review, however, focuses on the most recent developments in the electron transport layer as perovskite solar cells are the most important element for enhancing the performance and stability of the device. These summaries include



designs, electron transport (ETL) layers and perovskite active layers for efficient perovskite solar cells. The performance and stability issues with organic-inorganic halide perovskite solar cells are also covered in this article. Finally, recommendations for additional research on the ETL and perovskite active layer were offered.

Keywords: Perovskite, Doping, Active layer, Electron transport, Mesoporous

SEE-013

PARAMETRIC DESIGN CONSIDERATIONS OF HYBRID SOLAR PHOTOVOLTAIC – DIESEL SYSTEM

^{*1,2}Mawoli M., ³Sambo, A.S., ^{1,2}Dabai, K.A., Ganda Y.M. & ¹Rikoto, I.I.
¹Sokoto Energy Research Centre, Usmanu Danfodiyo University Sokoto

²Department of Electrical & Electronic Engineering,
Usmanu Danfodiyo University Sokoto

³Faculty of Engineering and Environmental Design,
Usmanu Danfodiyo University Sokoto

*Corresponding Email: mawoli.mohammed@udusok.edu.ng;

Abstracts:

Sub-Saharan Africa is characterized by inadequate supply of electricity; consequently stagnating the region's social and economic development. Attempt to proffer solution to lingering energy crisis in the region through the deployment of hybrid energy system (HES) motivated the study on parametric analysis of solar photovoltaic – diesel generator hybrid system design for off-grid applications. In accordance with the Rural Electrification Agency (REA) of Nigeria choice of solar photovoltaic-diesel generator hybrid systems for the implementation of energizing education programme (EEP), HES consisting of renewable and non-renewable energy systems is considered in this study. Other classifications of HES include hybrid renewable energy systems (HRES) and hybrid renewable-new energy system (HRNES). Design parameters were analyzed with focus on resources, consumption and cost and their impacts on the overall system performance considering the reliability, availability and maintainability (RAM) indicators.

Keywords: Hybrid, PV_Diesel, Design parameters, RAM indicators

SEE-014

AN OFF GRID PHOTOVOLTAIC SOLAR SYSTEM DESIGN: A CASE STUDY OF KADUNA POLYTECHNIC

^{*1}Hamisu Usman, ²Aminu Hamisu Kuraand, & ²Muhammad Mustapha Saleh

¹Department of Electrical and Electronic Engineering, Kaduna Polytechnic, Kaduna

²Department of Electrical Technology,

Federal College of Education (Technical) Gusau, Zamfara state

*Corresponding Email: hamisuusman@kadunapolytechnic.edu.ng

Abstracts:

The paper, presents an off-grid photovoltaic solar system as an alternative back up power supply for fifty business shops in College of Engineering Kaduna Polytechnic. Photovoltaic energy is one of the famous energy amongst the varieties of renewable energies that has no hazard to the environment and is friendly source of energy. PV system is free from sun and direct conversion of solar energy into electricity. The proposed paper highlights the details procedure which involves designing, selecting, sizing and determining the specifications of the various components involves in PV system installation. The aim of this work depends on the different factors such as geographical location, weather condition, solar irradiance and load profile of the proposed PV system design.

Keywords: PV System, Design, Sizing, Selection and Optimal used



SEE-015

A REVIEW: PEROVSKITE IN TANDEM SOLAR CELL

¹Muhammad B M., ²Isah K. U., ²Abdulkareem A. S., & ²Ibrahim S. O.

¹Department of Physics, Federal Polytechnic Bide,

²Department of Physics, Federal University of Technology, Minna

*Corresponding Email: bakeko4711@gmail.com

Abstracts:

In the last few years' metal halide perovskite has demonstrated excellent semiconductor properties with good photo absorption, band gap tuning simple processing allowing it to attain high sunlight to electricity conversion efficiency. Due to its tunable band gap it can be rapidly and cheaply deposited from low-cost precursors, making it ideal candidate materials for tandem solar cell, either by using perovskites as the front sub cell paired with a silicon or copper indium gallium selenide bottom cells or making an all perovskite tandem solar cells. This Review highlights the unique potential of perovskite Multi-Junction tandem solar cells to attain solar-to-electricity conversion efficiencies far above those of single-junction solar cells at low costs. We discussed challenges hindering the solar cell from achieving even a higher performance.

Keywords: Perovskite, Tandem, Solar Cell

SEE-016

ENERGY AUDIT AND SOLAR PV SYSTEM ANALYSIS OF A RESIDENTIAL BUILDING: A CASE STUDY OF 3 BEDROOM APARTMENTS AT AGRIC QUARTERS KADUNA

¹Labbo A., ²Utazi N. D., ²Soretire L. K., & ¹Yobo P.

¹Department of Business Administration,

Air Force Institute of Technology Kaduna, Nigeria

²Department of Mechanical Engineering,

Air Force Institute of Technology Kaduna, Nigeria

*Corresponding Email: aminazuru8890@gmail.com;

Telephone Number:08067300859

Abstracts:

The rising cost of electricity bills affects the disposable income of individuals which in turn affects the quality of life of the society. Based on the banding of the location and usage of prepaid metering system an increase in the cost of electricity was observed in residential buildings of Agric quarters Kaduna. Energy audit assessment was conducted to ensure efficient utilization of energy and replacement of lighting systems was suggested. A stand-alone Solar PV system analysis for the residential building was done. From the Energy Audit assessment a considerable reduction of Energy billing was found. A stand-alone PV system for the residential building and the payback period was found based on the current prices of equipment and energy.

Keywords: Energy Audit, Electricity Bill, Solar PV, Stand-alone



SEE-017

A REVIEW ON DYE SENSITIZED SOLAR CELLS (DSSCS): PRESENT STATUS AND FUTURE PROSPECTS

¹Abubakar A. A., ¹Isah K. U., ¹Kimpa M. I., ¹Ibrahim S. O., & ¹Yusuf A. S.

¹Department of Physics, School of Physical Sciences,
Federal University of Technology Minna.

*Corresponding Email: aa.ahmad@futminna.edu.ng

Abstracts:

The pursuit for the discovery of abundant and sustainable resource of energy has been of interest to many scientists due to accelerated depletion in non-renewable energy resources and environmental concerns. This draws attention to photovoltaic technology which converts solar radiation to electrical energy. Photovoltaic devices like inorganic, organic and hybrid solar cells have been invented for the past several years using several methods. The issue with traditional Silicon-based Solar Cell is the manufacturing costs and environmental problems which restricts its pervasive use. Tremendously, among all organic solar cells, Dye Sensitized Solar Cell (DSSCs) been study as an alternative to Silicon base Solar Cells have received much attention since the first report of 7 % efficient cell in 1991. Its low cost and easily implemented technology. Affirmed record efficiencies of DSSCs is now 13.29 % for optimized CdSe-TiO₂ photo-anode. This review describes the present status, future prospects and the research challenges that must be addressed to continue the rapid commercialization of DSSC.

Keywords: Dye-sensitized solar cells, Photovoltaic, Solar Radiation, Efficiency, Photo-anode, Stability

SEE-018

ASSESSMENT AND COST IMPLICATION FOR THE DESIGN OF A STANDALONE ALTERNATIVE SOLAR POWER FOR SULTAN BELLO JUMMAT MOSQUES, SOKOTO

¹Rikoto I. I., ¹Dabai K. A., ¹Yusuf N., ²Labbo A. & ³Abubakar I. L.

¹Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto

²Dept. of Business Administration, Air Force Institute Technology, Kaduna

³Department of Electrical Engineering, Waziri Umaru Polytechnic Birnin Kebbi

*Corresponding Author: rikoto2003@gmail.com; Tel: 08038498566

Abstracts:

Epileptic electricity supply by the National grid, indiscriminate load shedding and power quality electricity supply by the Distribution Companies in Nigeria has become a great challenge to the electricity consumers. Stand-alone (off grid photovoltaic (PV) systems has been considered to be reliable alternative for electrical energy generation for residential and other building applications. In this paper, Load assessment of power consumption based on the power rating of the appliances and the electrical energy demand of Sultan Bello Jummat mosque Sokoto was carried out. The total power of the mosque building was found to be 7.074KW translating to total daily energy requirement of 42.444KWh for an average 6 hours of usage. An off grid PV system was designed to power the building according to the load assessment. It was found that Based on the electrical appliances of the building design, 2pcs of 7.5kVA/48V, 36pcs of 300W/24 PV modules, 20pcs of 200Ah/12V Deep cycle batteries, 3pcs of 60A/48V Charge controllers. The system will require 16mm and 24mm copper wire cable for the installation with robust performance. The cost estimate for the installation of the system about 10 million naira. This cost is relatively high when compared with that of diesel engine fuel generator that would be purchase. However considering the high cost of diesel and maintenance cost and the hours of usage and environmental pollution, it is still preferred that the heavy duty diesel generator

Keywords: Cost Implication, Design, Solar PV



INVESTIGATING THE ABSORPTION OF SOLAR RADIATION BY DUST AND GLASS AND THEIR EFFECTS ON PV SOLAR PANELS IN KADUNA METROPOLIS

*Mohammed Mannir Aliyu

Physics Department, Kaduna State University, KASU, Kaduna

*Corresponding Email: mannir2003@yahoo.com;

Abstracts:

The photovoltaic solar cells are considered to play important roles as a source of green energy for the future due to their numerous advantages. However, one of the re-occurring challenges of this device is that low conversion efficiency. A further reduction in performance is due to solar radiation absorption by glass as well as dust accumulation as well as changing direction of incident due to the motion of the sun..While the effect of glass is nearly constant, dust accumulation varies greatly with season as well as environmental variables and location. This study attempted to investigate magnitude of solar radiation absorption by both glass and accumulated dust as well as the absorption at different incident angles. The effects of these on the performance of the PV Solar modules was investigated. Two 80W monocrystalline solar panels were exposed to outdoor environmental variables while the solar panels' output parameters were measured. A glass slide placed on top of each panel so that dust deposited on the panels was equally available on the slides. Solar irradiance measurements were made at horizontal surface as well as by adjusting the inclination angle until maximum radiations were attained incidence (corresponding to untracked and untracked system). By comparing the solar irradiance directly and through both clean clear glass and through dusted glass slides, the amount of light absorbed by both media were deduced, just as the absorption at different angles were observed. The highest monthly average values of 569.65 and 748.24W/m² for the irradiances at horizontal as well as for maximum incident (I_{oh} and I_{om}) respectively were obtained in the month of May, while the least values of 489.79 and 584.25W/m², respectively, were obtained in the month of April, corresponding to energy yield increase of 31.5% and 19.29% respectively due to tracking. By comparing these radiations, the viability and potential of using solar tracking was assessed. The largest difference was found in the months of December and May with values of 31.35% each. The lowest difference was obtained in April at 19.29%. The average absorption of the incident radiation (I_{oh} and I_{om}) in clear glass reduced the incident radiation to 89.01% and 89.69% respectively, whereas in dusted glass, the radiation was reduced to 85.75% and 82.31% respectively. The highest absorption of light due to dust was in June and the least absorption was in March. The Voc and Isc of the panels were found to follow the trends of the irradiance and since this was dependent on the received radiation, which in turn depends on the dust deposited, it implies the output parameters were determined by the dust accumulation.

Keywords: Solar Irradiance, Absorption, Dust, Glass

**Group 4: Wind Energy and Other Energy Resources****WEOER-001****ECONOMIC ANALYSIS OF WIND GENERATED ELECTRICITY
FROM THREE SELECTED SITES IN NIGERIA**¹Samuel M., ²Muhammad S.U., & ³Solomon W.C.^{1,2,3}Dept of Mechanical Engineering, Nigerian Defence Academy, Kaduna*Corresponding Email: marydibal267@gmail.com; sumuhammed@nda.edu.ng; s
cwunuken@nda.edu.ng**Abstracts:**

The study evaluates the economic analysis of generating electricity from wind energy in three locations in Nigeria. Wind energy, has grown into a global power generation business that competes favorably with existing power energy plants. While interest and investments in wind energy recycling systems are steadily rising around the world, scientific researches and commercial activities in this subject are growing day by day. The wind profile of the sites Zaria, Maiduguri and Abuja were obtained from the Nigerian Meteorological Agency (NiMet) for a period of eight year from 2008 - 2015. Microsoft excel platform was used to carry out the economic analysis. An existing three bladed horizontal-axis wind turbine from Dyna-Living, China was used to evaluate the total initial cost as NGN 557,350, for the three sites. However, the net present values obtained for Zaria, Maiduguri and Abuja sites were NGN 1,085,620.72, NGN 587,629 and NGN 506,355.60, respectively, while the internal rate of return of the investment when the capital is at zero interest rate were 94.78%, 94.57% and 9.15% respectively. The payback period were 6, 10 and 219 years for Zaria, Maiduguri and Abuja respectively and levelized cost of electricity for Zaria was found NGN33 which is the least as compared to the sites with NGN47.94 for Maiduguri and NGN172 for Abuja, because of the high value of extractable energy from Zaria site. From the levelized cost of electricity it could be inferred that the cost generating electricity from wind is cheaper in Zaria followed by Maiduguri and then Abuja with highest cost of kWh. The cost of one unit kWh of electricity from distribution companies from the selected sites where found to be NGN62 for Zaria, NGN48 for Maiduguri while in Abuja cost NGN42. Hence, electric energy generation from wind in the present analysis reveals that Zaria and Maiduguri have better potentials for such investment than Abuja.

Keywords: Wind turbine, Wind energy, levelized Cost, Net Present Value, Internal Rate Return, Payback Period



WEOER-002

AN OVERVIEW OF THE EXPLOITATION OF RENEWABLE ENERGY RESOURCES IN NIGERIA

¹Julius A. Y.; ²Zarma I. H.; & ³Garba I.

¹Energy Commission of Nigeria HQTRS, Abuja

²Africa Centre of Excellence for Sustainable Power and Energy Development (ACE-SPED), University of Nigeria, Nsukka

³Nigeria Defence Academy (NDA) Kaduna

*Corresponding email: juliusagaka2001@gmail.com and ismailzarma@gmail.com

Abstracts:

This study evaluated and discussed the current use of renewable energy in Nigeria as a feasible energy choice and alternative energy source from the perspective of sustainable development. When several African nations were compared, the issues and factors that affected the growth and use of renewable energy (RE) in the nation were noted and discussed. The effect of energy policies, policymakers, its implementation and financial backing, along with conventional energy related demands, were among the many factors that determined these countries' guidelines for developing renewable energy. This article provides a conceptual framework and an overview of how these important factors affect the development of RE. It also tries to influence politicians' decisions, contribute to policy creation, and draw funds to the countries under consideration, with a focus on Nigeria, in the discussion about how to promote renewable energy.

Keywords: Renewable energy, challenges, policy, Nigeria

WEOER-003

GEOHERMAL GRADIENTS IN RAFIN REWA HOT SPRING, LERE LOCAL GOVERNMENT AREA OF KADUNA STATE

¹Ezra D., ²Nehemiah A. & ³Nuhu M. G.

¹Department of General Studies, NuhuBamalli Polytechnic, Zaria, Kaduna, Nigeria.

²Department of Agricultural and Bio-Environmental Engineering, NuhuBamalli Polytechnic, Zaria, Kaduna, Nigeria.

³Department of Mechanical Engineering, NuhuBamalli Polytechnic, Zaria, Kaduna, Nigeria.

*Corresponding Email: ezradauda2014@gmail.com

Phone: (08050575522)

Abstracts:

Power generation is a major problem in many countries, So there is need for alternative renewable sources of energy. The geothermal gradients of Lere were estimated using high resolution aeromagnetic data interpretation through the method of spectral analysis. The study area is bounded by latitude 10.0°N to 10.5°N and longitude 8.5°E to 9.0°E. Regional-residual separation was carried out on the total magnetic-intensity of the study area to yield the residual magnetic intensity after subtracting the regional field. Four blocks of the residual magnetic intensity data were extracted. The data of each block were zero padded and tapered to correct for edge effect. Then, they were subjected to Fourier transform. Spectral analysis was carried out on the Fourier transformed data and



the results indicates that, the depth to top ranges from 1.25km to 1.9km with an average of 1.58km while the centroid varies from 4.2km to 4.9km with an average of 4.55km. It then, suggested that the study area undelain by a curie point depth between 6.8km to 8.4km with an average of 7.6km and corresponding geothermal gradient values varying from 0.070c/m to 0.090c/m with an average of 0.080c/m. The shallow Curie Point Depth recorded around RafinRewa hot spring is a reflection of high curie temperature which can be attributed to crustal thinning. The Curie Point Depth around the study area is shallower than the geothermal energy attributable to volcanic activity. The Curie Point Depth and the geothermal gradient around the northeast edge of the study area suggest a promising geothermal potential.

Keywords: Geothermal energy, Aeromagnetic data, Hot spring, Curie point depth & geothermal gradient.

WEOER-004

ANALYTICAL INVESTIGATION OF VARIATIONS FOR DAY-LENGTHS AND LENGTH OF OBJECTS' SHADOW AT VARIOUS SEASONS OF THE YEAR

*Dabai K. A. & Buda S.

Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto

*Corresponding Email: kabir.ahmed@udusok.edu.ng

Abstracts:

Installations of solar photovoltaic systems and solar thermal systems require solar radiation parameters and sunshine hour duration for determination of their optimum utilizations. These parameters vary seasonally. This work investigated analytically the variations of day-lengths and length of shadow of objects at various seasons of the year taking Sokoto (13.03°N, 5.2°E) as case for the study. The daily declination angles in degrees calculated show positive values from Mar 22nd to Sep 23rd with a peak value of 23.46°; but negative values on the other periods with a trough value of -23.42°. The day length hours range from 11.23 hours (i.e., about 11 hours, 14 minutes) to 12.77 hours (i.e., about 12 hours, 46 minutes) with longer day hours when the declination angle is positive (21st March to 23rd September) while longer night hours when the declination angle is negative. The results also show that the daily elevation angle at solar noon ranges from 53.65° to 90.0° and the values of ratio of shadow of any object as compared to its length at solar noon ranges from 0.18% to about 73.1%.

Keywords: Variations, Day-lengths, Objects' shadow, Seasons



WEOER-005

STUDIES OF THE MONTHLY AVERAGE GLOBAL SOLAR RADIATION OF SOKOTO STATE

¹Alor K P, ¹Nwokoye A O C & ²Offiah S U

¹Physics and Industrial Physics, Nnamdi Azikiwe University Awka,
Anambra, Nigeria

² National Centre for Energy Research and Development,
University of Nigeria Nsukka

*Corresponding Email: nazaekpere1977@gmail.com , offiahsolomon@gmail.com,

Phone: 08062152391

Abstracts:

The monthly average global solar radiation of Sokoto state was analyzed using data collected for Gunn-Bellani solar radiation (H_M), wind speed (WS), sunshine hours (S), maximum and minimum temperature for a period of 6 years. Monthly means were obtained from equations involving these meteorological parameters. The accuracy of the results was tested using correlation coefficient (R), coefficient of determination (R^2), root mean square error (RMSE), mean bias error (MBE), and mean percentage error (MPE). The obtained values of solar radiation for Sokoto has a peak value of $20.58 \text{mjm}^{-2}\text{day}^{-1}$ and the least value of $14.46 \text{mjm}^{-2}\text{day}^{-1}$, wind speed rises from the month of January through May with its peak in May then decreases rapidly from the month of May with its least value in the month of October after which it rises again, the sunshine duration decreases with its least value in the month of August, it again rises with its peak in the month of November. The air temperature difference rises in the dry months with its peak in the month of February and its least values in the month of July. In Sokoto, the global solar radiation increase by $1 \text{mjm}^{-2}\text{day}^{-1}$ as the sunshine hours increase by 8.2% and the air temperature increase by 1.8%.

Keyword: global, radiation, sunshine hours, air temperature

WEOER-006

STATUS OF LIFE CYCLE ASSESSMENT (LCA) OF SOLAR SYSTEMS IN NIGERIA

¹Baba M. T., ²Adamu A. A., & ²Yola I. A.

¹Department of Mechanical Engineering,
Federal Polytechnic Mubi Adamawa State

²Department of Mechanical Engineering, Bayero University Kano

*Corresponding Email: muhammadtankobaba@gmail.com

Phone: 08037259060; 08025194104

Abstracts:

Life Cycle Assessment (LCA), as a tool for analysing the environmental impacts of products and services has been receiving increased attention from various researchers for over 20 years. Globally, over 25,000 articles linked to LCA were published in scientific journal databases such as the Google scholar and Scopus; yet, the perception of LCA is comparatively under development in most African countries particularly Nigeria, where the number of links has been emphasised to be less when compared to other Africa's top economies. This article reviewed the life cycle assessments that were carried out in Nigeria



between the years 2010 to 2020, with the aim of establishing the existing research gap in the conduct of LCA of solar systems in Nigeria. A total of 16 LCA articles were traced for the country; this number is lower than that of other top economies like South Africa and Egypt with 41 and 37 articles respectively. Energy and Agricultural sectors have high number of articles (4 each), followed by Electricity and Waste (3 each), transport, and other sectors (1 article each); with no single article on photovoltaics Plant (PV Solar system). Most of these researches were conducted in the south-western Nigeria. Creating awareness on the importance of LCA of products, establishment of a specific Life Cycle Inventory (LCI) database for Nigeria are some of the steps identified to boost the number of LCA research articles to take care of solar photovoltaics.

Keywords: Review, Life cycle assessment, Environmental Impact; Nigeria, Solar System

WEOER-007

GEOHERMAL ENERGY DEVELOPMENT AND ITS POTENTIAL AS CLEAN ENERGY FOR ELECTRICITY GENERATION AND OTHER APPLICATIONS

^{*1,2}Eke Mkpamdi N

¹Department of Mechanical Engineering, University of Nigeria, Nsukka

²Africa Centre of Excellence for Sustainable Power and Energy Development (ACE-SPED)

*Corresponding Email: mkpamd.eke@unn.edu.ng,

Phone +2348037304156

Abstracts:

Geothermal energy comes from the natural generation of heat primarily due to the decay of the naturally occurring radioactive isotopes of uranium, thorium and potassium in the earth. It is considered one of the most promising sources of renewable and clean energy which may not be as benign as widely believed. In this paper, we look at geothermal energy capacity factor of geothermal power plants located in thirty (30) selected countries of the world, geothermal energy resources, types, applications, improvements, benefits, drawbacks and advancements and as clean energy for future. The actual energy output during this period and the capacity factor vary greatly depending on a range of factors. The result revealed that Australia has not witnessed any geothermal power development despite prospective sites that has potentials for power generation. Countries like Indonesia, Italy, Kenya, Mexico, New Zealand, Philippines, Turkey and U.S.A has robust geothermal power projects and development. Geothermal resources are large amounts of hot, natural fluids contained in fractures and pores within rocks at temperatures above ambient level. The type of the geothermal resource determines the method of its utilization. High-enthalpy resources, such as dry steam and hot fluids can be gainfully utilized to generate electric power. There are a number of ways to improve the value of geothermal fluid. Geothermal developers can leverage on existing infrastructure and greatly reduce the cost of development, conversely increasing the value of the fluid stream. One of the major benefits of geothermal system is that it provides a reliable source of energy as compared to other renewable resources such as wind and solar power. This is because the resource is always available to be tapped into, unlike with wind or solar energy. The largest single disadvantage of geothermal energy is that it is location specific. Geothermal plants need to be built in places where the energy is accessible, which means that some areas are not able to exploit this resource. The much advancement to geothermal technology that expand the range of possible resources for geothermal is enhanced geothermal systems (EGS) which make use of geothermal resources sourced from much deeper reservoirs.

Keywords: Capacity factor, geothermal resources, renewable energy, power generation



WEOER-008

GREEN HYDROGEN ENERGY DEVELOPMENT IN NIGERIA: A CASE STUDY OF H₂_ATLAS NIGERIA TOOL

¹Zarma I. H., ²Ugwuoke P. E., & ³Okhimamhe A. A.

¹Energy Commission of Nigeria, Abuja

²University of Nigeria, Nsukka,

³West African Centre for Climate Change and Adapted Land Use (WASCAL), FUT Minna,

* Corresponding Email: ismailzarma@gmail.com

Abstracts:

Africa has an increasing population of approximately 1.3 billion, which has been cumulative at an average annual rate of 2.5% for the last 10 years. The growing population directly indicates rising demand for energy and expanded infrastructure to contest the growth. The overall sustainable development of Africa and indeed the global struggle to lessen climate degradation will stem from all-inclusive energy system obsessed by renewable energy. These challenges of accomplishment 100% alternative based energy systems will necessitate joint effort and partnership across borders to find feasible climate - friendly solutions. In a new initiative, Germany is work together with African countries to explore the utilization of green hydrogen and hydrogen derivative as an energy option in a joint effort. In the first-phase of a joint initiative of the German Federal Ministry of Education and Research (BMBF) and African partners in the sus-Saharan region (SADC and ECOWAS countries) was to develop and H₂ ALTAS that would show the potentials of green hydrogen production from the enormous renewable energy sources within the sub-regions. A H₂ ALTAS – Nigeria, was developed with focus on assessing the potentials of generating hydrogen in Nigeria from renewable energy resources. Also, employs issues such as details on technological, environmental, economic and social feasibility assessment taking present and future local energy demands into consideration. it also assesses the availability and sustainability of land and water resources while taking into account land use for Agriculture and local demand for water. The paper x-rays the H₂ ALTAS – Nigeria showcasing potentials areas.

Keywords: Assessment, Potentials, Green Hydrogen, and Atlas

WEOER-009

ANALYSIS OF ENERGY USE INTENSITY IN INSTITUTIONAL BUILDINGS USING BUILDING INFORMATION MODELLING TOOL

¹Pindiga I. Y., ²Garba I, ²Muhammad S. U., & ³Zarmai M. T.

¹Department of Electrical Engineering, Kaduna Polytechnic, Kaduna

²Department of Mechanical Engineering, Nigerian Defence Academy, Kaduna

³Department of Mechanical Engineering, University of Abuja

*Corresponding Author's e-mail: ismailayusufpindiga@gmail.com

Abstracts:

Significant energy utilization occurs in the building sector with substantial implication on climate change and energy cost of building operation. Therefore, efficient energy utilization specifically in institutional buildings is essential in order to reduce carbon dioxide discharge as well as energy cost. Building Information Modelling (BIM) technology has been developed as a contemporary tool for analysis of energy performance in buildings in line with the foregoing. It is for these reasons



that this study investigates the energy performance of an institutional building using BIM technology. In this study, the Faculty of Pharmaceutical Science, Kaduna State University was selected for assessment. Autodesk Revit 2019 software was used to generate 3-D model of the Faculty building and also to analyze the cooling and heating loads. Nine different scenarios of the building model were created for both energy use intensity (EUI) and energy cost using Autodesk Insight 360. Each scenario of the model was optimized and the EUI and energy cost scores compared with the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE 90.1) standard. Furthermore, Autodesk Green Building Studio (GBS) was used to validate the EUI while energy cost optimization scores were obtained using Autodesk Insight 360. Simulation results showed that EUI and energy cost of the Faculty building before optimization was 247 kWh/m²/yr and \$20.1/m²/yr respectively, while after optimization it was 171 kWh/m²/yr and \$16.3/m²/yr respectively. Thus a saving of 76 kWh/m²/yr and \$3.8/m²/yr of EUI and energy cost respectively of the building under study was achieved. Hence, the use of BIM technology has clearly shown effectiveness for optimization of EUI and energy cost in institutional buildings thereby reducing carbon dioxide discharge and expenditures.

Key Words: Energy efficiency, Energy use intensity (EUI), Energy cost, Building Information Modelling (BIM), Autodesk Revit, Autodesk Insight 360, Autodesk Green Building Studio

WEOER-010

COMPARATIVE ANALYSIS BETWEEN LINEAR MODEL AND WEIBULL MODEL FOR ANALYSIS OF WIND ENERGY CONVERSION SYSTEMS

*Dabai K. A. & Buda S.

Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto

*Corresponding Email: kabir.ahmed@udusok.edu.ng

Abstracts:

Wind turbine operators need to fore-cast the power output of their turbines accurately. Various models are used to predict the power output between the cut-in and the rated speed of wind turbines. This work compare the performance of five different wind turbines based on the Weibull based model and the linear based model for calculating their power outputs. From the meteorological data obtained for Minna Nigeria, the monthly average wind speed recorded ranges from 3.14 to 4.78 m/s with annual average value of 4.07m/s; while the standard deviation ranges from 1.73 to 3.55 m/s. The Weibull Parameters at the Standard Anemometer Height (10m) for the location shows that the shape parameter (k-value) ranges from 1.755 to 2.092 with annual average of 1.932; while the scale parameter (c-value) ranges from 3.539 to 5.392 m/s with an annual average of 4.583 m/s. The power outputs for all the five selected turbines were compared with the values given by their manufactures, the Mean Bias Error (MBE) obtained based on the Simple Linear Model were found to be averagely over-estimated; while the results of the MBE obtained based on the Weibull based model shows over-estimation of the power output for the smallest and the largest selected turbines (the Ampair Pacific Hawk 0.3kW, and the Wind Runner / 25kW); but averagely under-estimation for all the other three turbines (Sirroco / 6kW, Alize/ 10kW, and Jonica Impianti / 20kW). Comparing the absolute values of the MBE obtained based on the two models, the Weibull Model were found to be closer to the values given by their Manufacturers than those obtained from the Linear Model.

Keywords: WECS, Linear Model, Weibull Model



ENERGETIC AND EXERGETIC PERFORMANCE EVALUATION OF HIGH PRESSURE HEATERS OF A STEAM POWER PLANT USING MODELING AND SIMULATION TECHNIQUES

¹Abubakar H., ²Adisa A. B., & ³Ejilah R. I.

¹Department of Energy Efficiency and Conservation, Centre for Renewable Energy Sustainable Technology and Development (CRESTAD),
Kaduna Polytechnic, Kaduna, Nigeria

²&³Mechanical/Production Engineering Department,
Abubakar Tafawa Balewa University, Bauchi, Nigeria

*Corresponding E-mail: harounasadeeq@yahoo.com Phone: +2348036009948

Abstracts:

Heaters are heat exchangers which could be either low pressure (LP) or high pressure (HP), used in power plants to heat the feed water before entering into the Boiler. The HP Heaters of the power plant of Kaduna refining and petro-chemicals company (KRPC) is faced with the problem of deterioration from its design output, which led to excess fuel consumption in the plant. Therefore, it is essential to adopt strategies that will improve the efficiency of the Heaters with the least fuel consumption. An essential tool for such an improvement is to develop a valid mathematical and simulation model for the HP Heaters using energy and exergy analysis. Energy and exergy analysis are based on first and second law of thermodynamics. However, mathematical model for the KRPC HP Heaters was developed and based on C# programming code a simulation model for energetic and exergetic analysis of the HP Heaters was developed and validated in free and open-source literature with benchmark percentage error of 10%. The validated result revealed 2.8% maximum error, hence confirming the validity of the simulation model. The simulation analysis was done at design and operating condition. As the input data were collated and processed, the energy and exergy efficiencies, energy losses and exergy destructions for the HP Heaters are calculated at both conditions. The result revealed that Heater 1 and 2 energy efficiencies which were 96.99% each at design condition are decreased to 87.38% and 84.17% at operating condition, exergy efficiencies which were 10.20% each at design condition are decreased to 6.89% and 3.73% at operating condition, energy losses which were 0.2375MW each at design condition are increased to 1.1667MW and 1.4635MW at operating condition and exergy destructions which were 2.5268MW each at design condition are increased to 3.0619MW and 3.1659MW at operating condition. The analysis inferred that, the Heaters have more energy and exergy efficiencies at design condition than in operating condition, and more energy is lost and more exergy is destructed at operating condition than in design condition. It has also been found that exergy efficiency is lower than energy efficiency at both conditions. These losses are due to leakages or improper insulation. Hence, it is recommended that the plant should be run at design condition and the control system of the plant should be in good condition.

Keywords: Energy, Exergy, Efficiency, Simulation

**WEOER-012****CLOUD COVER BASED HOURLY SOLAR RADIATION PREDICTION MODEL FOR DISTRIBUTED GENERATION: A NIGERIAN PROSPECTIVE AT NIGERIAN DEFENCE ACADEMY AFAKA KADUNA STATE NIGERIA**

*Sabo A..& Jae I. A.

Department of Electrical and Electronic Engineering,
Nigerian Defence Academy, Kaduna, Nigeria.Corresponding Email: s.aliyu@nda.edu.ng; iliyasujae@nda.edu.ng**Abstracts:**

Solar energy is free pollution, environmental friendly and abundant in all sites as compared to fossil fuel sources. Solar systems performed optimally at maximum irradiance and some site are having low irradiance due to their climate and geography of the location, so there is need for solar information of a site before installation, but this data is expensive where available, because it requires expensive equipment. This paper presents a MATLAB/SIMULINK model for predicting the hourly and sub hourly solar radiation on tilted surface under cloudy atmosphere situations at any site, at any period of the year for optimal performance of Distributed Generation (DG) for smart grid integration to complement the above shortcomings. The developed model will predict the hourly and sub hourly solar energy potential for different cities in Malaysia. The developed model was validated using measured data from PV Generators University Putra Malaysia site and the results were in good compliance, and then 50-60% was attenuated by cloud cover consideration which is in conformable with cloud type. Finally this work is proposed to be implemented in Nigeria considering 6 States Kaduna, Kano, Katsina, Jigawa Bauchi and Gombe respectively. Furthermore after the implementation of Pilot Photovoltaic Generators at Nigerian Defence Academy Afaka, it will serve as a base for data acquisition in solar Energy research and Development.

Keywords: *Solar Radiation Model (SRM), Renewable Energy (RE), Cloud Cover (CC), Distributed Generation (DG)*

WEOER-013**UNIVERSITY PUTRA MALAYSIA PILOT SOLAR PHOTOVOLTAIC PLANT: CASE STUDY AND IMPLEMENTATION PROPOSAL AT NIGERIAN DEFENCE ACADEMY AFAKA KADUNA STATE NIGERIA**

*Sabo A., Jae I.A, Lawan S., Danjuma I.M, & Ladodo A.R

Department of Electrical and Electronic Engineering,
Nigerian Defence Academy Kaduna, Nigeria.Corresponding Authors: s.aliyu@nda.edu.ng; iliyasujae@nda.edu.ng**Abstracts:**

A solar photovoltaic (PV) system comprises of many components and building blocks such as batteries, inverters, controllers etcthat provides alternative power source to both AC and DC loads. There are three basic types of solar PV systems based on mode of operation (stand-alone systems, grid connected systems, and hybrid systems) and also based on its capacity (Utility Scale PV systems in the range of 1–10 MW, Medium scale PV System in the range of 10–1,000 kW, and Small scale PV systems up to 10 kW range. This paper proposed pilot solar PV plant that consist of 10 solar PV panels comprising of two



fixed flat PV panels, two flat tracking panels and six concentrated photovoltaic (CPV) tracking panels to be implemented at NDA, Afaka, Kaduna State. Each of the fixed flat and tracking flat panels comprises of 12 PV modules per panel and is rated at 1kW peak power output. The Flat tracking PV System comprises of modules mounted on a tracking unit that follows the sun and the fixed flat PV system contains modules that are flat in geometry and use natural solar irradiance. The Tracking systems employ either flat-plate or concentrated modules. The Pilot solar PV system consist of weather measuring instruments such as pyrometers, thermometers, anemometers and data acquisition equipment for monitoring and evaluating the performance of the PV system to enable data collection and record keeping for further research and enquiries. This work is already in existence at university Putra Malaysia and is working perfectly well and is expected to be implemented at Nigerian Defence Academy Afaka, Kaduna state.

Keywords: *University Putra Malaysia (UPM), Nigerian Defence Academy (NDA), Photovoltaic (PV)*

WEOER-014

INVESTIGATING THE POSSIBILITY OF HYBRIDIZING SOLAR AND ENERGY RESOURCES FOR DOMESTIC NEEDS IN TWO CITIES IN NIGERIA

*Muhammad S. U., Solomon W. C., Samuel M. & Achara N.

Department of Mechanical Engineering, Nigerian Defence Academy. Kaduna.

*Corresponding Email: sumammed@nda.edu.ng

Abstracts:

The study investigate the suitability of hybridizing solar and wind energy as a source of providing sustainable energy for domestic activities for two cities in Nigeria. The data for the investigation were obtained from Nigerian Meteorological Agency (NiMet) Abuja. Empirical equations were deployed to analyze the raw data. The results of analysis revealed that two cities have good potentials of both solar and wind energy. The clear sky global solar radiation intensity were found to be within the range of 20 – 24 MJ/m²day and 20 – 25 MJ/m²day for Kaduna and Kano cities, respectively. The diffuse component of clear sky radiation, clearness index, Linke turbidity factor, and Angstrom coefficients were found to be in the range of 7.45-6.76 W/m², 0.499-0.622, 3.12-2.68, 0.071-0.055 and 7.40-6.56 W/m², 0.52- 0.64, 3.70-3.14, 0.106-1.089 for Kaduna and Kano cities, respectively. The higher the clearness index the higher the solar radiation and a corresponding decrease in aerosol content in the atmosphere. Maximum extractable energy from the ranged between 218-309 W/m² from April to August in Kano while that of Kaduna ranged between 85- 328 W/m² from January to December in Kaduna with minimum values in the month of September and October. The power from the wind are far better than those from solar during rainy season. Hence, the can be hybridized to develop sustainable path for domestic energy supply in these two cities.

Key words: *Solar, wind, clearness index, energy, radiation*

**WEOER-015**

COMPARISON OF AN ACTIVE SOLAR WATER HEATING SYSTEM CALCULATED DESIGN PARAMETERS AND DYNAMIC SIMULATION RESULTS USING T*SOL SOFTWARE

¹Sirajo Alhassan, ¹Isah Garba, ²Badamasi Haruna, ²Dauda Garba,

²Anas Abdullahi Muhammad, & ³Jamilu Ya'u Muhammad

¹Department of Mechanical Engineering, Faculty of Engineering, Bayero University, Kano

²Department of Welding and Fabrication Technology,

Kano State Polytechnic Kano, Nigeria

³Department of Mechanical Engineering,

Nigerian Army University, Biu, Borno State, Nigeria

*Corresponding Email: fatysira@gmail.com; GSM: 08032031756

Abstracts:

Proper design of solar water heating system is vital to provide efficient and safe operation of the entire system. The aim of this study is to compare the calculated results with the simulations results. For this purpose, simulations of the system, designed for Sheikh Muhammad Jidda General Hospital Fagge Kano latitude 12.05 N and longitude 8.53, were performed using T*sol software. Considering the design parameters obtained such as, efficiency 50%, collector area 32.92m², volume of the storage tank of 4.4m³, annual electricity savings of 51,100kWh/year, carbon dioxide reduction of 21,973kg and solar fraction of 63%. Comparing with the predicted results which shows efficiency of 56%, collector area of 31m², tank size of 4.35m³, annual electricity savings of 44,572kWh/year, carbon dioxide reduction of 29,685kg and solar fraction of 75% which validated the design results, the system could meet up most of the hot water demands of the hospital with the aid of auxiliary heating system and could be feasible based on the thermal analysis conducted using the software in this study.

*Keywords: Solar radiation, Solar fraction, T*sol, Simulations*

WEOER-016

PROMOTING NUCLEAR ENERGY GENERATION IN NIGERIA FOR LONG-TIME DEVELOPMENT

^{*1}Kabir A.; ¹Dalhat B A.; ¹Cecilia O.; & ¹Muhammad A.

¹Nuclear Energy, Energy Commission of Nigeria,

*Corresponding Email: aakabeer9@gmail.com

Abstracts:

Nigeria's woefully insufficient and unpredictable power supply has significantly hampered economic expansion and development. Many countries have embraced Renewable and Nuclear energy sources as an alternative to fossil fuels due to the threat of global warming and the increase of greenhouse gases. Nuclear, solar, bio-fuel, and wind energy are some of the sources of sustainable energy. A strong power industry with diverse energy sources is also critical for a country's independence. Nigeria has long relied on Hydro energy and Thermal energy, but there is a need to investigate the feasibility of promoting Nuclear energy generation for long-term energy security. This study examines the state of Nuclear energy today and its economic impact on the country, Strong legislative Nuclear energy policy and recommending its incorporation into Nigeria's energy mix as a way to increase the country's electricity demand and improve efficiency and dependability are essential for the growth of Nigeria's energy sector.

Keywords: Nuclear Energy, Sustainable Energy, Generation, Electricity, Energy Mix



EFFECT OF SOLAR REGENERATED SOLID DESICCANT DEHUMIDIFYING PAD ON INDOOR RELATIVE HUMIDITY IN DIRECT EVAPORATIVE COOLING

^{*1}Ahmadu T. O., ¹Ndagi H., ²Ibrahim T. K., & ¹Sanusi Y. S.

¹Department of Mechanical Engineering, Ahmadu Bello University, Zaria.

²Department of Chemical Engineering, Federal University, Wukari, Taraba.

^{*}Corresponding author: email: talibahmadu@gmail.com

phone: +2348023824226

Abstracts:

Direct evaporative cooling system when used for space cooling for human comfort could lead to reduction in high energy consumption which is usually associated with conventional vapour compression cooling systems. However, a major drawback in the use of direct evaporative cooling is the introduction of moisture to the space to be cooled, which could lead to human discomfort. In this study, the effect of a solar regenerated solid desiccant dehumidifying pad on the indoor relative humidity of the cooled space was carried out. The evaporative cooling system has the cooling pad made of luffa fibre lagged with charcoal, while the removable solid desiccant dehumidifying pad is made of activated carbon derived from tamarind seed. Experimental space cooling of a room with peak cooling load of 4.53 kW was conducted with and without the dehumidifying pad incorporated to the system. Results from experimental space cooling conducted without the dehumidifying pad showed a minimum room temperature of 24°C was achieved. However, indoor relative humidity increased to 84%, for an outdoor relative humidity of 30%. Experiment conducted with the dehumidifying pad incorporated to the system showed a minimum room temperature of 26.5°C was achieved, while maximum indoor relative humidity recorded was 49%, for an outdoor relative humidity of 34%. This indicates that the dehumidifying pad was able to absorb moisture and significantly reduce the moisture introduced to the cooling space. Cooling efficiency of 71.4% was achieved when the system operated with the dehumidifying pad. Regeneration of the moist dehumidifying pad was done using a concentrating solar dryer. Results indicated that it took 2 hours to regenerate the dehumidifying pad, at an average regeneration rate of 0.15kg/h. Generally, findings from the study show that introducing the solar regenerated solid desiccant dehumidifying pad into the evaporative cooling system resulted to indoor relative humidity being maintained within a range suitable for human comfort.

Key words: Evaporative cooling, dehumidifying pad, solid desiccant, solar dryer



BRIEF PROFILE ON SOLAR ENERGY SOCIETY OF NIGERIA

The Solar Energy Society of Nigeria (SESN) was founded in 1980 to promote the widespread utilization of solar and other renewable energy technologies. The society organizes its National Solar Energy Forum (NASEF) annually. The forum is aimed at providing a platform for meeting and interaction between stakeholders in renewable energy research and development, business, and policy-making, and also to access the level of penetrations of technology as well as ongoing development in renewable energy.

The Solar Energy Society of Nigeria (SESN) was inaugurated in March 1980 at the Project Development Institute (PRODA) Enugu. By 11th July of the same year the Society was officially launched at a brief ceremony performed by the then Deputy Governor of old Anambra State, Engr. A.S. Umenyi, assisted by the then Honourable Commissioner for Technology, Imo State, Chief Oji O. Okereke. Some of the pioneer members of the Society included such prominent people as Prof. A.O.E. Animalu (foundation President of the SESN), Prof. G.O. Ezekwe (Director, PRODA, Enugu), Prof. C.C.O. Ezeilo (University of Nigeria), Prof. U.A. Akinsote (University of Lagos), Prof. R.I. Salawu (University of Lagos), Late Prof. N. I. Ngoka (formerly of Obafemi Awolowo University Ife and later ESUT, Enugu), Prof. A. T. Sulaiman (Past President, SESN and former Vice Chancellor Federal University of Technology, Yola) and a host of others. During the inaugural meeting and conference of the Society in 1980, technical papers were presented. This inaugural meeting and conference consequently gave birth to the National Solar Energy Forum (NASEF), which since 1980 has been held annually in several places in Nigeria. The objectives for which the Society is established are:

- a. To provide a forum for Scientists and Engineers and other interested parties in Nigeria to meet from time to time to discuss problems relating to Solar Energy.
- b. To protect, promote, and foster the establishment of high standards in the study and application of Solar Energy in Nigeria.
- c. To advise the governments in Nigeria on all aspects relating to the development of Solar Energy programmes in the Country.
- d. To promote and facilitate the Society's membership to relevant International Organization such as the International Solar Energy Society (ISES).
- e. To disseminate knowledge and information on research and development in Solar Energy applications through various publications such as the Nigeria Journal of Solar Energy and Solar Energy News Letters.
- f. To encourage research and training activities in Solar Energy applications.
- g. To purchase, hold, lease, mortgage, sell, improve or otherwise acquire and dispose of any movable or immovable property and any rights and privileges which may be necessary or suitable for the advancement of the objectives of the Society.
- h. To lobby, apply or petition for any Legislation, Government policy, or otherwise which will assist in the Promotion of Solar Energy Applications in the Country.
- i. It is not the objective of the Society to become a Trade Union, or an affiliate of any Trade Union. It will not involve its members in any strike action.



The memberships comprise the following categories:

- i. Fellowship (F)
- ii. Full Membership (M)
- iii. Associate Membership (AM)
- iv. Student Membership (SM)
- v. Affiliate Membership (AFM)
- vi. Institutional Membership (IM)

Furthermore, the Society decided in 1980 to publish annually a technical journal named "The Nigeria Journal of Solar Energy (NJSE)" with the following aims:

- i. To provide a medium for national and international dissemination of information about solar Energy in particular, and other Energy sources in general, and their applications in elsewhere.
- ii. To promote cooperation among Scientists, Engineers and Technologists working in the field of Energy in Nigeria and elsewhere.
- iii. To provide a focal point for, but not limited to, papers presented at annual conference of SESN (all papers are published after they have been referred and acknowledged to be original and of high quality).

The technical papers presented at the 1980 inaugural meeting and conference formed the first issues of the NJSE which was launched at Lagos the same year. The Editorial Board of the NJSE was also formed to review technical papers submitted for consideration for publication in the NJSE. Since then, it has been the culture of the society to publish the journal of technical papers annually.

Through advocacy of our members, gazetting of the Energy Commission of Nigeria decree was sped up, funding was obtained for energy research where research centres were established in Nsukka and Sokoto, and so much more but to mention a few.



APPRECIATION

On behalf of the Executive Membership of the Solar Energy Society of Nigeria, I wish to extend our profound gratitude to our partners and stakeholders for your relentless commitment which has inspired us to do our best regardless of the challenges we face. Your ability to listen to others' ideas with concern and an open mind creates an environment of mutual respect where our relationships flourish. Your kind support financially is highly appreciated and we say a big thank you, names are too numerous to mention.

For our distinguished members of NASEF 2022 LOC, we deeply appreciated your hard work which led to the successful hosting of the 40th edition of Forum. Thank you for your wonderful team spirit.

To our Dear Host, the Nigerian Defence Academy, we sincerely lack words to express our gratitude for the warming support to the NASEF 2022.

To our Invited Guests, Speakers and participants, thank you for that brilliant idea shared during the plenary and technical sessions at NASEF'22.

See you again at the 41st NASEF' 23.

Sincerely yours.

Engr. Dr. Ismaila Haliru ZARMA, FSESNI,
Secretary-General,
Solar Energy Society of Nigeria



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| 5. Dr. I. H. Zarma | Secretary | 07084415597 |



SOLAR ENERGY SOCIETY EXECUTIVE MEMBERS

PRESIDENT

Prof. Isa Garba
Nigerian Defence Academy, Kaduna
Phone: 08065418536
Email: isagar2005@yahoo.com

VICE PRESIDENT I

Prof. A. O.C. Nwokoye
Department of Physics., Nnamdi Azikiwe
University, Awka, Anambra State
Phone number: 0803344136
Email: ositonyk@yahoo.com

VICE PRESIDENT II

Dr. Usman Sani Tunga
Waziri Umar Federal Polytechnic Birnin Kebbi.
Phone number: 08036059966
Email: tungausman@gmail.com

FINANCIAL SECRETARY

Dr. Uzoamka Ogwo
National Centre for Energy Research and
Development, University of Nigeria Nsukka
Phone number: 08039473344
Email: uzoamaka.ogwo@unnn.edu.ng

ASSISTANT SECRETARY

Mr. Mawoli Mohammed,
Sokoto Energy Research Centre,
Usmanu Danfodiyo University Sokoto.
Phone number: 08039158187
Email: yanda2001@gmail.com

ASSISTANT TECHNICAL SECRETARY

Engr. Ismaila Isa Rikoto,
Sokoto Energy Research Centre,
Usmanu Danfodiyo University Sokoto.
Phone number: 08038498566
Email: rikoto2003@gmail.com

TREASURER

Dr. Aminu Haruna Isa
Energy Commission of Nigeria, Abuja
Phone number: 08033502383
Email: jamiah1177@gmail.com

PUBLIC RELATION OFFICER

Dr. Offiah Solomon U.
National Centre for Energy Research and
Development, University of Nigeria Nsukka
Phone number: 08032845073
Email: offiahsolomon@gmail.com

SECRETARY GENERAL

Engr. Dr. Ismaila Haliru Zarma
Energy Commission of Nigeria, Abuja
Phone number: 07084415597
Email: ismailzarma@yahoo.com

TECHNICAL SECRETARY

Prof. Garba M. Argungu
Department of Physics,
Usmanu Danfodiyo University Sokoto.
Phone number: 08036039468
Email: garba.musa@udusok.edu.ng

EX-OFFICIAL I

Prof. Ifeabunike Joseph Dioha
Dean Faculty of Science,
Admiralty University of Nigeria
Phone number: 08036235359
Email: diohaiji@yahoo.com

EX-OFFICIAL II

Prof. Isaac N. Itodo
College of Engineering University of
Makurdi
Phone number: 08054621424
Email: dritodo@yahoo.com