UNIVERSITY OF ENERGY AND NATURAL RESOURCES (UENR)

INTERNATIONAL CONFERENCE ON ENERGY AND ENGINEERING (ICEE), 2025

THEME:

ENGINEERING THE FUTURE: SMART INNOVATIONS FOR SUSTAINABLE ENERGY, AGRICULTURE, INFRASTRUCTURE AND CLIMATE RESILIENCE.

Dates: **Wednesday 1st October 2025 to Friday 3rd October 2025**

Venue: **Regional Center for Energy and Environmental Sustainability (RCEES)**

CONFERENCE PROCEEDINGS

Contents

EXECUTIVE SUMMARY

The 2nd International Conference on Energy and Engineering (ICEE 2025) was successfully organised by the Schools of Energy and Engineering of the University of Energy and Natural Resources (UENR) from October 1st to 3rd, 2025.The conference was organised under the theme "Engineering the Future: Smart Innovations for Sustainable Energy, Agriculture, Infrastructure and Climate Resilience". The conference brought together distinguished leaders from government, academia, and industry to discuss critical global issues. Also, the conference had international appeal as it was attended by participants from countries such as Ethiopia, Kenya, Nigeria, Columbia, Chad, Cuba, Germany, Togo and Burkina Faso.

The conference commenced with an opening remark from the Vice-Chancellor, Prof. Elvis Asare-Bediako, who reaffirmed UENR's commitment to leading energy education in Ghana. The technical aspect of the conference was expatiated by four major keynote addresses. Ing. Prof. Kwadwo Adinkrah-Appiah emphasized the need for grid integration of renewables and the adoption of green hydrogen and storage technologies. Prof. Dr. C. Ing. Osvaldo Romero Romero highlighted the synergies between renewable energy and food production, advocating for biomass and integrated planning to support smallholder farmers. Ing. Dr. Joseph X. F. Ribeiro presented a vision for a smart grid enabled by IoT and AI to improve demand forecasting and integrate distributed resources. Dr. Felix Amankwah Diawuo stressed that energy efficiency is a prerequisite for sustainable systems, noting that efficiency reduces the cost and complexity of renewable infrastructure.

A total of 24 papers and 6 posters were presented during the conference, all of which aligned with and contributed to the conference's thematic areas, namely Sustainable Infrastructure and Civil Innovations; Smart and Renewable Energy Systems; Intelligent Manufacturing and Mechanical Systems; Climate-Smart Agricultural Engineering; Future Technologies in Electrical, Electronic and Computer Engineering; Petroleum and Gas Engineering for a Just Energy Transition; Engineering Education, Policy and Innovation; Earth Observation for Socio-Economic Development; and Sustainable Mining.

The conference concluded with a call for integrated planning that links renewable supply with grid modernization and development priorities. Participants and policymakers were encouraged to prioritize decentralized systems to enhance rural livelihoods and food security. Additionally, there was a strong emphasis on the need for behavioral change campaigns and smart technologies to drive efficiency in the public and residential sectors.

ICEE 2025 successfully demonstrated that engineering solutions are practical tools for national development. The conference closed with a unified resolve to translate knowledge into policies and projects that will **Engineer the Future** for Ghana and Africa.

ACKNOWLEDGMENTS

We wish to convey our deepest appreciation to the management of the University of Energy and Natural Resources (UENR), whose steadfast support was instrumental in ensuring the success of ICEE 2025.

We are equally indebted to the planning committee, whose tireless dedication and meticulous commitment brought about the seamless organisation of this conference.

Our heartfelt gratitude is extended to all sponsors and partners. Through your generous support and collaborative spirit, you enriched both the quality and the impact of this gathering.

Finally, we warmly acknowledge the invaluable contributions of our participants, distinguished keynote speakers, authors, and reviewers. Your insightful presentations, rigorous scholarship, and active engagement animated the discourse and greatly strengthened the achievements of ICEE 2025.

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The Rep of Hon. Minister of Energy and Green Transitions, and the Director of Renewal Energy, Ing. Seth Mahu. The Hon. Minister of Bono Region, Hon Joseph Akwaboah Addae. Prof. Stefan Wolf of Technische Universität Berlin.The Executive Secretary of Energy Commission Ghana, Madam Eunice Biritwum. The Deputy CEO of Bui Power Authority, Ing. Samuel Nimako-Boateng. The Rep of the President of the Ghana Institution of Engineering, Ing. Dr. Xavier Francis Ribeiro, Chair of Branch 1, Ashanti. The Ag. Pro Vice-Chancellor, Ing. Prof. Nana Sarfo Agyemang Derkyi, The Registrar, Dr. Mrs. Georgina Asi Owusu, Ing. Prof. Emmanuel Kwesi Nyantakyi, Co-Chair of ICEE 2025 and Dean, School of Engineering, UENR, Dr. Ruhiya Abubakar, Dean of the Faculty of Engineering, GCTU (Representing the VC of GCTU) Prof. Abukari Alhassan, representing the VC of UDS, Distinguished Keynote Speakers, Sponsors, Partners, Deans and Directors, Heads of Departments/Sections/Units, Esteemed Faculty and Staff, Invited Guests, Ladies and Gentlemen, The media. Good morning.

It is with great honour and a deep sense of responsibility that I welcome you all to the University of Energy and Natural Resources as we host the 2nd edition of the International Conference on Energy and Engineering (ICEE 2025). We gather here from the 1st to the

3rd of October at our state-of-the-art Regional Centre for Energy and Environmental Sustainability in Sunyani, a hub of innovation and sustainability. This conference is a significant milestone for UENR, reflecting our commitment to addressing some of the most pressing global challenges through cutting-edge research and collaboration.

We are privileged to host distinguished leaders from government, academia, industry, and civil society, gathered here to advance dialogue on one of the most pressing issues of our time: how we engineer a sustainable future through innovation in energy, agriculture, infrastructure, and climate resilience.

The theme for this year's conference, "Engineering the Future: Smart Innovations for Sustainable Energy, Agriculture, Infrastructure, and Climate Resilience", is both timely and relevant. It reflects the urgent need for integrated solutions that respond to the dual challenges of climate change and development. As an institution mandated to lead in training professionals and conducting research in energy and natural resources, UENR is proud to provide this platform for exchanging ideas, sharing knowledge, and building partnerships that will drive action. UENR is proud to be at the forefront of energy and natural resource education and research in Ghana. With over 520 staff, multiple research centres, and a growing number of diplomas, undergraduate, and postgraduate programmes, we are committed to producing graduates who can address real-world challenges.

Honourable Ministers and distinguished guests, our world is at a critical juncture. The transition to renewable energy, the pressure to build resilient cities, the demand for sustainable food systems, and the threats posed by climate change require not just incremental adjustments but bold and smart innovations. It is precisely this type of forward-looking thinking that ICEE seeks to foster.

Over the next three days, we will hear from experts who are pioneering solutions across diverse fields, from renewable energy integration and advanced storage systems, to Earth observation applications, petroleum transition pathways, and sustainable mining practices. These conversations are not just academic exercises; they represent pathways to real-world transformation in Ghana, Africa, and beyond.

At UENR, we see this conference as part of our broader commitment to contribute meaningfully to national and global development goals. Our research centres, such as the Regional Centre for Energy and Environmental Sustainability (RCEES), a world bank funded Centre of Excellence for Africa whose facility we are being hosted in today, the

Earth Observation Research and Innovation Centre (EORIC), and our collaborations with local and international partners, highlights our conviction that science, engineering, and innovation must inform decision-making at all levels.

This conference would not be possible without the generous support of our sponsors and partners. We are grateful to our sponsors and partners, including the Volta River Authority, Electricity Company of Ghana, Bui Power Authority, Ghana National Petroleum Corporation, Petroleum Commission Ghana, Energy Commission Ghana, BOST Energies, the Ghana Institution of Engineering, Associated Consultants and Zoomlion Ghana Limited, for their support in making this event possible. Your investment in knowledge and collaboration is an investment in the future.

To the participants, I urge you to use this conference not only to present your research and share your experiences, but also to forge new networks, inspire fresh ideas, and develop solutions that are actionable. Conferences are at their best when they translate knowledge into practice.

Let me also acknowledge the tireless efforts of the ICEE 2025 Planning Committee, co-chaired by Ing. Prof. Nana Sarfo Agyemang Derkyi and Ing. Prof. Emmanuel Kwesi Nyantakyi and the dedicated technical and administrative teams, whose commitment has brought us to this moment.

Ladies and Gentlemen, the University of Energy and Natural Resources is delighted to host you in Sunyani, a city known for its warmth and hospitality. I encourage you to take time, beyond the conference halls, to experience our campus and the beauty of the Bono Region.

On behalf of the Governing Council, Management, Faculty, and Students of UENR, I extend once again a heartfelt welcome to all of you. With great optimism, I look forward to the insights and partnerships that will emerge from our deliberations.

It is now my privilege to declare the International Conference on Energy and Engineering 2025 officially open. Thank you, and I wish you all fruitful engagements.

ADDRESS BY CO-CHAIR OF THE PLANNING COMMITTEE

Ing Prof. Emmanuel Kwesi Nyantakyi

Professor, Civil and Environmental Engineering Department

University of Energy Natural Resource (UENR)

Dean, School of Engineering, UENR

Coo-chair. ICEE Planning committee

The Vice-Chancellor of UENR and Chair, Prof. Elvis Asare-Bediako, The Representative of the Honourable Minister of Energy and Green Transitions, Ing. Seth Mahu, The Honourable Bono Regional Minister, Hon. Joseph Akwaboah Addae, Prof. Stefan Wolf of Technische Universität Berlin, The Executive Secretary of the Energy Commission, Madam Eunice Biritwum, The Deputy CEO of Bui Power Authority, Ing. Samuel Nimako-Boateng, The Representative of the President of the Ghana Institution of Engineering, Ing. Dr. Xavier Francis Ribeiro, The Ag. Pro Vice-Chancellor, Ing. Prof. Nana Sarfo Agyemang Derkyi, The Registrar, Dr. Mrs. Georgina Asi Owusu, Our distinguished colleagues from sister universities —Dr Ruhiya Abubakar of GCTU and Prof. Abukari Alhassan of UDS, Keynote Speakers, Sponsors, Partners, Deans, Directors, Faculty, Students, Members of the Media, Distinguished Ladies and Gentlemen:

It is with great pleasure that I welcome you to the University of Energy and Natural Resources for the 2nd International Conference on Energy and Engineering. I extend a special appreciation to all dignitaries, industry leaders, international participants, and researchers who have travelled from far and near to be with us today.

The theme for this year's conference, "Engineering the Future: Smart Innovations for Sustainable Energy, Agriculture, Infrastructure and Climate Resilience," is both timely and compelling. It reflects the urgent call on universities, industries, and governments to collaborate in developing innovative, practical, and sustainable solutions to the challenges of our time. Energy insecurity, climate change, and food system vulnerabilities are issues that transcend borders. Addressing them requires the ingenuity of engineers, the creativity of scientists, and the partnership of all stakeholders gathered here.

Over the next few days, we will engage in conversations and presentations covering renewable energy technologies, climate-smart agriculture, sustainable infrastructure, smart cities, and the application of artificial intelligence in engineering. These discussions are not meant to remain on paper; rather, they are opportunities to shape real policies, projects, and collaborations that can transform our societies.

I wish to sincerely acknowledge our sponsors and partners — the Volta River Authority, Electricity Company of Ghana, Bui Power Authority, GNPC, Petroleum Commission, Energy Commission, BOST Energies, Ghana Institution of Engineering, Associated Consultants, and Zoomlion Ghana Limited, whose commitment has made this gathering possible. Your support demonstrates the importance of bridging academia and industry to drive innovation.

Distinguished ladies and gentlemen, I am confident that the deliberations here will produce ideas and partnerships that extend well beyond this auditorium, helping us engineer a future that is smarter, greener, and more resilient.

On behalf of the University, I warmly welcome you once again and wish you fruitful deliberations. Thank you, and may God bless us all.

1.0 KEYNOTE SPEECHES

1.1 Keynote Speaker I

Ing. Prof. Kwadwo Adinkrah-Appiah
Vice Chancellor
Sunyani Technical University (STU)

Topic

Smart and Renewable Energy Systems: Advancing a Sustainable and Reliable Energy Mix in Ghana

The keynote speaker noted that the global energy transition is accelerating due to climate change pressures, emerging technologies and economic realities. Renewable energy has become a necessity for energy security, resilience and sustainable development. He addressed five major areas considered essential in advancing Ghana's smart and renewable energy systems.

Grid Integration of Renewable Energy

Prof Adinkra-Appiah emphasized the challenge of integrating variable solar and wind energy into grids originally designed for one directional power flow. Digitized smart grid technologies were highlighted as key enablers for balancing supply variations. The speaker also recognized the growing importance of decentralized systems such as hybrid mini-grids to expand access in remote communities. He cited examples including

the Kalë mini-grid project and the national target of achieving 10 percent renewable generation by 2030.

Energy Efficiency and Demand Side Management (DSM)

Prof Adinkra-Appiah stated further that the rising national electricity demand and technical inefficiencies remain major system challenges. The speaker referenced an estimated 20 percent power loss across Ghana's network.

Storage Technologies and Green Hydrogen

The speaker further highlighted that storage solutions were described as crucial to smoothing power fluctuations. The Bui Hydro Solar Hybrid Project was cited as a strong reference model. Green hydrogen was presented as a future strategic pillar due to its high energy density and long duration storage capability. He referenced Ghana's first hydrogen demonstration project commissioned in Tema as a milestone. Policy incentives such as tax exemptions could strengthen hydrogen market uptake.

Energy, Society and Environment

Prof Adinkra emphasized that the dependence of fossil fuels has impact of ecology and health. Cleaner energy must be embarrassed and communities must be prevented from the use of fossil fuels.

Policy, Finance and Inclusive Energy Development

Finally, the keynote speaker reiterated that energy sector is currently grappling with tariff distortions and financial deficits. He further stressed that policy shifts are needed to ensure fair access and environmental integrity.

The speaker recommended the following:

1. Strengthening of local content and provide concessional financing to support equitable renewable energy development in rural communities.
2. Promoting of community-based eco-energy parks with social and carbon credit incentives to boost local participation and benefits.
3. Integrating energy literacy and behavioral change programmes into both academic curricula and public education.

4. Adoption of innovative clean energy business models such as Energy-as-a-Service to reduce upfront costs and increase affordability.
5. Enhancing of regulatory frameworks and technical capacity to enable advanced solutions like Virtual Power Plants and peer-to-peer energy trading.

1.2 Keynote Speaker II

Prof. Dr. C. Ing. Osvaldo Romero Romero

Professor, *Chemical Process Engineering, Stiftung Rehabilitation Heidelberg (SRH) University of Applied Sciences, Berlin*

Head, *Engineering and International Business - Focus on Renewable Energy, Water and Waste Management, SRH University of Applied Sciences, Berlin*

Topic:

Exploring Synergies by the integration of renewable energy sources in food production systems for resilience and sustainability

The second keynote speaker addressed the growing convergence of global crises, each compounding the other and intensifying over time. He noted that as of 2024, approximately 294 million people across 53 countries were experiencing hunger, with Africa bearing a disproportionate share of this burden.

A central focus was the paradox of smallholder farmers, particularly in Africa. Despite 33 million smallholders supplying food to nearly 70 percent of the continent, they remain poor and face limited access to water and energy essential for sustained production. Globally, small farms cultivate 60 percent of arable land and produce 80 percent of food, yet continue to struggle with resource constraints. The speaker emphasized that sustainable solutions must prioritize vulnerable regions.

Professor Osvaldo cautioned against overreliance on solar PV and wind in renewable energy transitions, underscoring the complementary role of biomass in nutrient recycling and waste reduction, thereby supporting both food systems and clean

energy generation. He highlighted the interdependence of sectors, noting that by 2050 the world will require 50 percent more food, 50 percent more water, and 70 percent more energy, making integrated planning at farm and community levels indispensable.

He further explained that agrifood systems already account for 30 percent of global energy demand, with rising fossil fuel costs directly linked to higher food prices. The absence of agroprocessing infrastructure in rural areas exacerbates postharvest losses, as farmers often sell produce in raw form due to lack of energy for drying, cooling, milling, or refrigeration.

In conclusion, the keynote speaker stressed that integrating renewable energy into food systems is not simply a technological upgrade but a pathway to sustainable livelihoods, poverty reduction, and resilient rural economies. He urged stakeholders to empower farmers with tools that secure both food and energy systems.

1.3 Keynote Speaker III

Joseph X. F. Ribeiro
PhD. SPE. GhIE.

Senior Lecturer, *Faculty of Engineering and Technology, Kumasi Technical University (KsTU). Kumasi, Ghana.*

Topic:

Smart and Renewable energy systems in Ghana pathways for Africa sustainable transition

The third keynote speaker emphasized that Ghana stands at a pivotal moment where smart and renewable energy systems can drive national development, strengthen industries, and serve as a model for Africa's just energy transition. While Ghana already acknowledges the benefits of solar and other renewable resources, the speaker argued that true transformation lies in integrating Internet of Things (IoT) and Artificial Intelligence (AI) into energy planning and operations.

Ing. Joseph invited participants to envision an energy system capable of predicting demand surges before they occur, thereby enhancing resilience against outages. A smart grid, he explained, would integrate distributed resources such as rooftop solar, manage intermittent wind and small hydropower effectively, and empower consumers through mobilebased monitoring and management tools.

The keynote was structured around four strategic pillars:

Smart Grid Development Enabled by IoT and AI

Ghana's electricity mix remains dominated by hydropower and thermal plants, with less than 1 percent of renewables feeding the national grid. This dependence exposes the system to hydrological variability, fuel price shocks, and technical and commercial losses of 20–25 percent. Modernizing the grid with smart technologies would improve demand forecasting and load management.

Decentralized Systems and Microgrids

Grid extension remains insufficient, leaving some communities without electricity access. Decentralized models are essential to ensure productiveuse energy, including solarpowered irrigation, cold storage for perishable produce, and small agroprocessing units.

Bioenergy and WastetoEnergy

Ghana generates abundant agricultural residues such as cocoa husk, rice husk, and palm kernel waste, which are often discarded. Harnessing these resources can produce biofuels and electricity, support waste management, provide income to farmers, and reduce industrial energy costs.

Energy Storage and Efficiency

Sustainable storage systems are critical to ensure energy utilization at any time. The speaker stressed that efficiency is equally important, noting that provisions in Ghana's Renewable Energy Act and Grid Code enable demandside measures that can free capacity equivalent to new generation.

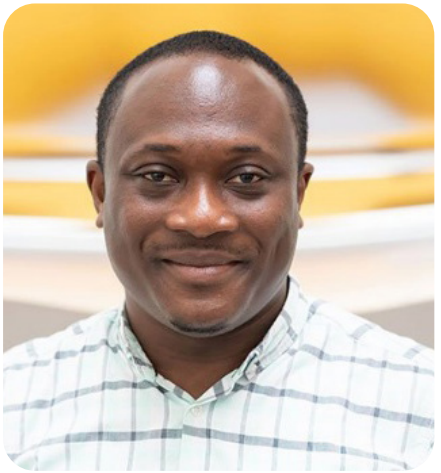
Key Call to Action

The address concluded with a call for government, academia, industry, and entrepreneurs to:

- Move from discussion to implementation
- Strengthen partnerships and innovation networks
- Position Ghana as a leader in Africa's clean energy transformation

He closed with the reminder: "The best way to predict the future is to innovate it together."

1.4 Keynote Speaker IV



Dr Felix Amankwah Diawuo

Senior Lecturer, *Renewable Energy Engineering Department, University of Energy and Natural Resources (UENR)*

Head, *Renewable Engineering Department, UENR*

Head of Research, *Regional Center for Energy and Environmental Sustainability (RCEES), UENR*

Head, *Sustainable Energy Services Center-UENR*

Topic

Smart and Global Energy Systems: Energy Efficiency and Integrated Planning for Developing Countries

The speaker advanced three key arguments on the critical role of efficiency in renewable energy systems.

Efficiency reduces renewable system costs. Lower demand achieved through efficient lighting, appliances, and industrial processes reduce the scale and expense of renewable infrastructure. Evidence from Ghanaian institutions demonstrates that replacing fluorescent lamps with LEDs significantly decreases electricity consumption and the solar capacity required.

Renewables decarbonize supply while efficiency maximizes benefits. The reliability of solar, wind, and minihydro systems improves when peak demand is moderated through efficient cooling and managed loads. Efficiency ensures that every unit of clean energy generated is effectively utilized, thereby accelerating progress toward Sustainable Development Goal (SDG) 7.

Efficiency reduces both the magnitude and complexity of energy challenges. Citing data, the speaker noted that efficiency can address nearly 40 percent of climate mitigation needs. In his words: “Efficiency reduces the size of the problem, while renewables change the nature of the solution.”

Dr. Felix concluded by stressing that renewables alone cannot deliver sustainability, and efficiency alone cannot solve access or decarbonization. Integrated planning, he argued, is the backbone of resilient, affordable, lowcarbon energy systems. He called on scientists, practitioners, and policymakers to champion integrated planning in research, projects, and advisory work, thereby enabling a future where clean, modern energy underpins inclusive development.

2.0 CONFERENCE OUTCOME

The conference outcome was anchored on the key discussion made during proceedings. The speakers encouraged participants to reflect on the outcomes as they are grouped into the three key areas, namely emerging trends, innovations and policy direction.

2.1 Emerging Trends and Technologies

- **Integration of Artificial Intelligence (AI) and the Internet of Things (IoT):**

  AI and IoT are becoming critical drivers for modernizing energy grids. These technologies enable predictive demand management, load balancing, and smart metering, thereby enhancing system resilience and efficiency.

- **Digital Twin Technology:**

  A major advancement in asset management, Digital Twins create realtime digital replicas of physical assets to simulate performance, anticipate faults, and optimize operations.

- **Future Market Structures:**

  Energy markets are evolving toward Virtual Power Plants (VPPs) and peertopeer (P2P) energy trading, allowing consumers to actively participate in energy generation, distribution, and exchange.

- **Green Hydrogen:**

  Identified as a strategic pillar for the future, green hydrogen is gaining traction due to its high energy density and longduration storage potential, offering a pathway to deep decarbonization.

- **Electric Vehicle (EV) Integration:**

  Research is advancing on the integration of EV infrastructure with solar PV minigrids, providing sustainable transport solutions while expanding energy access.

- **Innovative LandUse Models:**

Approaches such as agrivoltaics-combining solar generation with agriculture and vertical farming are being explored to mitigate landuse competition between food and energy production.

- **Advanced Storage Solutions:**

  Deployment of cuttingedge storage technologies is essential to smooth out fluctuations from variable renewable sources such as solar and wind.

- **Decentralized Systems:**

  Minigrids are prioritized to expand electricity access in remote communities. Complementary technologies including solarpowered irrigation, cold storage for perishable produce, and small agroprocessing units strengthen agricultural value chains and rural livelihoods.

2.2 Policy Directions

- Policymakers must link efficiency, renewable supply, and grid modernization together and recognize the approach as a cornerstone of sustainable development.
- Decision-makers need to strengthen their commitment to integrating smart and renewable energy into the national energy mix.
- Tariffs must be reformed and regulatory capacity strengthened to accommodate new market structures like peer-to-peer trading.
- Incentives must be expanded for energy storage and tax exemptions be provided to accelerate market uptake of new technologies.
- Concessional financing should be increased to support equitable energy development, particularly for rural electrification.
- Local content participation should be strengthened and community ownership models promoted, such as renewable energy cooperatives and eco-energy parks.
- Office holders should lead large-scale energy efficiency campaigns targeting public institutions, industries, and residential sectors.
- Integration of energy literacy and behavior change programmes must be developed into academic curricula and public education to foster a “smart energy culture”.

3.0 TECHNICAL ORAL PRESENTATIONS

3.1 Sustainable Infrastructure, Environment and Civil Innovation

Presenter	Topic
Brobbey William	Empirical Modelling and Optimisation of Waste-to-Energy Integration into Net Zero Energy Buildings Using Ghana-Specific Waste Stream Data
Godfred Adu Sarfo	Elemental characterization, sources and health risk assessment of PM 10 in urban Ghana during the dry season
Ing. Dr Prince Antwi Agyei	How risky is the work of pit emptiers and public toilet operator: A quantitative and qualitative assessment of the health and safety of sanitation workers in Kumasi
Joshua Seyi Ayejugbagbe	Exploratory Assessment of Monitoring Wetland Degradation in Ibadan, Nigeria, and the Implications for Sustainable Land Management

3.2 Smart and Renewable Energy Systems

Presenter	Topic
Alhassan Bismark, Damba Alhassan	Climate-Resilient Power Systems with High Solar Integration and Enhanced Grid Stability for Sustainable Energy Transition in Sub-Saharan Africa
Edward Ayurizoya Ayaane	The role of consumer behaviour in addressing the energy efficiency crisis
Isaac Kulah	Analyzing Hydropower Generator Performance Using Digital Twin Systems

Presenter	Topic
Jones Yeboah	Advancing Renewable Integration: Sustainable Materials and Life-Cycle Assessment of Next-Generation Energy Storage Systems
George Mensah	Designing Context-Specific Business Model to Accelerate Electric Mobility Adoption in Ghana
Romeo Djimasbe	Sustainable Energy Transition in Airports: Solar PV Integration and Impacts on Cost, Performance, and Emissions
Eric Nyarko	Analysis of electricity use in the residential sector: A case study of Tema Central Constituency in Ghana
Mamud Musah	OnSSET-Based Electrification Planning for Remote Communities in Northern Ghana
Prince Asabre	A comprehensive review on integrating both death \ rates into energy systems stability models: Along term simulation framework with AnyLogic
Raymond Batabe Abaveri	Frequent Burnout of 2.5MW Navrongo Photovoltaic Modules: An Investigative Study
Francisca Asare Bediako	Designing Solar PV Mini-Grid with Electric Vehicle (EV) Infrastructure Integration in Ghana
Romeo Dela Lavia	Assessment of the financial viability of a biomass powerplant in Ghana
Alfred S. Sumara	Satellite-Based Forecasting of Cloud Cover Variability and Its Impact on Short-Term Solar PV Grid Integration

3.3 Future Technologies in Electrical, Electronics and Computer Engineering

Presenter	Topic
Ayerko Emmanuel Herson	Quantum Kernel Embedding for Enhanced Classification Performance
Isaac Prempeh	Optimal Allocation and Sizing of Distributed Generation and Electric Vehicle Charging Stations using Artificial Bee Colony and Particle Swarm Optimization Algorithms

3.4 Earth Observation as a Decision tool for Socio-Economic Development

Presenter	Topic
Serah Kabui Kahuri	Up-Scaling Landsat 8 with sentinel 2 for rangeland laud use land cover change dynamics analysis in marsabit (1992-2023)
Tadesse Leta Jiru	Regression Kriging Based mapping of soil organic carbon across lowland d midland and highland farmland agro ecological zones of Negele District Ethiopia
Claudio Madaune	Eco social processes towards sustainability worldwide building up a permanent and resilient culture from grassroot level

3.5 Cross Cutting: Engineering Education, Policy and Innovation

Presenter	Topic
Worlali kwabla Ameevor	Evaluating Energy subsidy policy framework for sustainable energy
Nurideen Abdulai	Modelling Residential Electricity Consumption in Ghana: Integrating Demand-Side Management and Renewable

4.0 TECHNICAL POSTER PRESENTATIONS

4.1 Smart and Renewable Energy Systems

Presenter	Topic
Afrifa Daniel	Techno-Economic Analysis of Hybrid Energy System for Hospitals
Mohammed Okoe Alhassan	Enhancing time-horizon forecast of solar PV production in semi-arid regions using a novel CNN-LSTM-BiLSTM hybrid deep learning model
John Abban	Power Factor Optimization in Low-Voltage Distribution Networks Using FACTS-Assisted Hybrid PV–Wind Connected to Grid Systems
Jochebed Naa Akweley Oglie Tetteh	Siting and Sizing of an Electric Vehicle Charging Station using Meta-Heuristic Algorithm: The Case of AAMUSTED Campus
Mathias Bennet Michael	Integration of Solar Thermal Energy Storage System in Palm Oil Mills: A Systematic Literature Review

4.2 Petroleum and Natural Gas Engineering for a Just Energy Transition

Presenter	Topic
Fawziyah Oyefunke Olarinoye	Effect of salinity on the performance of mixed Agrowaste based amino acids as kinetic hydrate inhibitors

4.3 Earth Observation as a Decision tool for Socio-Economic Development

Presenter	Topic
Alonge Titus Adeyemi	An Earth Observation-Driven Hybrid MCDM Model for Prioritizing Soil Erosion Risk: A Methodology Preview

5.0 LIST OF FULL ABSTRACTS

Empirical Modelling and Optimisation of Waste-to-Energy Integration into Net Zero Energy Buildings Using Ghana-Specific Waste Stream Data

Brobbey Williams[a,b]

[a]Department of Renewable Energy Engineering, School of Energy, University of Energy and Natural Resources, Sunyani, Ghana.

[b]Regional Center for Energy and Environmental Sustainability, University of Energy and Natural Resources, Sunyani, Ghana.

Abstract:

This proposal builds on a global systematic review and meta-analysis of Waste-to-Energy (WtE) integration within Net Zero Energy Buildings (NZEBs). The review of 80 studies reported a moderate-to-strong pooled effect (SMD ≈ 0.80; 95% CI: 0.71–0.89) but very high heterogeneity (I^2 > 90%), indicating strong context dependence (Brobbey, 2025). While Europe and Asia demonstrate promising operational outcomes, Ghana-specific evidence remains weak due to fragmented policy, limited use of advanced modelling with local inputs, and a lack of empirical pilot data (Ahmed, 2024; Tahiru et al., 2024; Oduro et al., 2025).This PhD will: (i) generate Ghana-specific municipal solid waste (MSW) characterisation data; (ii) develop and calibrate HOMER- and MATLAB-based models for hybrid WtE–PV–battery NZEB configurations; (iii) apply multi-objective optimisation to minimise lifecycle cost and emissions while maximising reliability; (iv) implement and monitor a pilot anaerobic digestion (AD) unit integrated with an NZEB; and (v) conduct ISO 14040/44-compliant life-cycle assessment (LCA) and techno-economic analyses (Palomar-Torres et al., 2024; Lombardi & Carnevale, 2012). Outputs include a Ghana MSW energy dataset, validated models, pilot performance data, and a policy roadmap aligned with Ghana's NZEB agenda (Mohammed et al., 2023; Ohene, 2024).

Keywords:

Waste-to-Energy (WtE), Net Zero Energy Buildings (NZEB), Life Cycle Assessment, Municipal Solid Waste (MSW), Anaerobic Digestion (AD)

Elemental characterisation, sources and health risk assessment of PM_{10} in urban Ghana during the dry season

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Abstract:

The study examined the origin and potential health risks associated with exposure to trace elements in outdoor PM_{10} at the Winneba highway intersection (WHI) and the Apam fish-smoking community (AFC) during the dry season in Ghana. A Gent sampler, equipped with a Gast pump and a stacked filter unit, was employed to collect airborne particulates. Sampling was conducted three times per week from November 2022 to March 2023, with each session lasting 24 hours. The particulate samples were analysed for elemental and black carbon (BC) concentrations using an Ag-anode X-ray tube spectrometer and a smoke stain reflectometer, respectively. The US EPA Air Quality Index (AQI) and health risk assessment models were utilised to evaluate air quality and the cancer risk associated with trace elements. The analysed data revealed that the elemental composition of PM_{10} varied, with crustal elements exhibiting the highest concentrations. The average levels of chromium (Cr) at 77.29 ng/m^3 and nickel (Ni) at 217.10 ng/m^3 detected at WHI significantly exceeded the US EPA threshold limits, as did the values recorded at the AFC, which were 309.70 ng/m^3 and 472.08 ng/m^3, respectively. Principal component analysis (PCA) indicated that PM_{10} at WHI originated from soil dust, vehicular emissions, and two-stroke engines, whereas sea salt, soil dust, biomass burning and vehicular emissions contributed to PM_{10} at AFC. The AQI classified the air quality from December to February as moderate, suggesting that sensitive individuals should limit their exposure to PM_{10}. Overall, PM_{10}-bound elements were associated with cancer and non-cancer health effects upon chronic exposure via dermal contact. Implementing eco-friendly mobility solutions and utilising clean fuel are necessary to mitigate PM_{10} and its associated health concerns.

Keywords:

Principal Component Analysis (PCA); Black carbon; Biomass, Vehicular emissions;Fish-smoking community

How risky is the work of sanitation workers? A quantitative assessment of the health and safety risks among latrine operators and emptiers in the Kumasi Metropolis

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Abstract:

Sanitation workers play a crucial role in the sanitation service chain. Without them, heaps of vermin-infested waste and overflowing septic tanks will be common sights in cities, causing disease outbreaks. Although these workers bear huge risks in their line of work, they are frequently stigmatized, discriminated against and least protected. Many studies have assessed the health and safety risks faced by these workers, but none has quantified the risks associated with their work, especially for toilet operators - pit emptiers, janitors, public toilet attendants, and container-based sanitation operators, especially during the COVID-19 outbreak. This study therefore quantifies the health and safety risks faced by these workers by examining the common illnesses, job-specific risks, protective measures, incentives, and disincentives among this occupational group. This would enable decision-makers effectively prioritise and reduce high risks to their barest minimum to safeguard the well-being of these workers.

Keywords:

Sanitation workers; Occupational health and safety; Toilet operators; Pit emptiers; Public toilet attendants; Urban sanitation.

Exploratory Assessment of Monitoring Wetland Degradation in Ibadan, Nigeria, and the Implications for Sustainable Land Management

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Abstract:

This study aims to monitor wetland degradation in Ibadan, Nigeria, while also investigating the implications for sustainable land management. The study made use of remote sensing data such as Google Earth, Landsat 7, and Landsat 9 images for Land Use Land Cover Classification (LULCC) and Normalized Difference Water Index (NDWI). Supervised classification was done using ArcGIS 10.8, which showed the trends of wetland depletion between 1994 and 2024. A total of 399 questionnaires were administered to household heads using the systematic sampling method. Multiple linear regression was used in analyzing the inferential statistics. Findings revealed that over a period of 30 years, wetlands were lost and replaced with green spaces, built-up areas, and other land uses. The city, as a result of these, had experienced a heightened incidence of flooding. The negative regression analysis result shows that interventions such as restoration efforts and policy enforcement in the core and monitoring efforts in the peri-urban were reactive, indicating the occurrence of massive degradation. The positive outcome of effective strategies and restoration in the peri-urban has the potential for meaningful impact if proactive measures are taken. The study therefore recommends holistic adoption and implementation of a sustainable land management framework to guide and protect the wetlands.

Keywords:

Urbanization, Wetlands, Management, Conservation, Restoration, Policy.

Climate-Resilient Power Systems With High Solar Integration And Enhanced Grid Stability For Sustainable Energy Transition In Sub-Saharan Africa.

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Abstract:

The global energy landscape faces unprecedented challenges from climate change and the imperative for rapid renewable energy deployment. This research proposal addresses the critical need for climate-resilient power systems capable of accommodating high solar photovoltaic (PV) integration while maintaining enhanced grid stability. The study aims to develop comprehensive frameworks that simultaneously optimize for climate resilience and renewable energy integration, addressing a significant knowledge gap in existing literature where these challenges are typically examined separately. The research will employ a multi-phase approach combining climate vulnerability assessment, solar integration analysis, integrated solution development, and validation testing. The methodology incorporates advanced grid modeling, machine learning techniques, and empirical analysis using real-world data from utilities across different climate zones. Expected outcomes include the development of climate-resilient design standards, advanced control algorithms for high solar penetration systems, and integrated planning frameworks that combine climate adaptation with renewable energy deployment.The significance of this research extends beyond technical contributions to encompass substantial economic, environmental, and social benefits. With power outages costing the global economy billions annually and renewable energy integration challenges threatening grid stability, this research will provide essential tools for policymakers, utilities, and technology developers working to create sustainable and resilient electricity systems. The findings will be particularly valuable for developing countries, where aging infrastructure must simultaneously adapt to climate change and accommodate massive renewable energy deployment to meet growing electricity demand.

Keywords:

Solar Photovoltaic (PV); Grid stability; Renewable energy deployment; Climate change, Machine learning; Control algorithms; ,Energy transition; Developing countries.

The role of consumer behaviour in addressing the energy efficiency crisis

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Abstract:

Despite the advancements in energy-efficient technologies and supportive government policies, global and local energy systems continue to suffer from persistent inefficiencies in energy consumption, a significant portion of this inefficiency is attributed not to technological limitations, but to human behaviour. Consumers frequently exhibit behaviours such as neglecting to turn off unused appliances, failing to invest in energy-saving devices, or resisting energy-efficient practices, even when these actions would result in cost savings and environmental benefits. Traditional economic models often assume that consumers make rational decisions based on cost-benefit analyses, however, evidence increasingly shows that energy consumption decisions are influenced by cognitive biases, habits, limited information, and social norms, which are not adequately addressed by conventional policy approaches. Ghana is still experiencing an energy efficiency crisis, particularly in underdeveloped areas like the Upper East, despite the government's tremendous efforts to provide electricity access and encourage efficiency. Technical and infrastructure-based solutions have frequently been the focus of research and policy, ignoring the crucial role that consumer behaviour plays in influencing energy results. Across homes, enterprises, and public organizations, factors such as habitual consumption, constrained rationality, and a lack of understanding of cost-saving alternatives continue to exist. External variables like energy efficiency labels also have an impact on consumer behaviour, relevant data from other contexts demonstrate that customer trust and purchase behaviour regarding energy-efficient appliances can be considerably impacted by awareness and perceived value of energy efficiency labels. This realization is critical because it emphasizes how important it is to run public awareness efforts to inform consumers about the advantages of energy-efficient products, which encourage more people to buy them. This study intends to explore how consumer behaviour contributes to the continuation of energy efficiency crises, with a

focus on behavioural patterns, decision-making processes, and sociocultural elements that affect energy consumption at the household, institutional, and organizational levels.The research employed a mixed-methods approach, integrating semi-structured interviews, quantitative, qualitative surveys, and on-site energy audits in a few districts of Upper East Region (Kasena-Nankana East Municipality in the west zone, Bolgatanga Municipality in the central zone, and Bawku West District in the east zone).

Keywords:

Energy efficiency; Consumer behaviour; Cognitive biases, Energy audits; Sustainable energy practices.

Analyzing Hydropower Generator Performance Using Digital Twin Systems

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Abstract:

Digital Twin (DT) smart technology marks a major progress in hydropower asset management by creating a real-time, digital replica of a physical hydropower generator. Unlike traditional Supervisory Control and Data Acquisition (SCADA) systems, Digital Twin combines accurate physical models with live operational data to simulate, forecast, and optimize performance under different operating and fault scenarios. This ongoing synchronization between the physical and virtual worlds enables operators to predict issues early, reduce unexpected downtime, and enhance overall efficiency. DT, Framework for a Hydropower generator:

Model Development – Developing a physics-based model of the hydropower generator that includes turbine hydrodynamics, electromechanical properties, and governor-excitation control interactions.

Data Integration – Continuous data streaming from plant sensors (flow rate, head, power output, vibration, temperatures, excitation current, etc.) is fed into the DT via IoT-enabled SCADA or edge computing gateways.

Parameter Adaptation – Recursive identification and adaptive learning methods ensure that the DT evolves alongside physical wear, component replacements, or operational changes.

Fault Detection and Prognostics – Machine learning algorithms (e.g., Long Short-Term Memory (LSTM) networks, isolation forests) operate on DT outputs to detect anomalies and estimate Remaining Useful Life (RUL) for key components.

Scenario Simulation and Optimization – Operators can test "what-if" maintenance or load-dispatch strategies in the DT environment before applying them to the physical generator, thereby reducing risk and optimizing cost.

Digital Twin smart systems are transforming hydropower performance monitoring from a reactive inspection approach to a proactive, data-driven management strategy. By combining high-fidelity simulation, adaptive learning, and live telemetry integration, DTs enable more accurate diagnostics, reduce unplanned downtime, and optimize energy output. As Industry 4.0 technologies mature, the integration of open-platform DT frameworks, advanced prognostics, and AI-driven decision support will become standard practice across modern hydropower fleets.

Keywords:

Digital Twin; Hydropower;Remaining Useful Life (RUL); Machine learning;; SCADA integration

Advancing Renewable Integration: Sustainable Materials and Life-Cycle Assessment of Next-Generation Energy Storage Systems

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Abstract:

The global transition toward renewable energy integration necessitates the development of sustainable, high-performance energy storage systems (ESSs) capable of addressing intermittency, grid stability, and decarbonization goals. This review synthesizes recent advancements in next-generation ESS technologies, focusing on sustainable material innovations, life-cycle assessment (LCA) methodologies, and circular economy strategies. Emerging chemistries including sodium-ion, zinc-ion, magnesium–sulfur, solid-state, and organic redox flow batteries are examined for their performance metrics, environmental profiles, and resource sustainability. The analysis integrates LCA evidence from diverse methodological frameworks, highlighting the influence of system boundaries, functional units, and impact categories on environmental performance outcomes. Special attention is given to end-of-life strategies, including hydrometallurgical, pyrometallurgical, and direct recycling processes, as well as second-life applications that extend system usability and reduce lifecycle emissions. The review further explores policy mechanisms, such as Extended Producer Responsibility (EPR) and incentives for high-yield recycling, as enablers for sustainable ESS adoption. Findings indicate that coupling material innovation with harmonized LCA standards and circular economy models can significantly lower environmental burdens, enhance resource efficiency, and improve economic feasibility. The paper concludes with a research agenda that underscores the need for cross-disciplinary collaboration, standardized sustainability metrics, and scalable recycling infrastructures to fully realize the sustainability potential of next-generation ESSs. This work contributes to both academic discourse and policy development, offering an integrated framework for aligning technological innovation with environmental and socio-economic imperatives in the renewable energy transition.

Keywords:

Life cycle assessment, circular economy, renewable energy integration, renewable energy transition

Designing Context-Specific Business Model To Accelerate Electric Mobility Adoption In Ghana

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Abstract:

Ghana's transport sector is responsible for 47.7% of all energy related emissions. Despite efforts to meet the Nationally Determined Contribution pledge on reducing emissions by 15% by the year 2030, there is still an upward rise in emissions. This necessitates the need for cleaner and sustainable transport such as the electric two wheelers (E2Ws) and electric three wheelers (E3Ws) whose fossil-fuel based counterparts are becoming more popular modes of public transportation. However, financial issues persist in Ghana affecting the penetration. Drawing on existing literature in the Global North and some countries in the Global South, this research aims to deliver a context specific business model for e-mobility adoption, using Bechem in the Ahafo region as a case study. The research employs a mixed methods approach, using SPSS to analyze the qualitative data collected from stakeholder interviews and surveys. For quantitative analysis, Python is used to assess financial viability metrices like return on investment (ROI), net present value (NPV) and also develop a technology acceptance model (TAM). The findings of this study are intended to provide adequate information and insights to support decision makers in creating the right policy and regulatory environment to support the penetration of electric vehicles.

Keywords:

Business Models; Electric Vehicle Adoption; Financial Modelling

Sustainable Energy Transition in Airports: Solar PV Integration and Impacts on Cost, Performance, and Emissions.

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Abstract:

Airports are energy-intensive infrastructures, with electricity demand driven primarily by HVAC, lighting, and critical operational systems. In sub-Saharan Africa, limited renewable integration in airport facilities contributes to high operational costs, energy insecurity, and elevated carbon emissions. This study assesses the techno-economic and environmental feasibility of integrating solar photovoltaic (PV) systems into the energy supply of Kotoka International Airport (KIA) in Ghana, addressing three key research gaps: (i) absence of localized PV integration analyses for African airports, (ii) lack of modelling for KIA's hybrid grid–diesel configuration, and (iii) scarcity of replicable frameworks for tropical, developing economies. Using HOMER Pro optimization, multiple PV penetration scenarios (20% and 60%) were simulated under varying fuel prices (USD 0.71–1.12/L) and grid tariffs (USD 0.09–0.13/kWh). Results show that 60% PV penetration reduces annual operating costs by 35% (USD 407,764 to USD 266,042), achieves a levelized cost of energy (USD 0.0843–0.0966/kWh), and lowers CO_2 emissions by 40% (1.5×10^8 kg/year) compared to the baseline. Operationally, diesel fuel use decreases by 96%, and grid dependence is significantly reduced, enhancing resilience in an unreliable power context. Comparative analysis with recent hydrogen-based renewable integration studies highlights that direct PV deployment in KIA's tropical setting delivers lower LCOE and avoids efficiency losses inherent in power–H_2–power cycles. The findings provide a transferable, policy-relevant framework for renewable integration in energy-intensive facilities across sub-Saharan Africa, aligning with Ghana's national energy transition goals and ICAO's CORSIA targets.

Keywords:

Renewable Energy Integration, HOMER Pro Optimization, Economic Feasibility, Carbon Emissions Reduction, Energy Security, Airport Sustainability.

Analysis of electricity use in the residential sector: A case study of Tema Central Constituency in Ghana

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Abstract:

High incidence of electricity wastage and difficulties in managing load from residential consumers during peak demand is a great challenge. Understanding the drivers of electricity use in the residential sector is critical to improving energy efficiency and conservation practices. This research analyses the electricity consumption of 440 homes in Tema Central constituency, Ghana. The study examined how variables such as; building characteristics, economic, socio-demographics, and users behavior predict energy usage in residential buildings. Data were collected from respondents through smart meter reading, online survey, and face-to-face interviews using a structured questionnaire from January to December 2023. The results show that three factors, building floor size, income, and household size, explain 38%, 30%, and 1.9 % respectively of the energy consumption of the buildings. The findings emphasize differences in energy consumption among different household clusters. Other factors, including age, education, and gender, were shown to have minimal effect. Variations in respondent demographics, building designs, environmental concerns, and beliefs all contributed to the observed discrepancies in electricity consumption. The study recommends shared electrical appliances among larger households, promotion of natural ventilation, to reduce the dependency on fans and air conditioners, provision of financial support for low-income households to replace inefficient appliances, real-time monitoring of electricity consumption, shifting of high-consuming appliances to off-peak periods to reduce electricity losses, and support demand response programs.

Keywords:

Residential electricity consumption; Energy efficiency; Demand-side management; Household energy behaviour; Smart meter data; Socio-demographic factors.

OnSSET-Based Electrification Planning for Remote Communities in Northern Ghana

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Abstract:

This study applies the OnSSET modeling framework to evaluate least-cost electrification pathways for Ghana's Northern cluster by 2030. Two scenarios are assessed: a Business-as-Usual (BAU) case centered on grid expansion and a Decentralized scenario prioritizing off-grid solutions such as Solar Home Systems (SHS) and mini-grids. Both scenarios achieve universal access for over 4.37 million people; however, the Decentralized approach delivers a cost saving of 18% (USD 626.78 million vs. USD 767.27 million) while increasing total installed capacity. The results show that grid extension is economically viable only in high-density or industrial areas, whereas off-grid technologies offer more suitable solutions for rural and sparsely populated settlements. These findings align with Ghana's National Energy Transition Framework and Renewable Energy Master Plan, reinforcing the need to scale up decentralized electrification through targeted policies, financing mechanisms, and local capacity development.

Keywords:

OnSSET; Least-cost electrification; Decentralized energy systems; Solar Home Systems (SHS); Electrification pathways.

A comprehensive review on Integrating Birth–Death Rates into Energy System Stability Models: A Long-Term Simulation Framework with AnyLogic

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Abstract:

The intersection of demographic dynamics and energy system stability has attracted increasing scholarly attention, particularly in the context of long-term sustainability and planning. Birth and death rates directly shape population trajectories, which in turn determine patterns of energy demand, infrastructure stress, and resource utilization. But most of the research that has been done on energy stability has focused on technological, economic, and environmental issues, and has often downplayed the importance of demographic changes in making systems more resilient. This paper presents a comprehensive literature review on the integration of birth–death dynamics into energy stability modeling, with a focus on system dynamics approaches. The review synthesizes findings across demographic studies, energy forecasting models, and system dynamics applications, highlighting the fragmented treatment of demographic variables in current energy modeling frameworks. Special attention is given to the potential of AnyLogic as a flexible platform for bridging this gap by incorporating demographic feedback into long-term prediction models. The review identifies critical gaps in methodology, including limited scenario-based assessments of demographic change, insufficient exploration of feedback between population growth and energy demand, and a lack of integrated frameworks combining social and technical variables. By mapping the state of knowledge and methodological approaches, this review establishes the foundation for developing an AnyLogic-based simulation framework that explicitly links birth–death dynamics with long-term energy stability. The outcomes are expected to guide future research and provide policymakers with a holistic perspective on sustainable energy planning under demographic uncertainty. This framework could facilitate scenario analysis, allowing stakeholders to visualize the potential impacts of various demographic shifts on energy systems. Ultimately,

enhancing the understanding of these interconnections may lead to more resilient and adaptive energy policies that can respond to changing population dynamics.

Keywords:

Demographic dynamics; Birth–death modelling; Energy system stability; System dynamics; AnyLogic simulation; Sustainable energy policy.

Frequent Burnout of 2.5MW Navrongo Photovoltaic Modules: An Investigative Study

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Abstract:

The reliability and long-term performance of photovoltaic (PV) modules are crucial for sustainable solar energy production, particularly in high-temperature regions like northern Ghana. In PV installations, burnouts are a common failure often caused by excessive heat or electrical stress. In Navrongo, a town located in the Upper East Region of Ghana, a 2.5 MW grid-connected PV plant has been installed. The plant uses two types of modules, thus, the Jinko and Suntec modules. Notably, burnout incidents predominantly occur in the Jinko modules and not the Suntec ones. In this study, we investigate the frequent burnouts using a comprehensive diagnostic approach which involves: (a) Thermal imaging cameras to identify and evaluate hotspot formation, (b) A Seaward irradiance meter to measure site-level solar input, (c) a Top-view software for IV curve tracing to assess electrical characteristics, and (d) temperature data from an on-site weather station for correlation analysis. Additionally, technician and community feedback on operational challenges were evaluated, and SPSS was used for statistical modelling to correlate module failures with temperature, irradiance, and other environmental parameters. Key contributing factors such as high environmental temperatures, hotspot formation, module mismatch, soiling, poor substructure installation and ultraviolet degradation are considered. The results showed that the main causes of burnouts included electric fault, such as a ground fault, regular failure of the bypass diodes and drop in PV module reliability under high heat, high solar radiation and high temperatures conditions.

Keywords:

Photovoltaic (PV); Burnout failures; Hotspot formation; Thermal imaging; IV curve tracing; Statistical modelling.

Designing Solar PV Mini-Grid with Electric Vehicle (EV) Infrastructure Integration in Ghana.

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Abstract:

Achieving universal access to reliable and affordable energy in Sub-Saharan Africa requires integrated approaches that link electrification, clean mobility, agriculture, clean cooking and other productive uses. Despite Ghana's national electrification rate of 89%, rural areas particularly face access gaps and limited electric vehicle (EV) infrastructure. At the same time, rising transport-related emissions underscore the urgency of low carbon mobility pathways. This study aims to design a localized and suitable energy system configuration that integrates solar photovoltaic (PV) mini-grids with EV charging system to develop sustainable energy and transport solutions that meets community energy demands. The research applies a mixed-methods framework combining geospatial analysis, machine learning clustering, extreme value theory for solar irradiance forecasting, and mathematical optimization for system sizing and energy dispatch. Using Bechem in the Ahafo Region as a case study, energy demand across households, agriculture, health facilities, and transport are to be modelled alongside EV routing patterns for two- and three-wheelers. Preliminary studies and analysis indicate that integrating EV charging with community needs, health services and agricultural activities can enhance mini-grid productive energy use, financial viability and system reliability. The synergy between the technologies can improve grid stability and reduce system losses.

Keywords:

Solar PV mini-grids; Electric vehicles; Optimization; Forecasting; Energy transition;

Assessment of the Financial Feasibility of a 30MW Biomass Plant in Ghana

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Abstract:

Ghana faces significant environmental challenges from indiscriminate waste burning and improper disposal while simultaneously maintaining heavy dependence on fossil fuels for power generation, despite generating 3 million tons of wood waste and 39 million tons of crop residues annually that could serve as renewable energy feedstock. This study employed the International Atomic Energy Agency's Model for Financial Analysis of Electric Sector Expansion Plans (FINPLAN) to evaluate the financial viability of a 30MW biomass power plant in Ejura Sekyedumase District, Ghana for 25 years. The analysis utilized secondary data from the Bank of Ghana and OECD, with financing assumptions of 85% export credit and 15% commercial loans, examining three sensitivity scenarios: varying plant production capacity (25-100%), levelized cost of energy ($0.025-$0.10/kWh), and fuel costs ($0-8M annually). The analysis revealed that the biomass plant achieves financial viability at minimum 50% production capacity (100GWh/year), generating positive net present value and internal rate of return of 45.65% or higher, with potential shareholder dividends ranging from $5-14 million. The optimal levelized cost of energy was determined to be above $0.065/kWh, with $0.085/kWh providing superior debt service coverage. Fuel costs significantly impact profitability, with operations becoming unviable if annual fuel costs exceed $4 million. The study concludes that a 30MW biomass power plant in Ghana is financially viable under optimal operating conditions of at least 50% capacity utilization, energy pricing above $0.065/kWh, and controlled fuel costs below $4 million annually, offering a sustainable solution to address both waste management challenges and renewable energy needs while providing attractive returns for investors.

Keywords:

FINPLAN, Biomass, Ghana, waste management

Satellite-Based Forecasting of Cloud Cover Variability and Its Impact on Short-Term Solar PV Grid Integration

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Abstract:

This review synthesizes research on technological advancements in satellite-based forecasting of cloud cover variability, accuracy of forecasts, and integration with existing systems to address limitations in forecast precision, lead time, and operational interoperability. The review aimed to evaluate machine learning techniques for forecast accuracy, benchmark satellite data assimilation methods, identify integration strategies with numerical weather prediction systems, compare deep learning architectures for nowcasting, and analyze computational and resolution challenges. Literature was systematically selected based on recent studies employing machine learning, data assimilation, and multi-source satellite data fusion across diverse geographic regions and forecasting horizons. Findings indicates that advanced deep learning models, including convolutional and transformer architectures, substantially improve short-term cloud cover nowcasting accuracy and spatial-temporal resolution, outperforming traditional numerical weather prediction and optical flow methods. Multi-source data fusion and assimilation enhance forecast skill and lead time extension, particularly when integrating satellite radiances with ground and NWP data, though challenges remain in cloud microphysics representation and data heterogeneity. Computationally efficient frameworks enable near-real-time forecasting, yet scalability and model generalizability across climatic regimes require further development. Integration with operational systems improves forecast initialization and reliability but is constrained by cloud process complexity and data latency. Collectively, these advances demonstrate significant potential for improving meteorological forecasting systems, informing future research and operational implementation to support sectors reliant on accurate cloud cover predictions.

Keywords:

Solar PV integration, Multi-source satellite fusion; Numerical Weather Prediction (NWP); Convolutional neural networks (CNNs);

Quantum Kernel Embedding for Enhanced Classification Performance

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Abstract:

Although quantum machine learning has shown great promise in solving challenging classification problems, its applicability hinges on models that strike a compromise between scalability, prediction accuracy, and imbalanced data. The performance of the Quantum Support Vector Machine (QSVM) in comparison to a new Quantum Kernel Embedding (QKE) architecture for supervised classification is examined in this paper. QKE adaptively learns task-specific embeddings that improve separability in Hilbert space while reducing the drawbacks of shallow quantum circuits, in contrast to QSVM, which depends on a fixed quantum kernel. Using realistic simulation conditions, including feature preprocessing and simulator settings, we test both approaches on benchmark datasets. The study's findings show that QKE routinely performs better than QSVM in terms of accuracy, stability, and generalization across test datasets.In contrast to other studies that used a small number of hundreds to thousands of data samples, QKE notably obtains better decision boundaries with fewer qubits, indicating superior scalability. This work presents a new quantum classification model based on embeddings that is scalable and provides a mechanism to develop useful and resource-efficient quantum learning algorithms.

Keywords:

Quantum Machine Learning; Quantum Support Vector Machine (QSVM); Quantum Kernel Embedding (QKE); Resource-efficient quantum algorithms

Optimal Allocation and Sizing of Distributed Generation and Electric Vehicle Charging Stations using Artificial Bee Colony and Particle Swarm Optimization Algorithms.

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Abstract:

Distributed generation (DG) units are used to improve grid reliability and stability. Electric vehicle charging stations (EVCS) consume more power from the grid at peak periods. These two systems cannot be practically located on every part of the grid due to technical effects. In this study, two metaheuristic techniques are adopted to improve the voltage profile and minimize power losses by simultaneously allocating DG units and EVCS. The study employed the IEEE 33 bus test system in finding the solution. The study used standard Particle Swarm Optimization (PSO) and Artificial Bee Colony (ABC) algorithms for DG and EVCS allocation. The results show that PSO outperformed ABC and other algorithms in terms of the simultaneous allocation of DG units and EVCS. The power losses were 40.78% less when PSO is used for allocation. Buses 2 and 19 are the favorite buses for EVCS on an IEEE 33 bus system. The paper concludes that the addition of high-capacity EVCS should lead to the simultaneous introduction of DG units on the network.

Keywords:

Distributed Generation units, Electric Vehicle Charging Station, Voltage profile improvement, Active power losses

Up-sampling landsat-8 with sentinel-2 for rangeland land-use land-cover change dynamics analysis in marsabit (1993-2023).

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Abstract:

Rangelands in Kenya experience degradation from multifaceted drivers threatening the fragile ecosystem. A lot of vegetation in the rangelands that fall below the FAO forest desscription is omitted when mapping use medium resolution imagery. Using machine-based technology, this study will improve the resolution of Landsat 30m to 10m using Sentinel imagery. This will be implemented through super-resolution image fusion by up-sampling Landsat-8 (30 m) imagery to 10 m resolution using Sentinel-2 as a spatial reference within an Enhanced Deep Super-Resolution (EDSR) model and design high resolution LULCC maps. The high resolution LULCC maps will undergo integrated analysis to facilitate the design of H-Restoration Options maps. H-Restoration goes beyond restoring degraded landscapes; it also considers the LUs that are stable and prescribes conservation and/or management. Restoration Hot-spots are identified using a weighted approach. The H-Restoration maps are designed for each LU. A prescription-oriented Management Restoration Plan is then designed which is site-specific. Studies have argued that restoration cannot be successful if the Pro-Environmental Behaviour (PEB) of concerned communities is not known. This PhD study assess the limited understanding of pro-environmental behaviour for rangeland restoration among pastoralists in Marsabit, Kenya using Protection Motivation Theory (PMT). To contribute to the literature, we enhanced the existing PMT by including modifier variables such as perceived political willingness and perceived incentives. The final objective is to “Conduct Economic and Evaluation of the Landscape H-Restoration Options” to understand the full benefits and costs of undertaking restoration compared to status quo of not using sustainable land management practices. The finding from this study on degradation

hotspots, H-Restoration prescriptions and economic evaluation for the rangelands are all critical for Kenya which is made up of ~80 % Arid and Semi-Arid Lands (ASALs); they will assist in the progress tracking towards attaining SDG 15.3.1 and LDN as well improving the livelihoods of the pastoralists in a changing climate.

Key Words:

Rangelands, Degradation, LULCC, EDSR, Economic evaluation, ePMT.

Regression Kriging Based mapping of soil organic carbon across lowland d midland and highland farmland agro ecological zones of Negele District Ethiopia

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Abstract:

Soil organic carbon (SOC) is fundamental to soil fertility, climate moderation, and sustainable land use. However, there is limited of quantification of the spatial distribution of SOC in different agroecological zones in Ethiopia, especially on farmlands. This study aims to quantify and map SOC stocks; spatial distribution in the defined lowland, midland and highland agroecological zones of farmlands in the Negele Arsi District of Ethiopia using regression kriging. A total of 192 soil samples (0–30 cm depth) were collected and analyzed for SOC concentration using the Walkley–Black method with a 0.39 correction factor. In the study area bulk density was measured, and SOC stock was computed. Predictor variables including elevation, slope, land surface temperature, and soil texture (clay, sand, and silt) were evaluated through Pearson correlation and multicollinearity analysis, and a multiple regression model was developed. The model explained about 78% of the variation in SOC ($R^2 = 0.78$), which means it can predict SOC stock well. Residuals exhibited significant positive spatial autocorrelation (Moran's I = 0.275, $P < 0.01$), justifying geostatistical interpolation. Regression kriging with four semi variogram models revealed that the exponential model yielded the best performance ($R^2 = 0.94$). SOC stock exhibited a systematic variation across the agroecological zones, having mean values of 18.5 Mg/ha in lowland, 45.9 Mg/ha in midland and 67.3 Mg/ha in highland areas. Spatial predictions indicated a strong north to south gradient, with depleted SOC stock in the lowland areas and enriched SOC stocks in the highland areas. The study demonstrates the utility of regression kriging for high-resolution SOC stock mapping on farmlands and provides critical evidence to support sustainable land management and Ethiopia's Land Degradation Neutrality commitments.

Keywords:

Soil Organic Carbon (SOC), Regression Kriging, Spatial Mapping, Agroecological Zones, Farmlands.

Eco-social processes towards sustainability worldwide, building up a permanent and resilient culture from grassroot level,

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Abstract:

An aproach to the Energy and Engineering sector to: sustainable settlements (ecovillages, econeighborhoods and transition initiatives), apropriated technologies, eco-building techniques, biological waste wáter treatment systems, alternative agricultural systems, renewable energies, social tools for transformation throught participatory processes, among others. Civil society transition to life-transformation practices on simple low-cost solutions, where science, technology and ancestral knowledge meets with innovation and creativity. Concrete on going processes base on the 5 dimensions of sustainability: social, economical, ecological, world's view and regenerative design. Inspirational initiatives demonstrate to both rural and urban sector how it's posible to stop being part of the multicrises our modern society is facing from an integral and holistic botom up perspective. A call and an invitation to créate bridges and networking between the Academy, public and private sector with civil society and local communities towards win-win alternatives for a Sustainable and regenerative society.

Keywords:

Ecovillages, econeighborhoods, sustainability

Evaluating Energy subsidy Policy frameworks for sustainable energy

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Abstract:

Ghana's energy pricing and subsidy reforms intersect with clean-cooking initiatives, decentralized electrification, and demand-side management. Affordable access to modern energy remains uneven: recent evidence shows that low-income households spend a higher share of income on liquefied petroleum gas (LPG) compared to biomass fuels, constraining long-term adoption (Mawusi et al., 2025). Using a PRISMA 2020 aligned protocol (Page et al., 2021) and SWiM narrative synthesis guidance (Campbell et al., 2020), we systematically reviewed Ghana-focused empirical studies published between 2019 and 2025 on subsidy reforms and adjacent interventions (e.g., LPG promotion, improved stoves, mini-grids, and demand response). Fifteen studies met inclusion criteria, covering randomized controlled trials, econometric analyses, modeling, and political economy reviews. Three themes emerged. First, affordability and clean cooking: subsidies and stove programs raise short-run uptake, but the poorest remain constrained without financial instruments. Longitudinal research indicates that peer effects and household health needs significantly influence sustained LPG adoption (Adjei-Mantey et al., 2025). Second, reliability and governance: willingness-to-pay for electricity and mini-grid services rises with dependable supply and transparent tariffs. Evidence shows rural households are prepared to pay premiums for reliability, but inability to pay and technical challenges persist (Korzhenevych & Owusu, 2021; Nyarko et al., 2023). Third, political feasibility: transparent compensatory schemes and phased communication strategies reduce public resistance to tariff reforms, whereas abrupt, opaque reforms often face political backlash (Dye, 2023). Overall, sustainable subsidy reform in Ghana requires bundled strategies sequencing cost-reflective pricing with targeted transfers, consumer financing, and infrastructure upgrades underpinned by credible governance and public engagement. Future research should prioritize standardized affordability metrics, multi-period adherence studies, and evaluations of integrated reform packages.

These insights are critical for aligning Ghana's affordability goals with its clean energy transition commitments.

Keywords:

Ghana; energy subsidy reform; affordability; clean cooking; LPG adoption; mini-grids; demand-side management; political economy.

Modelling Residential Electricity Consumption in Ghana: Integrating Demand-Side Management and Renewable Adoption

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Abstract:

Residential electricity demand in Ghana is rising rapidly at an average annual growth rate of 6%, driven by income growth, urbanization, and appliance uptake. This is coupled grid distribution inefficiencies leading to losses of 31.4% as recorded in 2024. However, demand-side management (DSM) and renewable adoption remain underutilized despite their potential to improve efficiency and mitigate peak loads. In Ghana, DSMs programs are policy-driven rather than voluntary. This study models household-level electricity use behavior across 432 households in some regions of Ghana to identify key consumption drivers and how this feed into DSM and Renewable adoption for cost minimization. A logistic regression model was developed with a Pseudo showing valuable insights for both knowledge and policy.

The Logistic regression shows that high electricity use is strongly associated with household size, income, appliance ownership—especially air conditioners and refrigerators—and urban location. Larger households (>5 members) are up to 17 times more likely to be high consumers, while air conditioner ownership increases the odds by more than one hundred-fold. The Pseudo of 0.30 shows the independent variables, explaining 30% of variability in the household consumption levels.

These findings are then integrated into a system dynamics model to simulate daily load profiles and interventions under two major scenarios (i.e., Price-Based, assuming ToU tariff regime with 20% increase in Residential Tariffs; and Non-Priced-Based for High DSM Adoption and 10x Renewable Intervention) for a period of five (5) years. The results indicate that a 20% tariff adjustment could shift discretionary loads such as washing and ironing away from evening peaks, cutting peak demand by ~7%. Appliance use timing, particularly evening cooling and entertainment, emerges as a critical driver of

system stress. Moreover, under the second scenario, about 35% savings was realized for “High DSM and 10x Solar adoption in residential demand by 2030.

The study contributes an integrated modelling framework combining behavioral analysis, econometrics, and system dynamics to forecast residential demand under DSM and renewable adoption pathways. Insights highlight opportunities to design equitable DSM programs, incentivize efficient appliances, and accelerate rooftop solar adoption, supporting Ghana’s transition toward a more sustainable and resilient energy system.

Keyword:

Demand side management, renewable energy adoption, logistic regression appliance ownership

Techno-Economic Analysis of Hybrid Energy System for Hospitals

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Abstract:

This study assessed the techno-economic feasibility of a hybrid energy system for Wenchi Methodist Hospital, Ghana, using HOMER Pro simulations. The system design considered hospital energy demand, solar irradiation, and component costs. Results indicated that a configuration of 115 kW PV, 500 kW grid connection, 37.5 kW converter, and 70 kW generator could deliver reliable electricity with 96.7% renewable fraction and 0% capacity shortage (Figure 1). The system could also export excess power, offering financial and environmental benefits. The estimated Net Present Cost was US$156,358, with a Levelized Cost of Energy of $0.0679/kWh and O&M costs of US$10.44/year. Findings confirm the technical and economic viability of the hybrid system to enhance hospital energy reliability, reduce costs, and support Ghana's low-carbon transition.

Keywords:

Hybrid Energy Systems, Homer, Levelized Cost of Energy, Net Preset Cost

Enhancing time-horizon forecast of solar PV production in semi-arid regions using a novel CNN-LSTM-BiLSTM hybrid deep learning model

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Abstract:

Accurate solar PV production forecasting is critical for optimizing solar energy systems and enhancing energy resource planning. This research presents a novel hybrid deep learning (DL) model combining enhanced convolutional neural networks (CNNs), long short-term memory (LSTM) and bidirectional long short-term memory (BiLSTM) networks (CNN–LSTM–BiLSTM) to improve solar energy forecasting in semi-arid areas, such as the Savannah-zone, Ghana. The models were evaluated across multiple forecast horizons (a day, one week, and a month ahead), for forecasting the 15-min power output of grid-connected PV systems. A total of 31,031 PV generation and weather-related data from the study region were collected and analysed using statistical and graphical tools. Pearson correlation and sensitivity analysis revealed that Global Horizontal Irradiance (GHI) (~ 91.0 %), PV module temperature (~ 70.0 %), and ambient temperature (~ 60.0 %), were the most influential input weather variables affecting PV power output prediction. Comparative evaluations against conventional LSTM, CNN, BiLSTM, hybrid-based (CNN–LSTM), (LSTM–BiLSTM) and (CNN–BiLSTM)

models revealed that the CNN–LSTM–BiLSTM model consistently provided superior forecasting accuracy across all time-horizons. Explicitly, the proposed model achieved reductions in root mean square error (RMSE) of 0.0909 %, 0.0914%, and 0.0922% for one-day, one-week and a month ahead forecasting, and reductions in mean absolute error (MAE) of 0.0756%, 0.0865%, and 0.0913% respectively, along with high predictive coefficient of determination (R^2) values of 91.01%, 90.98% and 89.85%. These findings confirm the effectiveness and accuracy of the proposed hybrid DL approach for PV power output forecasting. The CNN–LSTM–BiLSTM framework supports sustainable development goals (SDGs) relevant to affordable and clean energy (SDG 7) and climate action (SDG 13). This study can offer practical insights and high precision tool for PV production forecasting, contributing to improved operational and energy planning, power management for grid resilience in semi-arid regions.

Keywords:

CNN–LSTM–BiLSTM, hybrid deep learning, photovoltaic forecasting, time-horizon, renewable energy.

Power Factor Optimization in Low-Voltage Distribution Networks Using FACTS-Assisted Hybrid PV–Wind Connected to Grid Systems

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Abstract:

This study investigates the impact of Flexible AC Transmission System (FACTS) devices on power factor in low-voltage (LV) networks connected to renewable energy sources within the GA West Municipal District electricity grid in Accra, Ghana. As renewable energy use grows, understanding its effect on LV networks and optimizing management strategies is crucial. The research models and simulates the GA West Network and the IEEE Low-Voltage Distribution Network (IEEE-LVDN) to assess the performance of FACTS devices, specifically the Static Synchronous Compensator (STATCOM), with a focus on power factor, active, and reactive power. A 23-busbar test network was modelled to evaluate the integration of photovoltaic (PV) and wind turbine systems, with IEEE-LVDN used for validation. MATLAB/Simulink simulations reveal that FACTS devices significantly improve power factor, achieve near-unity levels, reduce active and reactive power losses, and enhance overall network performance. Instead, active and reactive powers were 293.8 MW and -43.5 MVA, with a power factor of 0.99 at Bus 2. Systems with FACTS devices demonstrated improved performance in active and reactive power, as well as power factors. These findings demonstrate that FACTS devices play a key role in managing power quality and optimizing the performance of renewable energy systems in grid-connected networks.

Keywords:

Low voltage Distribution network, Power factor Optimisation, Flexible AC Transmission System (FACTS); Power quality improvement.

Siting And Sizing Of An Electric Vehicle Charging Station Using Meta-Heuristic Algorithm: The Case Of Aamusted Campus

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Abstract:

This study examines the integration of Electric Vehicle Charging Stations (EVCS) into the distribution system of the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED) campus. Growing concerns over air pollution, fossil fuel depletion, and climate change highlight electric vehicles (EVs) as a sustainable alternative for transportation. However, the adoption of EVs in Ghana is constrained by inadequate e charging infrastructure and network reliability challenges.

To address these issues, the research employed the Electrical Transient Analyzer Program (ETAP) to model the 11 kV distribution system and used the Backward/Forward Sweep (BFS) method to perform load flow analysis. The Particle Swarm Optimization (PSO) algorithm was applied to determine the optimal siting and sizing of EVCS. Five scenarios were evaluated: the first assessed the 23-bus distribution system without EVCS, while the remaining scenarios applied the PSO algorithm to strategically allocate and size charging stations. Results demonstrate that proper integration of EVCS significantly improves system performance. Specifically, optimized placement reduced both active and reactive power losses and enhanced voltage stability across the network. The findings underscore the importance of optimization techniques in supporting EV adoption in Ghana. This research provides a practical framework for researchers and decision-makers to guide future research and deployment of charging infrastructure, thereby strengthening sustainable mobility and ensuring reliable power distribution.

Keywords:

Electric Vehicles, Electric Charging, Charging Stations, Transportation, Electrical Transient Analyzer Program

Integration of Solar Thermal Energy Storage System in Palm Oil Mills: A Systematic Literature Review.

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Abstract:

This systematic literature review critically examines recent advances in the integration, optimization, and reliability of solar thermal energy systems for industrial process heat, with a focused lens on their applicability in palm oil mills. The review synthesizes 102 peer-reviewed studies published between 2018 and 2025, following PRISMA guidelines for selection and analysis. Key themes explored include solar thermal technologies (e.g., parabolic trough collectors, flat-plate systems), thermal energy storage configurations (sensible, latent, hybrid systems), and various optimization and control strategies. The results reveal a strong research focus on system integration 26 studies, with comparatively limited emphasis on optimization 9, thermal storage 4, and reliability 3, despite their critical role in achieving dependable energy supply. While techno-economic metrics such as cost savings, solar fraction, and emissions reduction are commonly reported, reliability assurance techniques and uncertainty analysis remain underdeveloped in most studies. Notably, advanced sizing strategies, such as probabilistic simulation and machine learning, demonstrated superior accuracy and cost effectiveness. The review highlights practical gains from optimized TES systems, including solar shares up to 90%, efficiency improvements exceeding 20%, and cost reductions over 25%. However, substantial gaps persist in reliability frameworks and adaptability assessments, particularly under real-world variability. The study concludes by proposing research directions that include hybrid solar–biomass integration, robust reliability-based design methods, and techno-economic modelling tailored to the unique thermal profiles of palm oil mills in tropical regions.

Keywords:

Solar thermal energy systems; Palm oil mills; Thermal energy storage; Energy system integration;Techno-economic analysis

Effect of Salinity on the Performance of Mixed Agrowaste-Based Amino Acids as Kinetic Hydrate Inhibitors.

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Abstract:

To simulate actual reservoir conditions, it is essential to examine the effect of kinetic hydrate inhibitors on gas hydrate formation in multiphase reservoir models. For experimental evaluations to be field- relevant, they must incorporate a liquid hydrocarbon phase, a multi-component gas system, or brine solutions. In this study, a high-pressure autoclave was used to investigate the impact of mixed amino acids (MBL4) on hydrate formation in saline environments. The inhibitory performance of MBL4 in saline water was assessed using the constant cooling method and compared to its performance in pure water and polyvinyl caprolactam (PVCap), a commercial kinetic hydrate inhibitor, at a pressure of 100 bar. The onset temperature and subcooling temperature were measured to evaluate inhibitor effectiveness in both pure water and brine systems. Experimental results revealed that high salinity significantly influences hydrate nucleation. The presence of saline water delayed hydrate formation, with MBL4 in brine exhibiting an onset temperature and subcooling temperature of 12.49°C and 5.39°C, respectively, at a 0.1 wt% dosage concentration. When comparing inhibitor effectiveness, the trend followed: MBL4 > MBL4-brine > PVCap at a 0.1 wt% concentration. Although salinity reduced the subcooling effect, MBL4 maintained strong inhibitory performance, reinforcing its potential as a sustainable alternative to commercial KHIs. The study further reveals that the presence of sodium chloride alters hydrogen bonding patterns, influencing hydrate suppression efficiency. Findings highlight the potential of mixed agro-waste amino acids as environmentally friendly KHIs, demonstrating resilience in saline environments and reinforcing their applicability in offshore oil and gas operations. These insights contribute to the advancement of sustainable flow assurance strategies by reducing dependency on synthetic inhibitors.

Keywords:

Salinity, Agrowaste-Based Amino Acids, Kinetic Hydrate Inhibitors.

An Earth Observation-Driven Hybrid MCDM Model for Prioritising Soil Erosion Risk: A Methodology Preview

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Abstract:

Soil erosion represents an escalating threat to agricultural productivity, water security, and land resilience, particularly in regions with limited data availability. Conventional susceptibility models frequently consider biophysical drivers in isolation, thereby overlooking their intricate interdependencies and consequently reducing the accuracy of prioritization efforts. This study introduces an Earth Observation (EO)-driven hybrid Multi-Criteria Decision-Making (MCDM) model, which integrates Fuzzy DEMATEL, DANP, and TOPSIS methodologies. This model is designed to map and rank sub-watersheds based on erosion risk, while explicitly capturing the causal interactions among drivers. Model inputs for this study were sourced from open-access Earth Observation (EO) datasets, thereby ensuring both scalability and reproducibility. Biophysical factors were identified through a comprehensive systematic review conducted between 2004 and 2024, complemented by field observations. These factors will subsequently be categorized into five groups: topographic, climate, geology, hydrogeomorphology, morphometry, and land cover management. An expert evaluation will be conducted to develop the Multi-Criteria Decision-Making (MDCM) model, and sub-watersheds will be ranked and prioritized accordingly. Although model outputs have not yet been generated, this methodological preview delineates the comprehensive EO-hybrid architecture and anticipated outcomes: (1) a cause-effect diagram, (2) a spatial susceptibility map, and (3) a priority-ranked sub-watersheds map, all meticulously designed to correspond with field-observed erosion zones. The conceptual graphs and map representations maintain originality while exhibiting structural coherence. Expert feedback is solicited on the model design, weighting logic, and validation strategy to ensure robustness prior to implementation.

By integrating open Earth Observation analytics with advanced hybrid MCDM techniques, this framework not only establishes a replicable methodology for prioritizing erosion risk in catchments but also aims to enhance evidence-based watershed management, agricultural planning, and land-use policy.

Keywords:

Earth Observation, soil erosion, sub-watershed, biophysical factors, MCDM

6.0 CLOSING REMARKS

Ing. Prof Nana Sarfo Agyemang Derkyi

Prof, *Renewable Energy Engineering Department, UENR*

Ag. Pro, Vice Chancellor UENR

Dean, School of Energy, UENR

Coo-chair, ICEE Planning committee

The Vice-Chancellor, Distinguished Guests and Keynote Speakers, Sponsors and Partners, Members of the University community, Colleagues from academia and industry, Students, Ladies and Gentlemen.

We have come to the end of the 2nd edition of the International Conference on Energy and Engineering (ICEE 2025). Over the past two days, we have witnessed a rich exchange of ideas, presentations of cutting-edge research, and meaningful dialogue on the theme "Engineering the Future: Smart Innovations for Sustainable Energy, Agriculture, Infrastructure, and Climate Resilience."

This conference has brought together an extraordinary community of thinkers and practitioners, scientists, engineers, policymakers, industry leaders, students, and international collaborators united by a common purpose: to seek solutions that respond to the pressing challenges of our time. The breadth of the discussions, ranging from renewable energy integration, sustainable mining, intelligent manufacturing, Earth observation technologies, to climate-smart agriculture and cross-cutting issues of education, governance, and innovation, has demonstrated the diversity and richness of the engineering sciences in addressing societal needs.

Ladies and gentlemen, we have heard inspiring keynote addresses that reminded us of the urgency and opportunity of energy transitions in Ghana and across Africa. We have seen technical sessions that showcased research excellence from both seasoned scholars and emerging young scientists. We have engaged in poster presentations, exhibitions, (and field visits tomorrow) that connected theory to practice. Together, these activities have created a platform for networking, learning, and collaboration that will endure beyond this conference.

As Chairman of ICEE 2025, I am particularly encouraged by the spirit of innovation and resilience that has run through our deliberations. It is clear that engineering solutions are not abstract; they are practical tools that can help us achieve national development goals, strengthen climate resilience, and open up economic opportunities for our people. The ideas shared here, if implemented, will not only shape academic discourse but will inform policy, guide industry practice, and improve livelihoods.

At this point, it is important to express our deepest gratitude. First, to the Vice-Chancellor of UENR, Professor Elvis Asare-Bediako, for his leadership and commitment to making this conference a success. To our Honourable dignitaries who graced us with their presence and words of encouragement, we are truly grateful. To our keynote speakers, both from Ghana and abroad, we extend our appreciation for sharing your expertise and insights. To our sponsors and partners-RCEES, the Volta River Authority, Electricity Company of Ghana, Bui Power Authority, GNPC, Petroleum Commission, Bulk Oil Storage and Transportation Company, Ghana Institution of Engineering, Zoomlion, Associated Consultants, and many others-we acknowledge your invaluable support. Without your investment, this conference would not have been possible.

Special thanks also go to the Planning Committee, the Technical Committee, and the administrative staff whose tireless efforts ensured that every detail of this conference was attended to. To the moderators, rapporteurs, volunteers, and the student community who supported us in diverse ways, we say a heartfelt thank you.

Ladies and gentlemen, as we close, let us remember that the true success of this conference will not be measured by the number of papers presented or the sessions held. It will be measured by how we translate the knowledge gained here into action - in our research labs, in our classrooms, in our companies, in our policies, and in our communities. Let us take forward the networks we have built and the ideas we have exchanged, and turn them into collaborations that will deliver tangible outcomes for Ghana and beyond.

On behalf of the University of Energy and Natural Resources and the ICEE 2025 Planning Committee, I extend my gratitude to all of you for participating. I wish our international guests safe travels back home, and to our local participants, I encourage you to remain connected and engaged with the ICEE platform as we prepare for the next edition.

With these words, I formally declare the 2nd edition of the International Conference on Energy and Engineering successfully closed.

Thank you, and may we all continue to engineer a sustainable and resilient future together.

APPENDICES

APPENDIX A: LIST OF PARTICIPANTS

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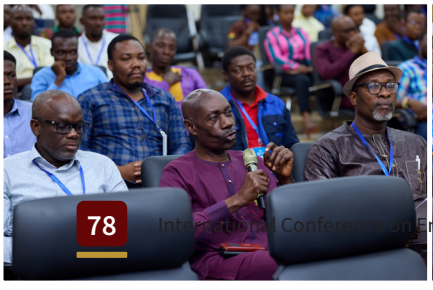



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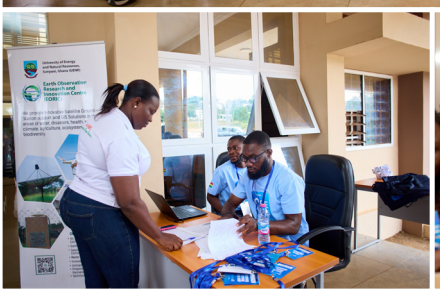









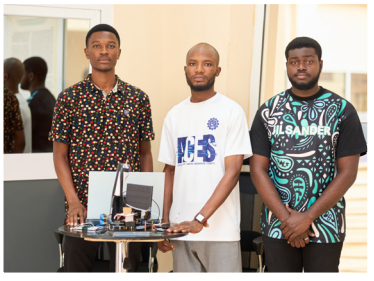

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