BOOK OF ABSTRACT

CONFERENCE PROCEEDINGS

CEAT2025
Kuala Lumpur, Malaysia

1ST & 2ND OCTOBER 2025
WYNDHAM GRAND BANGSAR
KUALA LUMPUR

AUN/SEED-Net Regional Conference towards Carbon Neutrality

in association with

The 7th Clean Energy and Technology International Conference

Zulhadi Iskandar Radzi
Asiful Habib
Norridah Amin

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AUN/SEED-Net Regional Conference towards Carbon Neutrality in association with

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Conference Topics
Renewable Energy
Energy Efficiency, Conservation and Sustainability
Net-Zero Emissions & Carbon Neutrality
Smart Grid
Electric Vehicle Technology
Energy Policy and Carbon Management
Hydrogen Economy
Environmental, Social and Governance

AUN/SEED-Net Regional Conference towards Carbon Neutrality in association with The 7th Clean Energy and Technology International Conference

1st & 2nd October 2025 Wyndham Grand Bangsar, Kuala Lumpur, Malaysia

26 September 2025

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FOREWORD

Assoc. Prof. Ts. Dr. Md. Hasanuzzaman
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The 7th International Conference on Clean Energy and Technology 2025
Higher Institution Centre of Excellence (HICoE)
UM Power Energy Dedicated Advanced Centre (UMPEDAC), Universiti Malaya
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The AUN/SEED-Net Regional Conference towards Carbon Neutrality, in association with the 7th Clean Energy and Technology International Conference (CEAT2025), continues the tradition of bringing together leading academics, researchers, industry practitioners, and policymakers to exchange ideas and explore solutions in the field of clean energy. With the theme "Towards Carbon Neutrality", this biennial conference serves as a multidisciplinary platform to address emerging challenges and opportunities in renewable energy, energy efficiency, sustainable technologies, and carbon-neutral pathways.

CEAT2025 is organized by the Higher Institution Centre of Excellence (HICoE), the UM Power Energy Dedicated Advanced Centre (UMPEDAC), Universiti Malaya, with support from regional and international partners. Backed by the ASEAN University Network / Southeast Asia Engineering Education Development Network (AUN/SEED-Net) and the Ministry of Higher Education (MOHE), the conference is held in association with the AUN/SEED-Net Regional Conference to strengthen regional cooperation and knowledge exchange. CEAT2025 is co-organized with Universiti Tun Hussein Onn Malaysia (UTHM), Universitas Telkom (Indonesia), Universiti Tenaga Nasional (UNITEN), Universitas Negeri Padang (Indonesia), Universiti Teknologi MARA (UiTM), Universiti Kuala Lumpur (UniKL), Universiti Teknikal Malaysia Melaka (UTeM), Universiti Malaysia Sarawak (UNIMAS), and Sunway University, whose contributions further reinforce the collaborative spirit of this event.

This year, CEAT2025 is hosted in Kuala Lumpur, Malaysia, from October 1-2, 2025, and proudly features a diverse range of conference topics, including renewable energy, smart grids, electric vehicle technology, hydrogen energy, and climate governance. Accepted papers will be published in SCOPUS-indexed proceedings, reflecting the academic and practical impact of the work presented.

We extend our warm appreciation to all participants, presenters, keynote speakers, reviewers, co-organizers, and partners for their invaluable contributions toward making CEAT2025 a success. We are confident that the discussions and collaborations forged here will advance the global effort to achieve carbon neutrality and a sustainable energy future.

EVENT PROGRAM

Day 1 – 1st October 2025	
OPENING CEREMONY **Level 2 (Ballroom 2)**	
Registration	*8:00 am - 9:00 am*
National Anthem & Recital of Doa	*9:15 am - 9:20 am*
Welcoming Remarks *Professor Ir. Dr. Jeyraj Selvaraj (HICoE UMPEDAC Executive Director)*	*9:20 am - 9:25 am*
Opening Speech *Professor Ir. Dr. Kaharudin Dimyati* *Deputy Vice-Chancellor (Research & Innovation)* *Universiti Malaya*	*9:25 am - 9:35 am*
Officiating Speech *Mdm Sugawara Minako* *Chief Representative (JICA Malaysia)*	*9:35 am - 9:45 am*
Conference Launching & Best Paper Award *Photo Session*	*9:45 am - 10:00 am*
Coffee Tea Break *(Foyer Ballroom 2)*	*10:00 am - 10:10 am*
KEYNOTES SESSION **Level 2 (Ballroom 2)**	
KGC Resources Sharing Session	*10:10 am - 10:20 am*
Keynote 1 *Dr. Feroz Sultan @ Maung Maung Myo Thant* *General Manager* *PETRONAS Group Technology & Commercialization* *Title: From Invention to Innovation: Driving Clean Energy Innovation at Scale*	*10:20 am - 10:50 am*
AUN/SEED-Net Presentation *Ms. Tonghathai Likhitweerawong* *Title: AUN/SEED-Net: Advancing Engineering Collaboration for a Sustainable ASEAN*	*10:50 am - 11:10 am*
AEJ Presentation *Prof. Dr. Norhazilan Md Noor (Editor-in-Chief AEJ)* *Title: ASEAN Engineering Journal: Achievements, Impact, and Opportunities for Researchers*	*11:10 am - 11:30 am*
Keynote 2 *Prof. Dr. Benjamin C McLellan* *Graduate School of Energy Science, Kyoto University, Japan* *Title: Justice Considerations in Resource Supply Chains for Clean Energy Transitions In ASEAN*	*11:30 am - 12:00 pm*

Lunch *(Annexe 1, Level 2)*	*12:00 pm - 2:00 pm*
WORKSHOPS AND PARALLEL SESSIONS **Level 3 (Studio 1, 2, 3, 9,10)**	
Mock Interview Session *Studio 1*	*2:00 pm - 3:40 pm*
Parallel Sessions *Studio 2, Studio 3, Studio 9, Studio 10*	*2:00 pm - 3:40 pm*
Coffee Tea Break *(Foyer, Level 3)*	*3:40 pm - 3:55 pm*
Parallel Sessions *Studio 2, Studio 3, Studio 9, Studio 10*	*3:55 pm - 5:30 pm*
END OF DAY 1	

Day 2 – 2nd October 2025	
WORKSHOPS AND PARALLEL SESSIONS **Level 3 (Studio 1, 2, 3, 9,10)**	
Parallel Sessions *Studio 2, Studio 3, Studio 9, Studio 10*	*9:00 am - 10:40 am*
Coffee Tea Break *(Foyer, Level 3)*	*10:40 am - 10:55 am*
Hardware-In-the-Loop Test Systems for Power Converters and Microgrid *by Driss Yousfi, Professor* *ENSA - Mohammed First University, Oujda Morocco* *Studio 1*	*10:55 am - 12:55 pm*
Parallel Sessions *Studio 2, Studio 3, Studio 9, Studio 10*	*10:55 am - 12:55 pm*
Lunch *(Annexe 1, Level 2)*	*12:55 pm - 2:00 pm*
Parallel Sessions *Studio 2, Studio 3, Studio 9, Studio 10*	*2:00 pm - 4:20 pm*
Coffee Tea Break *(Foyer, Level 3)*	*4:20 pm - 4:40 pm*
END OF DAY 2	

KEYNOTE SSESIONS

Keynote Speaker

Dr. Feroz Sultan @ Maung Maung Myo Thant
General Manager
PETRONAS Group Technology & Commercialization

Title: *From Invention to Innovation: Driving Clean Energy Innovation at Scale*

Biography

Dr. Feroz is a General Manager at PETRONAS Group Technology & Commercialization, where he leads the research and development of the Renewable Energy Technology Program. He is responsible for new technologies development in the area of renewable energy generation, energy storage and intelligent energy management system as well as green mobility supporting PETRONAS Energy Transition Strategy towards achieving net zero. With 22 years of industry experience, he also has expertise in hydrogen technologies, sand control and management, produced water management, digital twin of production facilities, and net-zero carbon facilities.

Dr. Feroz's academic credentials are equally impressive, holding a B.Eng. (Hons.) in Mechatronics Engineering from International Islamic University Malaysia and a Ph.D. in Chemical Engineering from Imperial College London. As inventor at heart, he has secured six patents, six copyrights, and trade secrets in the areas of sand management, flow assurance, and upstream production technologies.

Dr. Feroz's contributions to the industry have been recognized with several awards, including the prestigious 2022 SPE Regional Award for Production and Operations in the Northern Asia Pacific Region. He is known for his innovative thinking and values building relationships and teamwork. He is a mentor to young engineering talents and believes in nurturing future successors. His role as a General Manager of the Renewable Energy Technology Program is a testament to his leadership and commitment to advancing the frontiers of clean energy technology. His vision and expertise continue to drive innovation and progress within the renewable energy sector. He is inspired by the saying of Elon Musk, "People should pursue what they're passionate about. That will make them happier than pretty much anything else."

Keynote Speaker

Professor Benjamin C. McLellan
Graduate School of Energy Science
Kyoto University, Japan

Title: *Justice Considerations in Resource Supply Chains for Clean Energy Transitions In ASEAN*

Biography

Professor Benjamin C. McLellan has been with the Graduate School of Energy Science at Kyoto University since 2010. He previously served as a Postdoctoral Research Fellow at the University of Queensland (2006–2010), where he also completed his bachelor's degrees and PhD. He currently leads a dynamic research group of around 30 members, including postdoctoral fellows, PhD candidates, master's students, and research scholars. His work focuses on critical minerals, just energy-resource transitions, and sustainability, with particular interests in hydrogen and deep-sea mining. Beyond these themes, he even explores the role of coffee in sustainable systems. Over the course of his career, he has authored or co-authored more than 140 journal articles and a comparable number of conference papers across a wide range of energy and resource-related topics.

Professor McLellan is presently in Australia on a Japan Foundation Fellowship and serves as Editor-in-Chief of Resources (MDPI).

CONTENTS

Research Topic 1: Renewable Energy

Paper ID: 13 *Electrochemical Analyses of Eight Electrogenic Bacteria in Microbial Fuel Cells: Insights into their Electron Transfer Mechanisms*

Abdul Azeez Olayiwola Sirajudeen[1,2], Mohamad Suffian Mohamad Annuar[3], Shaliza Ibrahim[1], Wasiu Ayodele Abibu[4], Mohd Arif Dar[5], Siti Rohana Majid[5]
[1]AAIBE Chair of Renewable Energy Program, Institute of Sustainable Energy, Universiti Tenaga Nasional, 43000 Kajang, Selangor, Malaysia
[2]Department of Biological Sciences, College of Natural and Applied Sciences, Crescent University, 110001 Abeokuta, Nigeria
[3]Department of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur, Malaysia
[4]Department of Microbiology, College of Biosciences, Federal University of Agriculture, 110111 Abeokuta, Nigeria
[5]Centre for Ionics University Malaya, Department of Physics, Universiti Malaya, 50603 Kuala Lumpur, Malaysia

Electrogenic bacteria's electron transfer mechanisms in MFCs remain unclear, requiring electrochemical analysis of eight species for insights. This study evaluates eight bacterial strains in dual-chamber MFCs using cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and polarization analyses. P. aryabhattai AAS003 recorded the highest power density (PD) of 240 mW/m². Bacillus albus TAJ01 achieved impressive PD (206 mW/m^2) with efficient direct electron transfer (redox peaks at 686/183 mV, 69 Ω resistance). B. thuringiensis TAJ03 and Klebsiella pneumoniae CUAB-MS showed mediator-assisted transfer (peaks at 627/601 mV). B. velezensis TAJ02, B. cereus TAJ04, and Priestia strains relied on less efficient mediated transfer, while Escherichia coli produced minimal power (88 mW/m^2) despite a 701 mV peak, hindered by poor biofilm conductivity. TAJ01 and TAJ03 exhibited the lowest internal resistances (69 – 126 Ω), highlighting electron transfer mechanisms as key to MFC optimization.

Paper ID: 14 *Impacts of POME Dilution on Current Generation, COD Removal Efficiency, Cyclic Voltammetry Profiles, and Internal Resistance in Microbial Fuel Cells*

Abdul Azeez Olayiwola Sirajudeen[1,2], Mohamad Suffian Mohamad Annuar[3], Shaliza Ibrahim[1], Siti Rohana Majid[4]
[1]AAIBE Chair of Renewable Energy Program, Institute of Sustainable Energy, Universiti Tenaga Nasional, 43000 Kajang, Selangor, Malaysia
[2]Department of Biological Sciences, College of Natural and Applied Sciences, Crescent University, 110001 Abeokuta, Nigeria
[3]Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur, Malaysia
[4]Centre for Ionics University Malaya, Department of Physics, Universiti Malaya, 50603 Kuala Lumpur, Malaysia

This study examines how palm oil mill effluent (POME) dilution affects microbial fuel cell (MFC) performance. Testing 10%, 40%, 70%, and 100% POME dilutions, the 10% dilution yielded the highest power density (62 mW/m2), current density (322 mA/m2), COD removal (66.5%), and coulombic efficiency (15%), with low internal resistance (95 Ω) and a clear oxidation peak (610 mV). The 40% dilution showed moderate performance (34 mW/m2, 168 mA/m2, 52.3% COD removal), while 70% and 100% had poor outputs (≤4.2 mW/m2, ≤42.1% COD removal) and high resistance (407–560 Ω), indicating inhibited electron transfer. Optimal MFC efficiency requires lower POME concentrations, as undiluted POME causes system inefficiencies.

Paper ID: 25 *Biomethane Production from Durian Shell: A Synergistic Inoculum and Buffer Approach*

Nurul Nadhirah Amalina[1], Amir Izzuddin[2], Mei Yin Ong[2], Saifuddin Nomanbhay[2]
[1]Department of Mechanical Engineering, College of Engineering (COE), Universiti Tenaga Nasional (UNITEN), Kajang, Selangor, Malaysia
[2]Institute of Sustainable Energy (ISE), Universiti Tenaga Nasional (UNITEN), Kajang, Selangor, Malaysia

The growing global population has led to a significant increase in annual food waste, posing serious environmental and waste management challenges. One promising approach to mitigate this issue is the conversion of food waste into value-added products through anaerobic digestion (AD), a biological process that produces biogas—primarily methane. While methane is a renewable energy source, its production efficiency can be influenced by various operational parameters. This study explores the valorization of durian shell waste, a locally abundant lignocellulosic biomass in Malaysia, through AD. Two experimental strategies were employed: (i) optimizing the inoculum ratio of cow dung (CD) to ragi tapai (RT), and (ii) evaluating the effect of sodium phosphate buffer molarity under reduced inoculum conditions. Among the tested inoculum ratios, the highest methane content (37.8%) was achieved with a 3:2 CD:RT ratio after 15 days at ambient temperature (~28 °C), highlighting the synergistic role of methanogenic and hydrolytic microbes. In a separate trial, 0.2 M phosphate buffer yielded 36.8% methane despite a lower cow dung load, demonstrating that sufficient chemical buffering can sustain methane production with reduced organic inoculum input. These findings underscore the potential of integrating

traditional microbial sources and controlled buffering to enhance AD efficiency. This dual-approach strategy offers a cost-effective and scalable pathway for biogas generation from food waste, contributing to circular economy goals and sustainable energy development in resource-limited settings.

Paper ID: 32 *Effects of Torrefaction Pre-Treatment on Bio-Coke Properties*

Norain Abdullah[1], Tamio Ida[1]
[1]Bio-coke Research Institute, Kindai University, Higashiosaka, Osaka, 577-8502, Japan

In recent years, environmental issues have gained significant global attention. Among these concerns, the impact of carbon dioxide (CO_2) emissions on climate change has sparked widespread discussion, emphasizing the urgent need for sustainable energy solutions and the pursuit of carbon neutrality, which means having balance between emitting carbon and absorbing carbon from the atmosphere. In particular, iron and steel industries are the largest carbon emitters, and also require a lot of fossil fuels such as coal, coal cokes and so on. Due to this, biomass or biomass-based energy are being explored as viable alternatives. Aligning to this aim, bio-coke, a solid biofuel which densified from biomass, emerges as a promising substitute due to its high density, high mechanical strength and good combustion characteristics, especially for iron and steel industries application. However, to have a better combustion property near to that of coal coke, torrefaction treatment is a promising method. Present study explores the properties of bio-coke by using torrefied green tea. The raw green tea undergoes torrefaction treatment with varying temperatures for 1 hour with a heating rate of 1K/min, which then densifies into bio-coke. After that, the density, compressive strength, and the calorific value were calculated. The results indicate that the density and mechanical strength of the bio-coke decrease as the torrefaction treatment temperature increases, while the calorific value improves. These findings suggest that the properties of bio-coke can be enhanced when torrefaction treatment is applied.

Paper ID: 35 *Improving the Efficiency of Terthiophene Cyanoacrylic Acid Based Dye-Sensitized Solar Cells for Water Photosplitting Using Substituents*

Thomas Ojonugwa Daniel[1]
[1]Department of Physics, Faculty of Physical Sciences, Alex Ekwueme Federal University Ndufu-Alike, P.M.B 1010, Ebonyi State, Nigeria.

A challenge before mankind is the need for sustainable energy and the urge to reduce the impacts of pollution from the use of fossil fuels. Hydrogen, which can be obtained via water photosplitting using a low cost dye sensitized solar cell (DSSC), is a proven solution. The power conversion efficiency of DSSC, whose ability to absorb light in the visible spectrum is of research interest towards hydrogen production, is influenced by a number of dye-related factors. Using the NKX-2697 organic dye as the primary structure, with coumarin as the donor, terthiophene group as the π-linker and cyanoacrylic acid as the acceptor, this computational study (DFT and TD-DFT) examines the effects of substituting different electron-donating groups on the dye efficiency by examining the geometry, excited states, light absorption capacity and Stark effect. Three novel dyes (named NKX-2697-1, NKX-2697-2 and NKX2697-3) were identified from the reference coumarin NKX-2697 dye. Both NKX-2697 and NKX-2697-2 derivatives were identified to be more effective with an improved energy band gap, maximum absorption wavelength and photosensitization properties.

Paper ID: 50 *Phase Change Materials with Piezoelectric-Doped Graphene Nanocomposites: Supercapacitor in $GBa^{2+}GMn^{2+}$ Advancing Technology for Next-Generation Energy Storage Devices*

Sikiru Surajudeen[1,2], Olalekan[3], Mohd Muzamir Mahat[1]
[1]School of Physics & Materials Studies, Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor Darul Ehsan, Malaysia
[2]Sustainable Energy Materials Laboratory, Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor Darul Ehsan, Malaysia
[3]Department of Electronic & Communication Engineering, Graphic Era (Deemed to be University), Dehradun, Uttarakhand 248002, India

The study explores the development of advanced nanocomposites, specifically $BaTiO_3$, MnO_2, and their hybrids with graphene oxide (GO), to enhance supercapacitor performance. The inclusion of GO led to improved surface area and conductivity, while FTIR and Raman spectroscopy confirmed successful composite formation. X-ray diffraction analyses showed that GO introduction partially disrupted crystallinity, providing more accessible sites for ion transport. Electrochemical characterisations showed significant improvements in the $BaTiO_3$-GO and MnO_2-GO composites, with higher current response, better reversibility, and lower charge transfer resistance compared to their pure counterparts. $BaTiO_3$ has a limited redox reaction of (~±0.0025 A), MnO_2 redox reaction of (~0.25 V and -0.25 V), $BaTiO_3$-GO demonstrates enhanced current

response (~±0.0004 A) while MnO_2-GO shows broader, symmetric redox peaks (±0.22 V), with improved peak currents (±0.06 A).

Paper ID: 61 *Implementation Design of Solar Powered SYCLER (System of Cycling for NPK Fertilizer)*

I G P O I Wijaya[1,2], S P Jati1, R M Shiddiq[1], S Senin[1], E Kurniawan[1,2] and S Setiyadi[1]

[1]School of Electrical Engineering, Telkom University, Bandung, Indonesia
[2]Center of Excellence of Sustainable Energy and Climate Change, Telkom University, Bandung, Indonesia

A demand for technology that can streamline the NPK fertilizer production process to lighten the burden on farmers and increase agricultural productivity. Therefore, innovation in designing technology to produce NPK fertilizer independently and sustainably is proposed. In this study, it was conducted on the case of a potato farmer in Arjasari Village, Bandung. The innovation implemented in this project is the use of solar panels as a free energy source for the practical NPK fertilizer composting tool. The most valuable aspect of this research is the benefits that farmers can experience from the presence of the Sycler, which include energy efficiency, and more promising NPK fertilizer production compared to conventional methods. Through enhanced fertilizer due to a composting cycle that is four times more than conventional methods, farming costs are reduced by 75%.

Paper ID: 64 *Techno-Economic Analysis of Solar Power Plant Development in Cimahi Train Station: A Comparative Study of On-Grid and Off-Grid Scenarios for Energy Transition*

Kharisma Bani Adam[1,2], Ihsan Maulidin[3]

[1]Energy System Engineering, Telkom University, Jl. Telekomunikasi, Terusan Buah Batu, Dayeuh Kolot, Sukapura, Bandung, 40257, Indonesia
[2]Center of Excellence of Sustainable Energy and Climate Change, Telkom University, Bandung, Indonesia
[3]Master of Electrical Engineering, Telkom University, Jl. Telekomunikasi, Terusan Buah Batu, Dayeuh Kolot, Sukapura, Bandung, 40257, Indonesia

Commercial sector interest in solar photovoltaic (PV) systems has increased due to the growing need for clean energy and the pressing need to move away from fossil fuels. This study compares hybrid and off-grid photovoltaic systems to provide a techno-economic analysis of the development of solar power plants in Cimahi train station. In addition to simulated annual energy production data based on regional solar irradiation, the analysis uses a 24-hour load profile from a sample area in Cimahi. P10, P50, and P90 probability scenarios were used for reliability analysis, which provided information on the anticipated range of solar energy yields over the system's 25-year lifespan. Using factors like investment cost, energy price, discount rate, and system degradation, Net Present Value (NPV) calculations for the P50 scenario were used to assess the financial feasibility. As a result, the on-grid system outperformed the off-grid system, which reached a peak NPV of approximately IDR 300,000,000 at 30–35 kWp, and reached the highest NPV of around IDR 520,000,000 at 40 kWp capacity. The study concludes that installing an appropriately sized on-grid photovoltaic system offers a more practical way to maximize energy production and financial returns, thus helping the area transition to sustainable energy.

Paper ID: 65 *Evaluating the Optimal Pitch for Bifacial PV Arrays: A Tropical Case Study with and without Land Constraints*

Nur Diyana Nadirah Fuadi[1], Hedzlin Zainuddin[1], Shahril Irwan Sulaiman[2] and Nurmalessa Muhammad[1]

[1]Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia
[2]Faculty of Electrical Engineering, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia

This study investigated the optimal pitch for bifacial photovoltaic arrays under two distinct spatial conditions: with and without land constraints. Optimal pitch was denoted as the row spacing that maximized the specific energy yield while accounting for shading, albedo gain, and land utilization. Simulations were conducted under tropical climate region, for a site in Ijok, Selangor, Malaysia, at a fixed tilt angle of 5°, covering three case studies. The three case studies differed by varying PV module portrait layout configurations, which Case A was for one module arranged in height (2.38 m); Case B was for two modules arranged in height (4.79 m) and Case C was for three modules arranged in height (7.19 m). For each case, a third-degree polynomial regression was employed to analyze the relationship between pitch and specific yield. Results revealed a saturation trend, whereby the gain in specific yield diminished beyond a certain pitch, indicating an optimal point. Under space-constrained conditions, the optimal pitch ranged from 4.2 to 8.4 meters, with corresponding specific yields between 1498–1552 kWh/kW_p/year. In contrast, the unconstrained condition allowed a clearer observation of the energy yield plateau without compromising capacity. The findings will serve as a practical guide for PV system designers in determining the optimal pitch of bPV system to maximize energy output while minimizing

unnecessary land usage, highlighting the trade-off between maximizing bifacial gain and efficient land use.

Paper ID: 66 *COOPS: Cogeneration Optimization Simulator Through Real Data Processing and Control Through LabVIEW*

Oon Erixno[1,2], Farah Ramadhani[1,2], Mohd Syukri Ali[3]
[1]Energy System Engineering Study Program, School of Electrical Engineering, Telkom University, Main Campus (Bandung Campus), Jl. Telekomunikasi no.1, Bandung 40257, West Java, Indonesia
[2]Center of Excellence for Sustainable Energy and Climate Change, Research Institute for Intelligent Business and Sustainable Economy, Main Campus (Bandung Campus), Jl. Telekomunikasi no.1, Bandung 40257, West Java, Indonesia
[3] Higher Institution Centre of Excellence (HICoE), UM Power Energy Dedicated Advanced Centre (UMPEDAC), Universiti Malaya, Kuala Lumpur, Malaysia

This paper presents the Cogeneration Optimization Simulator (COOPS), which is a LabVIEW-based software designed to optimize cogeneration systems. The COOPS integrates real-world data, including solar irradiance, ambient temperature, electrical and thermal loads, and closed-loop control to enhance system performance. It features a validated mathematical model of components to ensure accurate predictions and control decisions that optimize energy output and minimize waste. The COOPS offers a user-friendly interface with real-time monitoring, graphical analysis, annual reports, and assessments covering energy, cost, and emissions. Performance tests confirm COOPS' ability to execute complex cogeneration simulations efficiently and offer users an intuitive visualization of operations. Its flexibility makes it suitable for diverse industrial cogeneration setups and subsequently contributes to improved energy management and sustainability.

Paper ID: 71 *Development of a Photovoltaic Real Simulator for Educational Use in Renewable Energy System Analysis*

Bramantya Indracahya[1], Oon Erixno[1,2], Satrio Pambudi Jati[1], Samuel Senin[1], Basuki Rahmat[1,2], Jaspar Hasudungan[1,2], I Gede Putu Oka Indra Wijaya[1,2]
[1]Energy systems engineering program, School of Electrical Engineering, Telkom University, Bandung, Indonesia
[2]Centre of Excellence Sustainable Energy and Climate Change, Telkom University, Bandung, Indonesia

This research presents the development of a photovoltaic real simulator (PVRS) for educational use. The system was built using an Arduino Mega 2560 microcontroller as a controller, which interfaces with sensors to measure solar irradiance, temperature, voltage, and current. Measured data are processed and transmitted in real time to a computer through serial communication and displayed in an interactive graphical user interface (GUI) using LabVIEW. To connect the controller and the GUI, a simple protocol was also developed for data transmission and supports local data storage through an SD card module with time synchronization. Experimental testing was conducted using both series and parallel PV panel configurations under varying irradiance levels. The results showed that the series configuration provided higher voltage but lower current, while the parallel configuration produced higher current but lower voltage. This simulator not only enables the observation and analysis of PV performance directly through real-time data visualization but also enhances the conceptual understanding of solar energy systems and electrical configurations. The developed system proves to be a valuable and accessible educational tool for renewable energy learning and experimentation.

Paper ID: 76 *Impact of Renewable Energy Penetration on Load Flow and Transient Stability in in Small-Scale Electrical System*

Lindiasari Martha Yustika[1,2], Affan Fathur Rabbani[3], Rifki Rahman Nur Ikhsan[1,2]
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The paper investigates the impact of integrating renewable energy specifically photovoltaic into small-scale using IEEE 9 BUS. The study focused on load flow and transient stability. Simulations were conducted using ETAP to analyse changes in power distribution, system losses, voltage profiles, and dynamic responses. The results show that PV integration significantly reduces the active and reactive power on synchronous generators, improves voltage stability. A transient disturbance analysis reveals that the system maintains stability after PV connection, indicating its ability to absorb fluctuations and return to steady-state. The findings underscore the importance of reactive power compensation when integrating inverter-based renewable sources into conventional grids.

Paper ID: 85 *The Influences of Macro-Environmental Factors on Renewable Energy Development*

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The development of renewable energy (RE) is essential for combating climate change, reducing fossil fuel dependency, and enhancing long-term energy security. However, progress in Malaysia remains slow, with renewable energy contributing less than 20% to Malaysia's electricity mix. Guided by Institutional Theory, this study investigates the influences of political, economic, social, and technological (PEST) factors on renewable energy development. A sample of 98 managers, whose companies had voluntarily adopted RE activities, participated in the online survey. Using Partial Least Squares Structural Equation Modelling (PLS-SEM), the study evidenced that political and social factors significantly influence RE development, but not for economic and technological factors. It is implied that challenges such as inconsistent incentives, high capital costs, and limited technology transfer may reduce the impact on renewable energy development. The findings offer valuable insights for policymakers and industry practitioners to refine strategies that promote renewable energy development through government policies and community expectations.

Paper ID: 88 *Tuning the pH: Unlocking the Growth Potential of Nannochloropsis Sp.*

Jassinnee Milano[1], Yew Pei Juan[1], Saiffuddin Nomanbhay[1], Sieh Kiong Tiong[1], Shir Reen Chia[1,2], Hwai Chyuan Ong[3], Surya Dharma[4]

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Microalgae have attracted considerable attention as a sustainable resource for biofuel production, carbon sequestration, and aquaculture feed, due to their fast growth and ability to produce high-value compounds. Nannochloropsis sp., in particular is a marine microalga well known for its high lipid content, especially eicosapentaenoic acid (EPA), and its adaptability to varying environmental conditions. Optimising the culture parameters is essential to maximise biomass yield and support large-scale cultivation. This study aims to determine the optimal pH level for maximising the growth and biomass yield of Nannochloropsis sp. over a 7-day cultivation period. The microalgae were grown in controlled laboratory conditions, and their growth was monitored every two days using optical density (OD) at 600 nm with a spectrophotometer. Biomass concentration was estimated based on OD readings using a pre-determined regression model. The results showed that pH 8.2 provided the most favorable conditions for Nannochloropsis sp. growth, achieving the highest OD value of 0.200 and biomass concentration of 0.076 g/L by Day 7. Cultures grown at pH 8.6 also performed moderately well, while those at lower pH levels (7.0 to 7.8) exhibited limited or stagnant growth. Enhanced growth at pH 8.2 is likely due to optimal enzymatic activity and increased availability of inorganic carbon (bicarbonate), supporting efficient photosynthesis. These findings underscore the importance of pH control in microalgae cultivation systems and provide useful insights for optimising Nannochloropsis sp. biomass production in commercial and environmental biotechnology applications.

Paper ID: 89 *Four-Ball Tribometry of Calophyllum Inophyllum Biodiesel: Assessing Lubrication Performance, Coefficient of Friction, And Wear Behavior*

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This study investigates the lubricating properties of Calophyllum inophyllum biodiesel through a standardised four-ball wear test in accordance with ASTM D4172. The experiment was performed using a fixed load of 392.4 N, with a spindle rotating at 1200 rpm, and the temperature maintained at 348.15 Kelvin for a period of one hour. Essential tribological metrics, such as the coefficient of friction and wear scar diameter, were measured to assess the biodiesel's effectiveness in preventing wear. The results indicated that Calophyllum inophyllum biodiesel exhibited a stable and low average CoF of 0.07 and an average WSD of 405.92 µm, suggesting good lubricating efficiency compared to conventional diesel. To gain deeper insight into the wear behaviour, the worn surfaces of the test samples were observed using Scanning Electron Microscopy (SEM). The SEM micrographs revealed relatively smooth wear

paths with minimal surface degradation, indicating a protective lubricant layer. Additionally, Energy Dispersive X-ray spectroscopy (EDX) was utilised to determine the elemental composition of the worn areas. The EDX results indicated the presence of oxygen-rich compounds, likely resulting from the biodiesel's inherent chemical structure, contributing to surface passivation and reduced wear. These results highlight the potential of CI biodiesel as an eco-friendly lubricant or fuel additive in high-performance tribological systems.

Paper ID: 94 *An Indoor Light-based Energy Harvesting System for Powering Wireless Motion Sensor*

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Indoor solar energy harvesting has emerged as a promising solution for powering wireless sensor networks (WSNs) and internet of things (IoTs) applications in smart buildings. It is essential to extend a rechargeable battery lifespan by continuously trickle-charging from ambient light, reducing deep discharges and replacement needs. Hence, this paper presents the design and evaluation of an indoor light-based energy harvesting system for powering wireless motion sensor. The system utilizes solar panels to convert ambient indoor light into electrical energy. Then, the electrical energy will be used to charge the rechargeable battery of wireless motion sensor. The experimental results demonstrate the system's performance under varying light intensities and with different solar panel types such as monocrystalline and polycrystalline solar panels. Besides, the battery charging time of the system was also studied. The findings revealed that monocrystalline solar panels are highly efficient in converting light energy into electricity and the voltage rises gradually during battery charging. Thus, the study highlights the potential of indoor light-based energy harvesting as a sustainable solution for low-power wireless devices.

Paper ID: 103 *Emerging Flexible Materials for Energy Storage Devices*

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With the widespread adoption of electric vehicles across the globe in hopes of reducing carbon emissions, the demand for safe, fast charging, and high energy density energy storage devices have surged. While conventional lithium-ion batteries that are powering most of the electric vehicles on the market are utilizing liquid electrolytes due to their high ionic conductivity and ease of preparation, they present potential risks of thermal runaway due to leakage of electrolyte or short circuit due to damage to the battery pack while driving. Moreover, the range of electric vehicles drops significantly in cold weather due to the freezing of liquid electrolytes leading to low ionic conductivity and thus low energy density. Hydrogel polymer electrolytes are promising alternatives to liquid electrolytes as they possess similar ionic conductivity to liquid electrolytes while having no risk of leakage as they trap water within their polymer matrix. Furthermore, they can be moulded into any desirable shape which enable the fabrication of energy storage devices of various shapes to fit into empty spaces of the electric vehicle to further improve the range. In addition, zwitterionic additives can be added into the hydrogel polymer electrolyte to endow anti-freezing properties, thus ensuring high electrochemical performance even in freezing temperatures, leading to negligible range drop in winter temperatures. In this research, we have synthesized a anti-freezing hydrogel polymer electrolyte with excellent electrochemical performance at low temperatures for energy storage devices.

Paper ID: 110 *Evaluation of the Temperature Variation in The Battery Pack Relative to The Cell Position*

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Lithium-ion battery is one of the key components for electric vehicles, which has evolved as a favourable type of transportation due to its environmentally friendly nature and relatively simple design.

Temperature variation during the operation of the batteries is an unavoidable phenomenon that cannot be disregarded, as it directly impacts the performance, durability, and safety of the battery. Therefore, Battery thermal management technology has been introduced, which maintains the battery temperatures within the optimal range of 15–35 °C. It also limits the maximum cell-to-cell temperature variation to less than 5°C and reduces the risk of thermal runaway. Battery thermal management systems (BTMS) can be classified as air-based, liquid-based, phase change materials (PCMs), and hybrid systems. In this research, we designed and fabricated a battery pack consisting of 20 cells. The battery pack is then operated under charging capacitance values from 1C to 3C at an interval of 0.5C. The charging and discharging phenomenon were analysed under an air-based cooling system (natural convection), and the temperatures developed across the battery packs for eight thermocouples attached at carefully selected positions are recorded. It was observed that the maximum average temperature difference between the cells placed at the centre and the cells placed at the outer side was 23 °C. Additionally, the maximum temperature is higher than the optimum safe temperature of the battery. Therefore, it is recommended for future studies to use the liquid cooling technique with different nanofluids.

Paper ID: 117 *Identifying and Matching of Solar Photovoltaic Defects Using Infra-Red Thermal and Electroluminescence Images*

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This research focuses on improving the detection of defects in solar photovoltaic (PV) panels using a combination of infrared (IR) thermal imaging, electroluminescence (EL) imaging, and deep learning algorithms (DLA). The objectives of the study are to capture IR thermal images of degraded solar panels using thermal cameras, to categorize solar PV defects based on EL images and to match the IR and EL images using AI image processing techniques. The research aims to address the challenge of efficiently inspecting and diagnosing issues in large-scale solar PV systems. The methodology involves capturing high-resolution IR and EL images of solar panels, followed by preprocessing to extract relevant features. The data is then analyzed using Convolutional Neural Networks (CNNs) and image augmentation techniques to enhance the dataset for training deep learning models. The models are evaluated through a split of training, validation, and testing datasets, with transfer learning used to improve the accuracy of defect detection. The findings reveal that the integration of IR and EL imaging, combined with AI, significantly improves the accuracy of detecting various defects such as cracks, hotspots, and delamination in solar PV panels. This approach provides a faster, more efficient, and scalable solution for monitoring and maintaining solar PV systems. The research concludes that AI-driven techniques offer a promising solution for automating solar panel inspections, enhancing their performance and longevity, and contributing to the growth of renewable energy systems.

Paper ID: 119 *2D-FEA Investigation of Hybrid Excitation Flux Switching Motor with Modular Rotor for Electric Vehicles*

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Nowadays, the increasing demand for compact, lightweight, and high-performance motors in electric vehicle systems positions the flux switching motor (FSM) as a strong candidate due to its robust rotor design. However, traditional FSMs often face limitations in magnetic flux control and torque production. Therefore, this paper presents a modular rotor hybrid excitation flux switching motor (HEFSM) designed specifically for electric vehicles. The motor is modelled using JMAG Designer v18.1, and its performance is evaluated through finite element analysis (FEA). The proposed motor is analysed in terms of flux lines, flux distribution, cogging torque, and back EMF. Simulation results reveal that the back EMF and cogging torque achieved are approximately 30 V and 20.3 Nm, respectively. The novel modular rotor configuration significantly shortens the magnetic flux path, which enhances torque density, improves magnetic flux control, and increases overall motor efficiency. This innovative HEFSM design not only bridges existing performance gaps but also offers a sustainable, manufacturable, and high-performance solution for modern electric mobility.

Paper ID: 120 *Optical and Morphological Characteristic of ZnO:Al/SiO_2 Nanorods for Enhanced Light Absorption in Dye-Sensitized Solar Cells Application*

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This study investigates the optical and morphological characteristics of ZnO, Al-doped ZnO (ZA), and ZnO:Al-SiO_2 (ZAS) nanorods prepared using a hydrothermal method. The incorporation of SiO_2 aims to enhance light absorption and surface properties, with potential relevance to dye-sensitized solar cell (DSSC) photoanode materials. UV-Vis spectroscopy showed a slight decrease in band gap with Al doping, while the addition of SiO_2 improved the overall absorbance. FESEM analysis revealed that the ZAS sample had a more compact and uniform morphology. These results suggest that the combined effects of Al doping and SiO_2 compositing can enhance the structural and optical properties of ZnO nanorods, making them promising candidates for future application in DSSC devices.

Paper ID: 123 *Effect of Using Crude Palm Oil Biodiesel on Diesel Engine Performances*

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The current scarcity of fossil fuels requires the use of alternative fuels in motor fuels, especially diesel engines and gasoline engines. One of the alternative fuels used in plant-based internal combustion engines is biodiesel fuel produced from palm oil. A comprehensive analysis is needed with the use of crude palm oil (CPO) biodiesel fuel because it still causes decreased diesel engine performances. The purpose of this study was to determine the impact of using crude palm oil biodiesel fuel on performance of diesel engine. The research method was carried out experimentally on a diesel engine by comparing the performance of engines using pure biodiesel (B100) and biodiesel (B30) fuels from CPO fuel and compared with diesel fuel (B0) as a control parameter tested by varying the engine loads. The results showed that pure biodiesel fuel (B100) can be used in diesel engines, especially in biodiesel fuel (B30) even though the engine performance is still below diesel fuel (B0). This is marked by the power of 4.24 kW and torque of 19.83 Nm at a high engine load. The use of biodiesel fuel also causes reduced thermal efficiency and increased specific fuel consumption (SFC).

Paper ID: 130 *Design and Implementation of an IoT-Enhanced Dynamic Solar Tracking and Monitoring System*

Julie Roslita Rusli[1], Muhamad Shahmi Afif Shahron[1], Izanoordina Ahmad[1], Nor Hidayah Abdul Kahar[1], Siti Marwangi Mohamad Maharum[1], Nor Shafiqin Shariffuddin[1]

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The growing demand for efficient renewable energy solutions necessitates improvements in PV system performance, particularly in addressing the limitations of fixed-angle solar panels that fail to track the sun's movement, resulting in significant energy losses. This study proposes an IoT-enhanced dynamic solar tracking and monitoring system designed to optimize solar energy harvesting by continuously aligning the panel with the sun and enabling real-time performance feedback. The system employs an ESP32 microcontroller integrated with MG995 servo motors to adjust panel orientation based on light intensity detected by LDR sensors, while key parameters such as voltage, current, temperature, and irradiance are monitored using an INA226 current sensor, voltage sensor, and LM35 temperature sensor. Real-time data is displayed on an I2C LCD and monitored remotely via the Blynk IoT platform. Experimental testing under controlled conditions revealed an increase of 8%–12% in current output and 2%–3% in voltage compared to a static panel setup. These findings demonstrate that combining dynamic tracking with IoT-based monitoring significantly enhances PV efficiency, and the system holds promise for further optimization through the integration of solar concentrators and advanced tracking algorithms.

Paper ID: 134 *Improved Grey Wolf Optimization Algorithm for Optimal Distributed Generation Sizing and Placement for Minimum Power Loss and Voltage Deviation*

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Optimal placement and sizing of DG are critical for enhancing the performance of distribution networks. Among the many optimization techniques applied for DG allocation, Grey Wolf Optimization (GWO) has shown promise; however, its reliance on the three best individuals during the position update process limits its exploration capability and increases the risk of premature convergence. Therefore, this study introduces a hybrid GWOPSO algorithm that GWO with Particle Swarm Optimization (PSO), leveraging PSO's strength in population-wide information sharing to improve solution diversity and convergence behavior. A multi-objective problem is formulated, focusing on power loss and voltage deviation, and solved using the normalization technique. The hybrid GWOPSO algorithm is validated on IEEE 33-bus distribution systems. Simulation results show that hybrid GWOPSO achieves 2.4% lower power loss and 0.3% lower voltage deviation than PSO, confirming its superior multi-objective performance.

Paper ID: 135 *Unlocking Biogas Potential from Livestock Waste in Malaysia: A Sustainable Pathway for Renewable Energy and Circular Agriculture*

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Malaysia has a thriving livestock industry that plays a vital role in the nation's agricultural sector. However, the high density of livestock farming also results in the generation of large volumes of waste, particularly manure, which poses considerable environmental challenges. This challenge, nevertheless, presents an opportunity to convert livestock waste into renewable energy, thereby promoting sustainable agricultural practices and improving manure management efficiency. This paper assesses the potential of converting livestock manure in Malaysia into biogas which predominately composed of methane as a renewable energy source and a strategy for environmental mitigation. Preliminary estimates indicate that livestock manure could yield around 1.68 billion cubic meters of methane annually which is equivalent to 3.03 billion MWh of renewable energy. An economic evaluation was also performed to assess the feasibility of biogas generation using different types of livestock manure. The analysis revealed that bioenergy projects based on chicken, cattle, and swine manure achieved internal rates of return (IRR) exceeding 13%, with average payback periods ranging from 3 to 6 years across both East and West Malaysia, indicating strong potential for commercial viability. The findings emphasize the role of the livestock sector as one of the contributors to Malaysia's renewable energy goals and environmental sustainability through the enhanced utilization of livestock biomass for biogas production.

Paper ID: 148 *Comparative Study of Lab-Scale and Upscaled Malaysia Dolomite Catalysts for Green Diesel Production*

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This study examines the impact of increasing the dolomite catalyst preparation's physicochemical characteristics and catalytic effectiveness in converting used cooking oil into green diesel from laboratory scale (100 g) to 1 kg. Catalysts were synthesised using calcination under uniform temperature, duration, and heating rate parameters. A comprehensive catalyst characterisation was performed via BET surface area, SEM, and XRD analysis, while the composition of green diesel was assessed through GC-MS. The lab-scale catalyst (CMDLS) displayed a greater surface area, larger macropores (63.07 nm), and diminished crystallinity as compared to the upscaled catalyst (CMDUS). Catalyst characterization demonstrated that CMDLS achieved superior deoxygenation efficiency (52.75 % elimination of oxygenates), enhanced hydrocarbon compound (53.68 %), and reduced coke formation. These findings highlight the necessity for meticulous optimisation of pore structure and crystallinity during scaling up to maintain catalytic efficiency.

Paper ID: 149 *A Case Study of Pilot Reactor Producing Premixed Bio-Based Fogging Solution (BFS) via Transesterification of Non-Edible Oil*

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The insatiable demand for sustainable energy sources has driven interest in converting waste into fuels. Here, a case study on a batch-scale production of liquid carrier from waste cooking oil using an 80-litre capacity reactor is presented. The primary objective was to evaluate the feasibility and effectiveness of producing a bio-based fogging solution at a medium scale via a conventional transesterification process. For the transesterification process, this system employs a base-catalysed reaction, leading to an average yield of 62.7 %. Kinematic viscosity, density, and acid value of the liquid carrier are 4.49 mm^2/s, 871.7 kg/m^3, and 0.37 mgKOH/g, respectively, which are all within the ranges stipulated in the ASTM D6751 biodiesel standard. This work supports the practicality of converting waste into a more environmentally friendly product for insect fogging activities.

Paper ID: 152 *Development of Clean Energy Generation with Hydrogen*

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The growing need for renewable energy has necessitated researchers to come up with new and sustainable ways to produce electricity. This paper focuses on solving the challenge of developing clean energy by introducing a system that combines electrolysis and solar power for electricity generation. A 12V solar panel powers stainless steel electrodes placed in water, causing the electrolysis process which produces hydrogen and oxygen gases. The hydrogen gas is then sent into a fuel cell to create electricity. IoT technology is used for real time monitoring and better performance. Experiments show that using a KOH electrolyte can produce a maximum hydrogen fuel cell voltage of 1.2V within 10 minutes, while tap water only reaches 0.3V within the same duration. This shows how electrolyte greatly affects the system's efficiency. The study highlights the potential of combining electrolysis, hydrogen fuel cells, and IoT to improve renewable energy systems and offers a scalable solution for generating electricity sustainably.

Paper ID: 153 *Performance Analysis of Snubber Circuit Integration in Transformerless Inverters*

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Transformerless inverters are widely employed in photovoltaic (PV) systems due to their reduced cost, weight, and improved efficiency. However, the absence of galvanic isolation introduces leakage current, primarily caused by common mode voltage fluctuations. The H5 topology is a well-established transformerless inverter configuration that inherently maintains a constant common mode voltage, thereby mitigating leakage current. Nevertheless, noticeable transient spikes during switching transitions persists due to the interaction of parasitic capacitance and switch junction capacitances, contributing to residual leakage current and electromagnetic interference (EMI). This paper investigates the integration of an RC snubber circuit across the switches (S1-S4) of an H5 inverter to suppress switching transients and further reduce leakage current. A detailed performance comparison between the conventional H5 inverter and the proposed modified H5 inverter with snubbers is conducted through PSIM (version 2025) simulations. Results demonstrate that the proposed design achieves a substantial reduction in leakage current from 0.4032 mA to 0.0052 mA. These findings confirm that snubber integration not only improves switching transient suppression but also reduce leakage current in transformerless inverter applications.

Paper ID: 154 *Experimental Evaluation of Synchronous Buck Converter White-Box and Black-Box State-Space Models*

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This paper presents the system identification and validation of Synchronous Buck Converter models using both white-box and black-box approaches. The white-box methodology employs difference equations derived from continuous state-space formulations, while the black-box approach estimates second- and fourth-order state-space models. Experimental validation is carried out against laboratory measurements to evaluate the model accuracy through Root Mean Square Error. By analysing the trade-off between model fidelity and real-time feasibility, the study identifies optimal conditions for reliable real-time simulation.

Paper ID: 155 *Advancing Bioenergy: Simulation-Based Development of a Multistage Membrane System for Renewable Natural Gas from Organic Waste*

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This Renewable Natural Gas (RNG) from organic waste is emerging as critical solution to achieve national carbon neutrality targets and drive energy sustainability. To address these challenges, this study employs a simulation-based approach to design the process of multistage membrane system integrated with dry anaerobic digester (DAD) using Malaysia's organic waste for grid-compatible natural gas (>93±2 mol% CH_4). Aspen Plus® was used to develop steady-state models that include pretreatment, H2S and moisture removal, multistage membrane purification, compression, and storage. Three membrane configurations which are single-stage, two-stage, and three-stage were evaluated. Sensitivity analysis explored the effects of membrane pressure drop (8–25 bar) a nd CH_4 composition in feed gas (50–65%) on system performance. The results indicate all systems met purity requirements, with the two-stage membrane achieving the highest CH_4 purity (96.0 mol%) and the three-stage configuration maximizing recovery (94.3%) and showing resilience to feed variation. Equipment sizing confirmed feasibility of compressor, pipe, and tank designs. The model demonstrates that multistage membrane setups with strategic recycling improve product quality and recovery. These insights facilitate RNG pilot deployment and strengthen Malaysia's low-carbon transition through organic solid waste valorisation, advancing bioenergy towards the national renewable energy target.

Paper ID: 156 *An Overview: Implementation of Storage Systems for Enhancement of Solar and Wind Hybrid Systems*

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Renewable energy sources such as solar and wind are gaining prominence as sustainable alternatives to fossil fuels. However, their intermittent nature necessitates efficient energy storage systems to ensure consistent energy availability. This paper presents technical study of the role of the storage systems in enhancing the performance of hybrid solar and wind energy systems. It explores different storage technologies used in solar and wind energy systems, analysing their principles, advantages, limitations, and application scenarios. Storage systems play critical role for the enhancement of the performance of the solar and wind hybrid systems in balancing the Intermittency of Both Energy Sources, Smoothing Output Fluctuations, Peak Shaving, load Shifting and Time-of-Use Optimization, integration with Micro grids, grid Independence and Resilience, efficient Utilization of Surplus Energy

Research Topic 2: Energy Efficiency, Conservation and Sustainability

Paper ID: 1 *Design Optimization of Rings in Polymer Insulators with Quad Bundle Conductor*

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Bundled conductors are widely used design in Extra High Voltage (EHV) and ultra-high voltage (UHV) power transmission lines to reduce CR loss, line reactance, skin effect, proximity effect and improve voltage regulation and current carrying capacity of the conductor. The EHV and UHV transmission lines are subjected to CR interferences which cause radio interference, Audible noise, CR discharge, electromagnetic compatibility issues. Ring-like structures are used on the insulators to evenly distribute the E (Electric) field and reduce the CR discharge. The reduced E fields in the unsafe regions of the 765 kV and 1200 kV polymer insulator carrying four sub-conductors are suggested in this work by optimizing the design of these rings. Multi-objective Antlion Algorithm (MOALO) are used to optimize the structural parameters of these rings. Cost analysis of the optimized rings is also performed and reduction in the material cost of the rings after optimization is observed.

Paper ID: 3 *Potential Remediation of Rare Earth Element Synthetic Wastewater Containing Ammonium-Nitrogen Pollutant Using a Greener Electrocoagulation Approach*

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Electrocoagulation is a promising water treatment method that integrates coagulation and electrochemistry principles. This research investigates the efficiency of electrocoagulation in treating rare earth element synthetic wastewater containing ammonium-nitrogen pollutants using aluminium and iron electrodes. Experiments were conducted with electrochemical cells equipped with monopolar aluminium and iron electrodes connected in parallel. The study compared the treatment efficiency of both electrodes. Results indicate a strong correlation between electrode type and electrolysis duration. Aluminium achieved the highest treatment efficiency of 99.878% at 50 minutes, while iron reached 96.748% at the same duration. Statistical analysis using the General Full Factorial Design (GFFD) showed a highly significant effect of electrode type (P-value = 0.000) on treatment efficiency. However, the duration alone (P-value = 0.081) was not statistically significant. The interaction between electrode type and duration (P-value = 0.009) significantly influenced treatment efficiency. These findings suggest that electrocoagulation is an effective method for treating synthetic wastewater containing ammonium-nitrogen pollutants, compared to membrane-based treatment systems. The study highlights aluminium electrodes as more efficient than iron, emphasizing the importance of selecting appropriate materials and optimizing treatment duration for enhanced wastewater treatment efficacy.

Paper ID: 4 *Design and Optimization of CeTi-Based Composite Catalysts for Simultaneous Removal of NO_x and Toluene*

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This study developed CeTi-based composite catalysts for the simultaneous removal of NO_x and toluene. The catalysts were synthesized via the co-precipitation method and characterized using XRD, specific surface area analysis, and SEM. The $Ce_{0.5}Ti_{0.5}O_x$ catalyst achieved NO_x and toluene removal rates of 96.0% and 91.3% at 300℃, respectively, attributed to its large surface area and excellent reducibility. Additionally, calcination temperature affected catalytic performance, as excessive heat led to particle agglomeration, potentially reducing the catalytic activity of CeTi catalysts. The results indicate that Ce-Ti interactions enhance redox activity and pollutant removal efficiency, providing valuable insights for optimizing industrial air pollution control.

Paper ID: 12 *Caravan Cabin Heating Using PEM Fuel Cells in Arid Environments*

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In the Saharan desert, tourist caravans rely on photovoltaic-thermal systems to produce electricity and heat during sunny periods. However, without sufficient solar radiation, alternative energy sources are necessary to maintain thermal comfort, typically provided by high consumption, polluting conventional devices. Integrating renewable energy is essential to address these challenges. Hydrogen and fuel cells have emerged as promising solutions for electricity production. This study treats the application of PEM (proton exchange membrane) fuel cells for providing power and heat to a caravan cabin in the arid climate of southern Algeria. These fuel cells operate by compressed hydrogen transported in small cans. A biphasic model is adopted to predict the various phenomena of converting chemical energy into electricity. An array of electrical resistors is introduced to heat the caravan cabin, and the excess heat generated by the fuel cells is recovered to support the heating system. Numerical simulations are conducted using Matlab software to solve the governing equations, and the effects of various parameters on system performance are analyzed. The results indicate that the energy produced by the fuel cells is sufficient to meet the heating and electrical needs of the caravan during a cold winter night. Hydrogen consumption remains below six liters from a tank compressed at 100 bars.

Paper ID: 21 *Design of a Centrifugal Pump Permanent Magnet Motor with Line-Start Capability*

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This paper presents the design methodology of a permanent magnet motor with line-start capability, developed specifically for single-stage centrifugal pump applications. This motor configuration integrates the direct-on-line (DOL) start-up reliability of squirrel cage induction motors with the high

efficiency synchronous permanent magnet machines. The design aims to enable seamless transition from asynchronous startup to synchronous operation without the use of external controllers. Electromagnetic parameters are evaluated through analytical modelling, and the design is further validated using Finite Element Analysis (FEA). The rotor is optimized through techniques such as magnetic skewing and core shaping to minimize torque ripple and enhance transient response, meeting out IE4 efficiency.

Paper ID: 27 *Recent Advancements in the Synthesis of Bio-Based PA and PET from Biomass*

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Plastics have brought tremendous convenience to human civilization, but traditional production of plastics from fossil fuels is not sustainable and environmentally friendly. This gave rise to the research in bioplastics, which are obtained from renewable and sustainable sources, biomass. Bioplastics can be broadly divided into two classes, biodegradable and non-biodegradable bioplastics. In particular, non-biodegradable bioplastics is an attractive alternative option that has the potential to replace fossil-based plastics. This is because when compared to traditional plastics, non-biodegradable bioplastics are renewable, possess lower carbon footprint during synthesis, and resistant to degradation by microorganisms. Consequently, non-biodegradable bioplastics can be used in applications that mandate the utilization of durable and long-lasting polymeric materials. Currently, non-biodegradable bioplastics derived from biomass sources account for roughly 43.7% of all bioplastics, whereby bio-based polyamide (PA) makes up the majority, followed by bio-based polytrimethylene terephthalate (PTT), bio-based polyethylene (PE), and bio-based polyethylene terephthalate (PET). In this review, the recent advancements in the synthesis of bio-based PA and PET from biomass due to the large production of PA and ubiquitous nature of PET in the daily lives of humans.

Paper ID: 31 *Experimental Investigation of a Low-Oscillation Incremental Conductance MPPT For Enhanced Energy Harvesting in a Photovoltaic System*

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Power output fluctuations due to oscillations are persistent issue in photovoltaic systems, especially under varying irradiance. Conventional Maximum Power Point Tracking (MPPT) algorithm like incremental conductance (IncCond) often inadequately address these oscillations, degrading system efficiency. This study purposes an enhanced IncCond MPPT algorithm integrating Variable Step Size (VSS) and drift-free logic to overcome these limitations. The purposed method dynamically adjusts the tracking step based on power and voltage changes, aiming to suppress oscillation and accelerate convergence to the Maximum Power Point. Experimental validation using boost converter under real-time irradiance changes shows that the proposed algorithm effectively reduce oscillations, enhances system stability, and significantly improves tracking speed and power output compared to the conventional IncCond method. Our findings highlight the potential of the proposed approach to enhance MPPT performance in practical PV applications.

Paper ID: 38 *Effective Microalgae Harvesting via Biosurfactant-assisted Foam Flotation*

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Microalgae represent a valuable resource for various industrial applications, particularly biofuel production, offering significant potential for sustainability and environmental protection. However, one of the main challenges in microalgae production is the harvesting process, which is often energy-intensive and operationally costly. Presently, foam flotation is a promising technique for microalgae harvesting, but it necessitates the use of surfactants to reduce the surface tension between water and microalgae for

biomass extraction. While high recovery efficiencies have been reported, most surfactants used are synthetic and environmentally toxic. To mitigate these challenges, this study investigates the use of a green biosurfactant, specifically rhamnolipid, for efficient harvesting of microalgae via foam flotation. Four rhamnolipid concentrations ranging from 8.28 ppm to 18.8 ppm were assessed. The optimal concentration was identified at its critical micelle concentration (CMC) of 18.8 ppm, which exhibited lowest surface tension at 35.7 mN/m and a fast foam decay rate of 1.1 cm/min when harvesting from a 0.72 g/L Chlorella sorokiniana culture. A rapid biomass yield of 80% harvesting efficiency was also achieved at this optimal concentration. These findings indicate that biosurfactants are promising alternative surfactants in foam flotation for the harvesting of microalgae, offering a more sustainable and economically viable approach to biomass production.

Paper ID: 47 *Thermal Feasibility Study of Liquid Hydrogen Storage Tank for Clean Energy Transport in the Context of Energy Transition*

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Globally, the shift to clean energy is accelerating, and hydrogen due to its high energy density and zero emissions is emerging as a key energy carrier. In Indonesia, hydrogen's potential to decarbonize transportation and industry is recognized in the National Energy Grand Strategy (GSEN) and the national hydrogen roadmap. However, the extremely low boiling point of liquid hydrogen presents critical challenges for storage and distribution, particularly regarding thermal stability. This study evaluates the thermal feasibility of a proposed liquid hydrogen storage tank for clean energy transport using finite element simulation in ANSYS Workbench. The simulation assesses temperature variation and heat flux distribution across three tank layers over 24 hours. The outer layer experiences a total heat flux that stabilizes between 900 and 1300 W/m², but thanks to multi-layer insulation (MLI), the inner layer is effectively shielded, receiving less than 0.0015 W/m². Consequently, the internal hydrogen temperature remains stable at approximately −253 °C (20 K) throughout the simulation. These results demonstrate the tank's ability to maintain cryogenic conditions, making it suitable for medium-duration transport without significant boiloff. This study contributes to the development of thermally reliable hydrogen infrastructure, aligning with Indonesia's broader goals in the energy transition.

Paper ID: 49 *Phase Shifted Full Bridge (PSFB) Converter with Active Clamp and Synchronous Rectifier (SR) Using Gallium Nitride Devices*

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This paper investigates the performance of a Phase-Shifted Full-Bridge (PSFB) converter integrated with active clamping and synchronous rectification, utilizing Gallium Nitride (GaN) power devices. The adoption of GaN technology significantly enhances the converter's switching behaviour, enabling lower switching losses and higher power density compared to conventional silicon-based counterparts. The study explores key operational modes, control sequences, and switching dynamics, offering a comparative analysis between GaN-based FETs and traditional MOSFETs. Results demonstrate notable improvements in dynamic response and overall energy efficiency, emphasizing the suitability of GaN-based PSFB converters for next-generation applications in renewable energy, electric mobility, and advanced industrial systems.

Paper ID: 52 *End-of-life Vehicle (ELV) Management Promoting Remanufacturing within a Circular Economy Framework to Control Carbon Emission*

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Effective End-of-Life Vehicle (ELV) management is essential for reducing the environmental impact of the automotive sector and fostering the transition to a circular economy. This paper investigates the role of remanufacturing as a value-retention strategy within ELV processing, emphasizing its potential to minimize carbon emissions and reduce the consumption of raw materials. By extending the life of components and materials through systematic recovery and reuse, remanufacturing offers a low-carbon alternative to traditional recycling or disposal methods. The study synthesizes current practices, policy frameworks, and technological developments supporting ELV remanufacturing, and employs lifecycle assessment (LCA) tools to quantify associated carbon savings.

Key barriers, including regulatory inconsistencies, limited infrastructure, and market acceptance, are critically examined. The findings demonstrate that integrating remanufacturing into ELV management not only supports decarbonization goals but also enhances resource efficiency and economic resilience. This work contributes to the growing discourse on sustainable vehicle lifecycle strategies and provides actionable insights for policymakers and industry stakeholders.

Paper ID: 54 *Investigation on the Parameters Influence the Generation of Carbon Dioxide in Performance of Direct Methanol Fuel Cell*

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Carbon dioxide (CO_2) emissions are the primary driver of global climate change and needs to urgently reduce its emissions. Therefore, objective of this study is to investigate the parameters that influence the generation of CO_2 in DMFCs. The scope of the study includes developing an optimum model based on parameters affecting CO_2 production in DMFCs via MATLAB. Based on the analysis, maximum concentration of CO_2 was 23 mg/s, which is approximately 11.7 ppm when active area about 15 cm^2, while the minimum concentration of CO_2 was 0.01 mg/s or approximately 0.0051 ppm when flow design is about 0.01mm. In this case, maximum power and voltage were 9.75 W and 0.45V respectively. As the CO_2 concentration above, proven CO_2 results were comparable and safe to use in indoor or confined space area.

Paper ID: 57 *Estimation of the Winding Rise Temperature Ranges of the Dry-Type Transformer (DTTH) for Higher Loading Capability Based on Performance Evaluation*

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Loading capability represents the capacity of the device or equipment to safely and effectively deliver electrical power to connected loads without exceeding its designed limits. For instance, the dry-type transformer uses its winding rise temperature design limits to determine the loading capability at the rated ambient temperature. Increasing the winding rise temperature beyond the designed limits results in lower loading capability since the winding rise temperature is not constant all the time and needs to be estimated during operation to avoid overheating. Thus, the objective of the winding rise temperature estimation is to have a higher loading capability based on the performance evaluation. Practically, the transformer will experience the usage of half loads, full loads, and maybe overloads as it is directly connected to the loads. Thus, the transformer winding must be capable of withstanding the loading in the form of temperature rise as well as the heat generated. As a result, the transformer routine tests were carried out in order to analyse the temperature rise variation caused by raising the winding rise temperature from the calculation and measurement results. The variability between the calculation and measurement is used to estimate ranges of temperature, estimate the tolerances of the transformer against the load increase as well as to estimate the ability of the transformer to withstand heat due to temperature rising. From here, Pearson correlation techniques were used to provide an estimation of the winding rise temperature, enabling the loading capabilities to experience almost a 50% increment per degree Celsius above the normal loading capability of 13%. Based on the results, the winding rise temperature range estimate can be used for upcoming loading usage for higher loading capability and encourage future studies to extend the remaining life span service of the transformer from the temperature and loading controls.

Paper ID: 60 *Effect of Water Volume Filling Ratio on Thermal Resistance in a Custom-Designed Vapor Chamber*

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This paper presents an experimental study on vapor chamber (VC) that have emerged as effective passive thermal management, investigating the influence of filling ratio (FR) for wickless VC. Most existing studies focus on wicked VCs with well-established capillary structures, leaving a gap in understanding the thermal behaviour of wickless systems, particularly under

varying filling ratios. Although no wick structure was applied in the current setup, this study aims to provide a clear baseline for future development of metal foam–based wicks. During this study, the experiment setup, procedure and calculation are illustrated. Results indicate that thermal resistance decreases with increasing FR compared to dry-run condition. After optimal domain, performance deteriorates due to vapor blockage, among all filling ratios (FRs), the lowest thermal resistance is achieved at 0.022 ℃/W. An uncertainty and instability analysis of unsuitable FR is also provided.

Paper ID: 68 *Optimized Sustainable Spray Drying of Pineapple–Centella asiatica L. Powder for Improved Yield and Stability*

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Spray drying is an established technique in food preservation, especially for fruit powders, however high sugar and acid content of pineapple juice often results in drawbacks such as stickiness, caking, and lower powder yield during processing. This study aimed to optimize the spray drying conditions to improve the recovery and physical properties of pineapple powder by incorporating maltodextrin and Centella asiatica L. (CAL) as carrier materials. Response surface methodology was employed to evaluate the effects of inlet air temperature, feed flowrate, and CAL concentration on powder recovery and moisture content. The optimized spray dried pineapple-Centella asiatica L (PCAL) powder was further characterized for thermal, physical and flow properties. The addition of CAL enhanced powder recovery and reduced moisture content of PCAL powder compared to pineapple powder. The bulk and tapped densities of PCAL powders ranged from 0.437 ± 0.003 and 0.522 ± 0.010 g/mL, respectively. Flowability analysis using Carr's Compressibility Index (CI) and Hausner Ratio (HR) demonstrated acceptable flow properties in PCAL powders, with CI and HR values of 16.31% and 1.195, respectively, classified as fair to good, indicating suitability for handling and processing in industrial applications. Physicochemical characterization revealed a higher glass transition temperature (118 °C), reduced hygroscopicity, and acceptable flow properties, indicating the potential of CAL to produce stable, functional fruit powders for sustainable food applications.

Paper ID: 70 *Performance Evaluation of a Hybrid Solar Photovoltaic-Thermal (PV-T) System under Malaysian Climatic Conditions*

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This study explores the performance of a hybrid photovoltaic-thermal (PV-T) solar system under Malaysian climatic conditions, with the aim of enhancing energy efficiency. A comparative analysis was conducted between standalone photovoltaic (PV) and hybrid PV-T systems. The experimental setup integrated monocrystalline PV panels, copper piping for water circulation, thermal sensors, and microcontrollers to enable real-time data acquisition and performance monitoring. The PV-T system was designed to simultaneously harvest electrical and thermal energy, optimizing the use of solar irradiance. Results revealed that the hybrid system achieved a combined average electrical and thermal efficiency of up to 33.2%, surpassing the maximum electrical efficiency of 22.87% observed in the standalone PV system. Additionally, the PV-T configuration demonstrated a cooling effect on the panel surface, mitigating temperature-induced efficiency losses and potentially prolonging the system's operational lifespan. The thermal component successfully heated water to a temperature of 40.64°C, making it suitable for domestic applications such as bathing and washing. These findings underscore the practical viability of PV-T systems for residential use in tropical climates. Recommendations include scaling the system for broader implementation, using enhanced materials to improve thermal conductivity, incorporating smart monitoring technologies, and increasing public awareness to drive adoption. Overall, the study supports the potential of PV-T technology to contribute significantly to Malaysia's renewable energy targets and sustainable energy transition.

Paper ID: 72 *A New Stator Coil Design for Improving the Performance of 3-Phase Induction Motors without Expensive Additional Costs*

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Three-phase induction motors are favored by contemporary manufacturers due to their cost-effectiveness, durability, and operational simplicity. Numerous studies aimed at enhancing the performance of this motor are ongoing, with the improvement in performance being commensurate with the additional expenses paid. Consequently, further initiatives are required to enhance the performance of three-phase induction motors without incurring substantial additional expenses. This study aims to enhance the performance of three-phase induction motors cost-effectively through the development of the stator coil design. The stator winding was designed with a 2-layer coil configuration, with each layer constituting its pole, resembling a 20-degree asymmetric six-phase coil design. The study's results indicated a performance enhancement in the newly designed 3-phase induction motor, with output power and load torque increasing by 16.47% each. Our revolutionary design has the potential to improve the performance of other 3-phase induction motors without incurring significant additional costs.

Paper ID: 74 *A Review: Comparison of Pyrolysis Oil Quality from Plastic Waste and Biomass and Its Effects on Internal Combustion Engine Performance*

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Pyrolysis oil is a potential alternative fuel. Using pyrolysis oil as a fuel supports sustainable energy and can reduce the use of fossil fuels and utilize waste that can pollute the environment. This study aims to provide a systematic literature review regarding the pyrolysis process and its production of oils. Moreover, this study also compares the performance of pyrolysis oil from plastic waste and biomass on engine performance. Biomass pyrolysis oil is more environmentally friendly, even though its calorific value is lower. But its performance on the engine is not too superior. In this study, pyrolysis oil plastic is superior to engine performance because it has a higher calorific value, and its properties are close to fossil fuels, so that engine performance is better.

Paper ID: 75 *Analysis of Potential Alkaline Water Produced by Electrolysis Method for Agricultural Fertilizers Using Solar Cell Modules*

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The growing population and rising food demand have driven the agricultural sector to seek sustainable alternatives to chemical fertilizers. In Indonesia, this need aligns with the Minister of Agriculture Regulation No. 64 of 2013, which promotes environmentally friendly farming. Previous studies on ionized water demonstrated its potential to improve plant growth and soil properties, but limited research has explored its integration with renewable energy for agricultural use. This study investigates the production of alkaline water through electrolysis powered by a 20 Wp solar cell module using five test solutions: raw water, NaCl, KCl, KIO_3, and NH_4Cl. A Portable Water Ionizer (PWI) was used to analyze pH, TDS, energy performance, and soil response. NaCl yielded the highest pH (9.26) and energy output (24.05 Wh), while alkaline irrigation improved soil pH up to 7.0 without affecting moisture (maintained at 58–60%). In contrast, NH_4Cl produced strong acidification (pH 3.48). These results demonstrate that electrolyzed NaCl and KCl solutions can serve as low-cost, solar-powered alternatives to improve soil conditions and reduce chemical fertilizer dependency in tropical agriculture like Indonesia.

Paper ID: 79 *Stem Starch-Derived Biopolymer Solid Electrolytes: A Green Approach to Supercapacitor Development*

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In this work, solid polymer electrolytes (SPEs) based on pineapple stem starch (PAS) were doped with ammonium nitrate (NH_4NO_3) and plasticised with glycerol. Complexation between starch and NH_4NO_3 was confirmed via Fourier transform infrared (FTIR)

spectroscopy. The influence of varying salt content on film morphology was examined using field emission scanning electron microscopy (FESEM). A room temperature conductivity of 7.19 × 10^{-4} S cm^{-1} was achieved with the 70 wt% starch -30 wt% NH_4NO_3 composition, which was further enhanced to 1.27 × 10^{-2} S cm^{-1} upon the addition of 40 wt% glycerol, as shown in the FESEM micrographs in Figure 1 (a) and (b). All electrolytes demonstrated a linear relationship between conductivity and temperature at elevated temperatures, indicating Arrhenius-type behavior. These findings underscore the potential of PAS-based SPEs as a safer and more sustainable alternative to conventional electrolytes for use in electrochemical energy storage devices such as electrochemical double-layer capacitors (EDLCs).

Paper ID: 81 *Development of an Image-Processing-Based Adaptive Solar Tracker with IoT Capability: A Simulation Study Towards High Accuracy and Enhanced Power Generation*

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Optimising photovoltaic (PV) energy capture requires accurate solar panel alignment to the sun's position throughout the day. Fixed-tilt systems underperform due to their static orientation. This paper presents a MATLAB Simulink simulation of a two-axis solar tracker integrating image processing for sun detection, Model Reference Adaptive Control (MRAC) for real-time gain tuning, and an IoT interface for remote access. The image processing module uses centroid detection with noise and delay modelling, while MRAC enhances control under environmental variability. Simulations show the system achieves 97.29% azimuth and 97.33% elevation accuracy and generates 4.80 kWh daily, 41.2% more than a 3.40 kWh fixed-tilt system. These results demonstrate the promise of combining adaptive control, image-based sensing, and IoT for high-performance smart solar tracking

Paper ID: 82 *The Role of Co-products from Sustainable Aviation Fuel in Enhancing the Utilization of Non-Food Feedstocks for Automotive Applications*

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Aiming to reduce greenhouse gas emission in the aviation sector, enhance energy security, and create value from domestic, non-food feedstocks, Thailand has set the Sustainable Aviation Fuel (SAF) blending targets to increase from 1% in 2026 to 8% by 2037. This study examines the potential of non-food based SAF co-products to supplement the road transport fuel supply. Thailand's SAF deployment will primarily rely on Hydro-processed Esters and Fatty Acids (HEFA) and Alcohol-to-Jet (AtJ) pathways, utilizing non-food feedstocks such as Used Cooking Oil (UCO), Palm Fatty Acid Distillate (PFAD), and molasses-derived ethanol. Therefore, this study estimated the quantity of co-products from considered pathways from literature based on the feedstock availability expected from the SAF targets in the Thailand energy plan. Based on projected feedstock availability, the study estimates that by 2026, HEFA-derived SAF could produce approximately 0.13 million liters per day (ML/D) of diesel and 0.04 ML/D of gasoline-range co-products. With the addition of molasses-based (AtJ) by 2030, these volumes could rise to 0.74 ML/D of diesel and 0.32 ML/D of gasoline. These co-product volumes contribute significantly to Thailand's AEDP goals, providing an additional 37.68% beyond biodiesel targets for renewable diesel, and 34.37% beyond ethanol targets for renewable gasoline. These findings indicate that SAF deployment not only supports decarbonization in the aviation sector but also provides co-benefits for the land transport sector by enhancing the supply of renewable diesel and gasoline. This dual-sector impact can help reduce fossil fuel consumption and support Thailand's greenhouse gas (GHG) reduction targets under the Nationally Determined Contribution (NDC). By quantifying the contribution of SAF co-products to road transport fuels, this study addresses a critical research gap—an area that has received limited attention in the Thai context. However, the support actions are needed to ensure that the utilization of SAF co-products for transport sector can sustainably decarbonizations such as cooperation of relevant industry sector needs, process improvement, emission factor analysis.

Paper ID: 90 *Simulation and Analysis of MPPT Control Based on Artificial Lemming Algorithm for PV System*

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The efficiency of photovoltaic (PV) power generation has attracted much attention recently. However, typical photovoltaic arrays exhibit multi-peak characteristics during partial shading condition (PSC). Searching for global maximum power point (GMPP) is troublesome for conventional maximum power point tracking (MPPT) approaches such as incremental conductance (INC) and perturbation & observation (P&O). Due to the shortcoming, this paper introduces a new MPPT control method known as Artificial Lemming algorithm (ALA). Hence, a computer-based simulation of MPPT control on a simple PV system is carried out using MATLAB Simulink tool to verify the feasibility of the proposed ALA. The proposed ALA simulates four typical characteristics of lemmings in natural environment as well as utilizes an energy-diminishing mechanism. To investigate further, ALA's performance is compared with the Grey Wolf Optimization (GWO) and the Particle Swarm Optimization (PSO) algorithms. The proposed ALA proves its effectiveness through better global optimal searchability and higher control accuracy as well as effectively solve the multi-peak problem of PV arrays. ALA contributes 99.87%, 99.46% and 99.81% of tracking efficiency for each case, while obtained 23 ms, 107 ms and 75 ms of tracking time for each case. In conclusion, results comparison analysis on tracking accuracy, efficiency and speed, ALA shows superior performance than GWO and PSO.

Paper ID: 92 *Valorization of Pineapple Peels into High-Performance Hard Carbon for Sustainable Sodium-Ion Batteries*

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The increasing need for economical and environmentally friendly energy storage solutions has accelerated studies on sodium-ion batteries (SIBs), which show promise as lithium-ion system substitutes. A significant obstacle in the development of SIBs is the creation of effective anode materials that can support sodium's greater ionic radius without sacrificing functionality. Using pyrolysis at different temperatures, we synthesize and characterize hard carbon anodes from biomass waste in this study, specifically pineapple peels. As cost-effective and environmentally friendly substitutes for traditional hard carbons generated from petroleum, these materials are being researched. Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy with Energy Dispersive X-ray analysis (SEM-EDX), X-ray Diffraction (XRD), and Brunauer–Emmett–Teller (BET) surface area analysis were used to provide a thorough characterization. Cyclic voltammetry and charge-discharge cycling were used to assess electrochemical performance. The findings show encouraging electrochemical performance and structural characteristics, suggesting that these agricultural wastes could be used as practical precursors for affordable, environmentally acceptable hard carbon anodes in next-generation sodium-ion batteries.

Paper ID: 93 *Structural and Photoluminescent Behaviour of Eu-Doped Calcium Carbonate ($CaCo_3$) Nanoparticles Prepared by the Solid-State Diffusion Method for Energy Conversion*

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Rare earth doped carbonated material was prepared by the solid-state diffusion method with a combination of $CaCO_3$ as a host material and Europium (Eu) as activator materials to boost the photoluminescence properties. The phase purity of the prepared material was examined using X-ray diffraction (XRD), Field Emission–Scanning Electron Microscopy (FE-SEM), Energy Dispersive X-Ray Spectroscopy (EDX), Fourier Transform Infrared Spectroscopy (FTIR), and photoluminescence (PL). Photoluminescence spectra were measured for Eu-doped CaCO3 phosphors at the 591nm emission peak due to the $^5D_0 \rightarrow {}^7F_1$ transition of Eu^{3+} ions under excitation at 251 nm. The investigated prepared suitable phosphors for a down conversion material which able to convert high energy photons into two or more low-energy photons. This will help to absorb more photons, and solar cells can

convert more to electrical energy; hence, solar cells' efficiency improves.

Paper ID: 99 *Discovering Best Practices for Managing Solar Hybrid Systems in Rural Malaysian Schools*

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Solar Hybrid Systems (SHS) are a vital energy solution for Malaysian rural schools beyond the national grid. Despite their intended benefits, operational issues, including delayed maintenance and insufficient monitoring, have reduced system effectiveness. This study aims to determine what causes maintenance delays and evaluate how inadequate monitoring affects the performance and reliability of SHS operations. A qualitative research design involved semi-structured interviews with five purposively selected participants: three school representatives, one Public Works Department (PWD) officer, and one Ministry of Education (MOE) program manager. Thematic analysis revealed four key issues: delayed contractor response, inadequate stakeholder coordination, lack of routine monitoring, and insufficient technical capacity at the school level. These limitations impacted operational performance and undermined users' trust in SHS. As a result, the research proposes the Effective Management Model of Solar Hybrid System (EMMS), which focuses on local capacity development, communication enhancement, and preventive maintenance programs. This model provides valuable insights on how to help SHS be more sustainable and performant. Furthermore, the study contributes to renewable energy discourse by offering location-based knowledge on energy systems optimization in off-grid educational environments. Overall, it informs future policy actions for the resilience of energy infrastructure.

Paper ID: 100 *Simulation of Line Performance Based on Criticality Assessment to Mitigate Blackout and Cascading Failures in Central Java*

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In a large and linked power system, grid reliability must be maintained for the reason that it directly impacts consumers. It is still necessary to evaluate vulnerabilities that exist within the transmission network considering blackouts of the past in various countries in addition to issues of the Java-Bali system particularly within Central Java. This study makes use of the FMECA method for assessment of the levels of risk for system components. This method uses RAMS criteria also. The analysis uses historical disturbances and load data. For identifying the most vulnerable parts of the network, a risk matrix is employed. Also, Risk Priority Number (RPN) is used within this identification. DigSilent Power Factory simulates power flow and contingency subsequently, then tests these critical lines to evaluate voltage stability and overall system performance. The findings guide system enhancements so as to reduce disturbances' propagation also to protect against blackouts. This approach helps create a more stable strong electricity supply by finding weakness in the networks as the grid gains in complexity.

Paper ID: 104 *End-of-life Vehicle (ELV) Management Promoting Remanufacturing within a Circular Economy Framework to Control Carbon Emission*

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Effective End-of-Life Vehicle (ELV) management is essential for reducing the environmental impact of the automotive sector and fostering the transition to a circular economy. This paper investigates the role of remanufacturing as a value-retention strategy within ELV processing, emphasizing its potential to minimize carbon emissions and reduce the consumption of raw materials. By extending the life of components and materials through systematic recovery and reuse, remanufacturing offers a low-carbon alternative to traditional recycling or disposal methods. The study synthesizes current practices, policy frameworks, and technological developments supporting ELV

remanufacturing, and employs critical literature review to identify associated carbon savings. Key barriers, including regulatory inconsistencies, limited circular economy (CE) infrastructure, and socioeconomic acceptance, are critically examined. The findings demonstrate that integrating remanufacturing into ELV management not only supports decarbonization goals and adhering CE but also enhances resource efficiency and economic resilience. This work contributes to the growing discourse on sustainable vehicle lifecycle strategies and provides actionable insights for policymakers and industry stakeholders.

Paper ID: 105 *Advancement in Solar ETC-based Air Heating Systems as a Sustainable Technology*

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This review manuscript focuses on a solar evacuated tube collector (ETC) system integrated with thermal energy storage (TES) for air-based heating applications. It presents a detailed classification of ETC collectors suitable for air heating, highlighting their operating principles and configurations. Additionally, the paper discusses different ETC design approaches to enhance thermal efficiency and reliability. It also discusses the various TES materials, especially sensible and latent heat storage materials, and suitability in solar air heating systems. Additionally, various design configurations of ETC-based solar air heaters are discussed, encompassing single-pass, double-pass, and hybrid systems, as well as innovations in air flow arrangements, absorber surface modifications, and insulation strategies. The article concludes with the future directions for enhancing the performance, cost-effectiveness, and adaptability of ETC-TES systems in solar air heating applications.

Paper ID: 111 *Performance Evaluation of Thermoelectric Generator Under Variable Resistive Load Conditions: A Numerical Approach*

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Thermal energy, being one of the widely available energy sources, consists of a significant amount of waste heat, which gives rise to environmental pollution and global warming. Thermoelectric generators, due to their various advantages, are considered one of the potential alternative technologies for waste heat recovery. Although there are limitations, such as low conversion efficiency and high cost of modules. However, these issues are addressed with the use of the latest state-of-the-art materials and other techniques, which yield a sufficient temperature difference. Another parameter influencing the output power of the systems was identified as external load resistance. Current research is based on the performance evaluation of the thermoelectric generator system under the variation in the external resistive load conditions. This research is based on numerical and experimental investigation of the thermoelectric generator. Numerical results of the system obtained through COMSOL Multiphysics modelling are in better agreement with the published literature. Experimental analysis of the system has been carried out by considering natural convective cooling technique. Results reveal that these systems exhibit their optimal performance when the external load resistance matches the internal resistance of the system. For future work, it is recommended to experimentally and numerically analyze the effect of variable load resistance for a thermoelectric generator system consisting of multiple modules for performance evaluation of the system.

Paper ID: 112 *Design of Controller for FTMS based on BAT Optimization*

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This study describes the decoupling control method for a four-tank MIMO system (FTMS). FTMS is a laboratory design consisting of two pumps and four connected tanks. Maintaining the level of the tanks is the main motivation of the controller design. The purpose of the relative gain array (RGA)-based decoupler is coupling effects exclusion. Second, the BAT optimization technique is employed for an optimal PID controller design. The echolocation activity of bats serves as the inspiration for bat optimization techniques, which have many benefits for resolving optimization issues. These include

simplicity of implementation, quick convergence, adaptability, and balance between exploitation and exploration. The effectiveness of the suggested decoupling control approach is evaluated using the simulation results

Paper ID: 115 *Isolation of Nanocrystalline Cellulose from Elephant Grass Fibers using Microwave assisted Acid Hydrolysis*

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Cellulose is widely studied due to its eco-friendly properties such as biodegradability, renewability, sustainability and ease of modification. In this study, crystalline cellulose was isolated from elephant grass fibers using a microwave assisted technique. The fibers were produced by pre-treatment and bleaching of elephant grass using alkali (10 wt% NaOH) and (H2O2) in a microwave assisted process. Microwave was also used to isolate crystalline cellulose from the fibers by using phosphoric acid (H_3PO_4) hydrolysis. The morphology of the materials was investigated using FESEM. This study successfully isolated crystalline cellulose from elephant grass fiber. The surface of the sample became rough after alkali pretreatment, and the bleaching process disrupted the fiber components by removing lignin. The cellulose size reduced from 150-355 mm to 3.6 – 1718 nm after acid hydrolysis process. The XRD analysis revealed that the crystallinity index of the material increased from 47.50% to 69.48% because of the destruction of amorphous structure and then slightly decreased to 69.19% after acid hydrolysis. The crystallite size increased from 1.2997 nm to 3.9349 nm. Zetasizer measurements showed that 32.9% of the suspended solids after acid hydrolysis were in nanosize range while 67.1% was in microsize due to the agglomeration of the cellulose during dialysis process.

Paper ID: 127 *Mitigation Techniques on the Effect of Power Quality Issues in the Distribution System*

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This research investigates the impact of various nonlinear loads on the Total Harmonic Distortion (THD) in distribution system. The primary objective is to analyse the extent of THD caused by these loads and to evaluate the effectiveness of filter-based mitigation techniques. A comprehensive modelling approach is undertaken using the IEEE 14-bus test system, incorporating typical nonlinear load profiles. Subsequently, several mitigation strategies including Shunt Passive Filter (SPF), Shunt Active Power Filter (SAPF), and Hybrid Filter are designed and implemented. The performance of these filters is assessed based on IEEE 519 standards, focusing on their ability to reduce harmonic distortion and improve overall power quality. The findings reveal that, although all filter types contribute to the reduction of THD level, the hybrid filter demonstrates the most effective performance by combining the stability of passive components with the adaptive control of active filtering.

Paper ID: 128 *Modelling and Simulation of The Impact of Electric Vehicle Penetration to Vehicle Energy Consumption, Environment and Chargers' Location*

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This study presents a comparative analysis between Electric Vehicles (EVs) and Internal Combustion Engine Vehicles (ICEVs) in terms of energy consumption, travel time, environmental impact, and charger placement. Using AIMSUN simulation software, two route scenarios were designed: a short 7.5 km urban-suburban route in Gua Musang, and a long 200 km intercity route from Gua Musang to Kota Bharu. Simulation results revealed that EVs consistently outperformed ICEVs in energy efficiency, exhibiting an average consumption of 0.1678 kWh/km compared to ICEVs' 0.971 kWh/km. EVs also demonstrated zero tailpipe emissions, with notable advantages in travel time and congestion management. The study further identified Machang as the optimal location for a mid-route EVs charger based on charge-level analysis. These Findings support the case for EVs adoption in Malaysia, especially in achieving carbon neutrality and efficient long-distance mobility.

Paper ID: 131 *The Effect of Circular Turbulator on Velocity Distribution and Turbulence Intensity in a 90° Elbow Channel*

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Indoor thermal comfort is an important aspect of modern building design, especially in tropical countries like Indonesia. The HVAC (Heating, Ventilation, and Air Conditioning) system uses ducting for air distribution, with the elbow component playing a crucial role in directing airflow. However, the use of elbows often causes pressure drops due to separation and the formation of secondary flows. This study evaluates the effect of installing a circular turbulator (CT) on the inner radius of a 90° elbow, focusing on fluid flow characteristics, particularly turbulence intensity and velocity distribution. Numerical simulations were performed using Ansys Fluent software with variations in CT installation angles of α = 15° and α = 20° on a 90° elbow channel. The results show that CT placement can significantly increase turbulence intensity, especially on elbows with an angle of 30°, which reaches a peak turbulence of up to 26%. CT had also been shown to be effective in delaying separation and increasing the homogeneity of velocity distribution on the inner elbow side. However, its effectiveness decreases at an angle of 90°, because the CT position is too far from the bend point. Thus, CT has the potential to be an efficient solution in improving the performance of HVAC ducting systems, especially if installed at the right position and angle according to the duct configuration.

Paper ID: 132 *Comparative Analysis of Si and InGaAs Photodiodes for Adaptive Communication in Low-Power IoT Applications*

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As the Internet of Things (IoT) expands into energy-constrained and remote environments, efficient energy harvesting becomes a critical enabler of long-term autonomous operation. Photodiodes, particularly those based on silicon (Si) and indium gallium arsenide (InGaAs), serve as key components in harvesting solar and optical energy for low-power IoT nodes. These two materials are widely used due to their commercial availability, cost-effectiveness, broad spectral sensitivity and proven integration in compact, low-power energy harvesting systems. This paper presents a comparative study of the current-voltage (I-V) characteristics of commercial Si and InGaAs photodiodes under varying illumination conditions, using a Source Measure Unit (SMU) to capture real-time performance data. The I-V data is modelled to extract key metrics such as shortcircuit current, open-circuit voltage, fill factor (FF), and maximum power point (MPP). Results show that InGaAs photodiodes, despite their smaller active area, exhibit superior fill factor and broader spectral responsiveness, making them more suitable for indoor or low-light environments, while Si photodiodes remain efficient under standard solar conditions. These findings are mapped against the energy demands of various IoT communication protocols to evaluate adaptive transmission strategies. Among the protocols studied, Bluetooth Low Energy (BLE) emerges as the most viable option, enabling thousands of transmissions per day on harvested power alone. The study concludes that selecting the appropriate photodiode material based on deployment environment and communication load; can significantly enhance energy efficiency and extend the operational lifespan of solar-powered IoT systems.

Paper ID: 142 *Development of High-Performance Supercapacitors from Oil Palm Empty Fruit Bunch (EFB) Biomass*

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Supercapacitor electrodes have several critical challenges, including low energy density, inferior cycling stability, and high material expense. Graphene and activated carbon are some of the high-performance materials that are expensive and based on nonrenewable resources. Natural cellulose biochar from biomass has emerged as a competitive alternative due to its high specific surface area and good electrochemical properties. This research provides an approach to synthesize cellulose biochar-based electrodes from empty fruit bunch by pyrolysis process accompanied by KOH chemical activation to produce hierarchical porous biochar. For instance, empty fruit bunches (EFB) were pyrolysed at 350℃, 400℃, and 450℃. Furthermore, after

synthesis, these materials were analyzed using characterization techniques such as Fourier Transform Infrared Spectroscopy (FTIR), Field-Emission Scanning Electron Microscopy (FESEM), and Energy-Dispersive X-ray Spectroscopy (EDS). At current density of 1 A/g specific capacitance of this biochar was 164 F/g, energy density was 258 Wh/kg, and power density was 6380 W/kg. The electrochemical characteristic of the biochar was very good, and this electrode retained 65% capacitance after 10,000 cycles, indicating the superior cyclic stability of the material. Additional proof of stability of the electrode was provided from galvanostatic charge-discharge testing and electrochemical impedance spectroscopy. Consequently, based on these results, KOH-activated EFB biochar is a cheap and promising material to use as a supercapacitor.

Paper ID: 143 *Synthesis and Characterization of Palm-Based ZnO/Biochar Composites as Electrode Material for Supercapacitor*

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Biochar made from Empty Fruit Bunch (EFB) and biochar/metal oxide composite have recently drawn interest as supercapacitor electrode materials because of their high specific surface area, potential stability, and affordability. High-performance supercapacitors were created in this work using biochar and its derivatives. Using a sodium hydroxide solution, biochar was activated after being produced by the gasification process. The physico-chemical properties of the obtained biochar and composite of ZnO/biochar with different mass ratio were investigated through X- ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Field emission scanning electron microscopy (FESEM), and X-ray spectroscopy (EDS) to confirm the successful integration of biochar and ZnO into a composite material and examine their structural and morphological properties. Electrochemical analyses, including cyclic voltammetry (CV), galvanostatic charge discharge (GCD), and electrochemical impedance spectroscopy (EIS), were then performed on the biochar and all synthesized composites of ZnO/biochar with mass ratios of 1:1, 1:2, and 1:3. Results from experiments on biochar and ZnO/biochar demonstrate good electrochemical performance. A maximum specific capacitance of 161 F/g for biochar and 375 F/g for ZnO/biochar ratio of 1:2 at a current density 0.5 A/g is achieved for 3-electrode system. The fabricated supercapacitor achieved the maximum specific capacitance of 128 F/g for biochar and 251 F/g for ZnO/biochar (1:2) with the capacity retention of 89% for biochar and 92% for ZnO/biochar (1:2), respectively after 5000 charge discharge cycles. Overall, results revealed promising potential properties of biochar in supercapacitors.

Paper ID: 145 *Sorption of Heavy Metals on Polyethylene Microplastics in Johor River Basin: Implication for Aquatic Pollution and Sustainable Water Management*

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This study examines the sorption capacity of chromium (Cr), cadmium (Cd), and zinc (Zn) onto virgin polyethylene (PE) microplastics deployed for six months in two contrasting environments within the Johor River Basin: a freshwater site in the Sayong River and an estuary site at the Kota Tinggi River Mouth. Monthly samples were collected and analysed for metal concentrations using Atomic Absorption Spectrophotometry (AAS). Sorption was consistently higher in the estuary environment, with maximum concentration of 2.7 µg/g for Cr, 0.32 µg/g for Cd, and 0.23 µg/g for Zn. Sorption levels increased steadily over the study period, influenced by environmental factors such as pH, salinity, and organic matter. The findings highlight the role of PE microplastics as effective carrier of heavy metals, with potential implications for bioaccumulation in aquatic food webs. The results underscore the need for integrated management strategies that address both microplastics and heavy metal pollution to safeguard aquatic ecosystems health.

Paper ID: 146 *Environmental Aging of Polyethylene Microplastics: Surface Degradation and Enhanced Sorption Behavior Toward Aquatic Pollutants*

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Polyethylene (PE) microplastics were exposed to natural sunlight in ultrapure water to investigate surface changes due to environmental photoaging. Characterization by ATR-FTIR and VPSEM showed that pristine microplastics had smooth, rounded surfaces and no visible defects. Following exposure, aged particles exhibited surface roughness, pores, cracks and structural degradation. These alterations significantly increased their surface area and affinity for pollutant adsorption. Photoaged microplastics may persist longer in ecosystems, acting as vectors for harmful contaminants like heavy metals, which accumulate in aquatic organisms, disrupting ecosystems and biodiversity. Moreover, their degradation can release toxic byproducts into the environment. For human health, these enhanced microplastics can enter the food chain, potentially leading to human health issues.

Paper ID: 150 *Biopolymer Electrolytes as a Promising Material for Energy storage applications*

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Biopolymer electrolytes (BPEs) are advanced materials derived from natural polymers such as starch, cellulose, and chitosan, and are typically doped with organic or alkali metal salts. They offer several advantages, including biodegradability, leak resistance, high thermal and chemical stability, excellent interfacial contact with electrodes, non-toxicity, and the ability to form stable films with good mechanical properties. Despite these benefits, BPEs generally exhibit low electrical conductivity at ambient temperatures. Their ionic conductivity stems from functional groups or heteroatoms (e.g., oxygen, nitrogen) in the polymer chains, which possess lone electron pairs that interact with salt ions to facilitate ion transport via complexation. Due to these properties, BPEs are suitable for use in electrochemical capacitors. BPEs based on biopolymer were studied and optimized using electrochemical impedance spectroscopy, XRD, FTIR and TGA. The optimized sample has the maximum bulk dc conductivity ~1.20×10^{-4} Scm^{-1} at 30 °C, ionic transference number ~0.99, and electrochemical stability window ~2.4 V. The fabricated electrochemical double layer (EDLC), based on the optimal sample, has been analysed using CV, GCD and stability test.

Research Topic 3: Electric Vehicle Technology; Hydrogen Economy

Paper ID: 7 *Advancing Malaysia's Electric Vehicle Ecosystem: A Critical Analysis of Current Policy Issues and a Strategic Roadmap to Address Societal and Environmental Challenges*

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This study evaluates Malaysia's electric vehicle (EV) ecosystem, highlighting policy gaps, societal barriers, infrastructure issues, and industrial limitations. Despite the goals of the National Automotive Policy (NAP) 2020, EV adoption remains low. Using a systems thinking approach and qualitative methods, the research draws on policy documents, workshops, and international benchmarks. Findings reveal fragmented regulations, limited charging access, low public trust, and weak manufacturing capacity. Insights from China, Norway, and the UK underscore the need for integrated governance. The paper proposes a framework to improve coordination, support public-private partnerships, and boost investment and public engagement for a sustainable EV transition.

Paper ID: 8 *Precision-Driven State of Energy Prediction for Electric Vehicles Using Random Forest and Evolutionary Algorithms*

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Accurate State of Energy (SOE) estimation is crucial for efficient battery management in electric vehicles (EVs), especially under extreme temperatures. This study investigates SOE estimation for the LG 18650HG2 Lithium-ion (Li-ion) battery at 0°C, utilizing a Random Forest with Differential Evolution (RFDE) optimization approach. The method was evaluated on HWFET and LA92 drive cycles, demonstrating improved accuracy over baseline models. DE

optimization effectively reduced Max Error and MAE by 20% and 10%, respectively, enhancing prediction performance. Comparative analysis with LSTM and DFFA-EKF methods highlights the model's efficiency, the proposed RFDE method shows a max error ranging from 0.1281 % to 0.1998% for different datasets, whereas the previous work by DFAEKF shows the max error of 0.98%; also the RMSE of the proposed method is from 0.0023% to 0.0045%, much lower than the LSTM methods in earlier work i.e. 0.012%. Future work will explore deep learning models, multitemperature analysis, and real-time deployment for enhanced SOE estimation.

Paper ID: 28 *A Sustainable Energy Transition via Hydrogen Power in SOFC and PEMFC*

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The current human civilization is still heavily dependent on fossil fuels to satisfy the ever-increasing demand for more energy, in the forms of gaseous fuels (like methane and hydrogen), liquid fuels (like diesel, gasoline, and kerosene), and electricity. The surging demand for fossil fuels has resulted in global warming and climate change, both of which are negatively impacting all lives on Earth. These worldwide issues have sparked a global and rapid search for alternative energy sources to replace fossil fuels. Amongst the various alternative energies, hydrogen is widely regarded as one of the most potentially viable fuel for the future and capable of satisfying our high energy needs. The benefits of utilizing hydrogen as an energy source are: (i) it is a fuel with zero emission; (ii) it can be produced from clean and sustainable routes (such as solar-powered water electrolysis); (iii) through fuel cell technology, hydrogen can be used in transportation and heating applications; (iv) it can be used as an energy storage medium. Despite the benefits, there are still many technological and socioeconomical barriers to overcome if a hydrogen energy transition is to be realized. This paper aims to reflect the current status and challenges of solid oxide fuel cell (SOFC) as well as polymer electrolyte membrane fuel cell (PEMFC) in the implementation of energy transition.

Paper ID: 34 *Design of 4.5 kW Dual Rotor Permanent Magnet Motor for Electric Vehicle*

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This paper proposes the design and evaluation of a 4.5 kW dual rotor permanent magnet motor optimized for electric vehicle (EV) applications. The motor employs a reduced permanent magnet configuration to lower material costs and dependence on rare earth elements, while maintaining high efficiency and torque output. The dual rotor architecture enhances magnetic utilization and enables compact packaging suitable for in-wheel applications. Detailed electromagnetic simulations, Finite Element Analysis (FEA), and thermal assessments were performed to evaluate torque characteristics, efficiency, and thermal performance. The results demonstrate that the dual rotor motor achieves performance levels comparable to conventional permanent magnet motors, with a significant reduction in magnet volume and improved suitability for cost sensitive EV systems.

Paper ID: 39 *Dynamic Modelling and Control an Electric Motorcycle for Energy Recovery via Regenerative Braking*

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The rapid expansion of the automobile industry, largely driven by population growth and urbanization, has intensified the demand for sustainable transportation solutions. In response, electric vehicles (EVs) have gained significant traction as cities strive to mitigate carbon emissions and improve energy efficiency. This paper presents the development and modelling of an electric motorcycle system incorporating energy recovery mechanism to enhance overall energy efficiency. The system was

formulated using longitudinal vehicle dynamics equation and simulated in MATLAB to evaluate its performance. A regenerative braking system (RBS) was integrated into the model to investigate its effectiveness in energy recuperation, laying the groundwork for future advancements in electric motorcycle technology. Unlike conventional motorcycles, electric motorcycles leverage energy recovery to optimize performance and extend operational range. In this study, the World Motorcycle Test Cycle (WMTC) was selected as standardized drive cycles to assess the system's response. The braking control was implemented using a Proportional-Integral controller to regulate braking force distribution effectively. Simulation results demonstrate that the integration of regenerative braking significantly enhances the state of charge (SOC), thereby extending the travel range. These findings highlight the potential further optimization through the implementing of advanced braking control strategies, contributing to the evolution of more efficient and sustainable electric mobility solutions.

Paper ID: 95 *Simulation Study on The Flame Acceleration of Premixed Hydrocarbons/Air Mixtures in Tee Pipes*

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Pipeline explosions pose major risks to public safety, infrastructure, and the environment due to rapid flame propagation of flammable gases in confined spaces. With such incidents becoming more frequent, understanding flame acceleration, overpressure, and temperature in complex pipeline geometries is crucial. This study simulates the flame behaviour of C_3H_8/air, H_2/air, and C_2H_4/air mixtures at various equivalence ratios in a symmetric tee-junction pipeline. Results indicate that C_2H_4/air mixtures generate the highest overpressure at the inlet and junction, due to ethylene's short ignition distance. Maximum flame speed was recorded at the ends of straight branches, driven by its low molecular weight and weak intermolecular forces. The highest temperatures occurred at 70% air composition, especially at the junction and lower branch. For H_2/air mixtures, complete combustion was achieved with only 10% air, resulting in high velocities, pressure, and temperature due to hydrogen's high reactivity and diffusional-thermal instability. In C_3H_8/air mixtures, peak parameters were observed at a 50% mixture ratio, indicating optimal combustion conditions. These findings enhance understanding of explosion behaviour in branched pipelines and offer critical data for improving predictive models, selecting materials, and developing safer designs and mitigation strategies in the oil, gas, and hydrogen sectors.

Paper ID: 101 *Enhanced Vehicle-to-Grid Power Flow Using Predictive Optimization of Bidirectional Converters*

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The widespread adoption of electric vehicles (EVs) offers substantial potential for enhancing grid stability and efficiency through Vehicle-to-Grid (V2G) operations. This paper presents an optimized predictive control framework based on Particle Swarm Optimization (PSO) to improve the performance of bidirectional converters used in V2G and Grid-to-Vehicle (G2V) systems. The developed PSO approach dynamically predicts optimal charging and discharging schedules considering grid demand, electricity pricing, and battery state-of -charge (SOC). Extensive MATLAB/Simulink simulations validate the effectiveness of the proposed method, demonstrating reduced prediction errors, enhanced battery efficiency, improved grid support capabilities, and superior economic outcomes compared to traditional control methods.

Paper ID: 102 *A Review on Thermal Management Systems for Lithium-Ion Batteries: Enhancing the Performance and Safety in Electric Vehicles*

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Effective thermal regulation of lithium-ion batteries plays a vital role in improving the efficiency, safety, and overall lifespan of electric vehicles. Advanced heat management approaches for battery packs with

lithium-ion are analyzed, with a focus on electrically powered vehicle applications. Sustainable energy storage and temperature variations have a huge influence on the performance and longevity of lithium-ion batteries. For the purpose to maintain the ideal operating temperature, the study investigates a multitude of temperature control solutions, including cooling with air, cooling through liquids, phase-changing materials, heat pipes, and hybrid systems. Experimental and simulated investigations have been reviewed to assess the impact of various Cooling techniques and performance of batteries. According to the findings, new methods and creative designs are essential for increasing heat dissipation and consistency in temperature as well as for significantly enhancing battery refreshing effectiveness and reliability. The article concludes by recommending additional areas of study to enhance heat management systems to support the growing adoption and use of electric vehicles for green mobility.

Paper ID: 113 *Flexible and Mechanically Strong PVA/Corn Starch-based Hydrogel Electrolyte with Wide Electrochemical Potential Window for Zinc ion Hybrid Supercapacitors*

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Zinc ion hybrid supercapacitors are promising alternatives to lithium-ion batteries as they combine capacitive-type and battery-type electrode to achieve great power density, high energy density and excellent capacity retention. However, they are yet to achieve their theoretical energy density of >100 Wh kg^{-1} which are the energy density of conventional lithium-ion batteries. This is attributed to the restricted electrochemical potential window of aqueous electrolytes that are typically used which is 1.23 V as the water present will undergo hydrogen evolution and oxygen evolution reactions. Herein, PVA/corn starch-based hydrogels have been prepared by crosslinking using glutaraldehyde in acidic conditions. The formed hydrogels are then soaked in varying concentrations of zinc sulphate solutions and the best performing hydrogel which is the hydrogel soaked in 3M $ZnSO_4$ achieved ionic conductivity of 1.37 × 10^2 S cm^{-1} at ambient conditions. The electrochemical potential window of the fabricated device based on the optimized hydrogel was 2.2 V which is significantly higher than that of aqueous electrolytes. Moreover, the fabricated device achieved maximum energy density of 127.7 Wh kg^{-1} and power density of 1561.5 W kg^{-1}. Furthermore, soaking of hydrogel in zinc sulphate solution caused the hydrogel to shrink due to the formation of stronger intermolecular bonding within the matrix. This resulted in a mechanically strong and flexible hydrogel with high maximum yield strength to be formed.

Paper ID: 121 *Molecular Imprinting Meets Green Hydrogen: A Convergence of Material Innovation and Clean Energy Demand*

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Hydrogen is a rapidly emerging clean energy vector, which plays a significant role towards carbon neutrality in the global green energy transition. As the hydrogen production from microalgae cultivation and ammonia cracking introduces a promising technology, the critical need for a scalable, selective, and low-cost hydrogen detection and capture systems is indeed in need. Molecularly imprinted polymer (MIP) is a synthetic nanomaterial capable of specific molecular structures printing, which offers unique advantages as in gas capturing platform due to their excellence in tunability, stability, and cost effectiveness. This review presents the integration of MIP advancement for hydrogen sensing and capture in the aim of establishing a decentralized green environment. A specific attention is given to capturing hydrogen derived from microalgae cultivation and ammonia cracking, highlighting the MIP stability for developing hydrogen capturing stream in the presence of ammonia decomposition and photobiological routes of algae. Nanozyme coupling, polymer hybridization, and catalytic imprinting are several emerging strategies, which are discussed to develop MIP based hydrogen capturing system in a complex environment. The proposed system ensures the attainment of circular economy with positioning MIP enables biohydrogen production streams in the direction of waste-to-energy processes.

Paper ID: 122 *A Review of Tracking Technologies for Validating Future Trip Profile Nominations in Electric Vehicles*

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Future Trip Profile Nomination (FTPN) is a proactive framework for electric vehicle (EV) routing in which users declare future travel plans—origin, destination, departure time and optional stops. Unlike stationary Future Behavior Nomination (FBN) systems such as Future Load Profile Nomination (FLPN) in the energy sector, which rely on high fidelity sensors like smart meters, FTPN faces the challenge of validating mobile agents in dynamic and often unpredictable environments. This paper reviews existing tracking technologies— including GPS, RFID checkpoints, tolling infrastructure, CCTV, and social media data—and assesses their potential for verifying declared trips. Artificial intelligence (AI) techniques and data fusion are examined for improving accuracy, while privacy and cybersecurity is sues are identified as key barriers. The paper argues that robust FTPN validation is essential for credible, scalable, and sustainable EV coordination. The findings contribute to the development of intelligent transport systems aligned with the United Nations Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action).

Paper ID: 126 *Impact of Electric Vehicle Penetration on Distribution Grid Stability during the Energy Transition*

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The global transition to sustainable energy has accelerated the adoption of electric vehicles (EVs), resulting in increased load on the electricity distribution network. This study evaluates the technical impact of EV penetration on distribution network stability through steady-state power flow simulations. A modified IEEE 13-Bus radial distribution system is implemented using MATLAB and the MATPOWER simulation package. Three EV penetration scenarios; 20%, 40%, and 60%, are modeled to reflect the increased charging demand during the evening peak load hours. Simulation results show that as EV penetration increases, the voltage at some buses drops significantly and total power losses increase. In the 60% scenario, the voltage at the weakest bus drops to 0.846 p.u., approaching the critical limit. Smart charging strategies and vehicle-to-grid (V2G) technologies are not implemented in this study, highlighting the challenges of uncoordinated EV charging. These findings emphasize the importance of a coordinated integration strategy to ensure reliable and efficient distribution system operation in the context of widespread EV adoption

Paper ID: 136 *Optimization of Permanent Magnet Flux Switching Motor Using Sequential Technique*

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Permanent Magnet Flux Switching Machine (PMFSM) has emerged as a promising technology in electric motor design with clear potential for high power density and efficiency. However, many PMFSM configurations with uneven slot-to-pole ratios, such as the 6S–7P design, often suffer from lower torque output. To address this limitation, this study focuses on optimizing the 6S–7P configuration to maximize its torque performance. The optimization process employs the Sequential Parameter Optimization (SPO) technique, which systematically explores six different parameter adjustment sequences involving the rotor, permanent magnet, and armature coil. Among these, the second sequence (permanent magnet–rotor–armature coil) achieved the highest average torque of 2.73 Nm, nearly double the initial value of 1.28 Nm, demonstrating the effectiveness of the chosen tuning strategy.

Paper ID: 147 *Analysis for Cogging Torque Reduction Method of Outer Rotor Hybrid Excitation Flux Switching Machine*

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Cogging torque, caused by the interaction of stator slots and rotor magnets, degrades motor

performance by producing noise, vibration, and torque ripple even without current in the windings. This study investigates cogging torque reduction techniques in Outer Rotor Hybrid Excitation Flux Switching Machines (OR-HEFSMs) using JMAG Designer. Three approaches- chamfering, notching, and pole pairing—are modelled and compared. The results show that pole pairing reduced cogging torque by 18.77% while improving output torque by 10.46 Nm, making it the most effective method. These findings provide practical design insights for developing smoother, more reliable, and efficient OR-HEFSMs for industrial, renewable energy, and electric vehicle applications.

Research Topic 4: Smart-Grid; Environmental, Social, and Governance (ESG); Energy Policy and Carbon Management; Net-Zero Emissions and Carbon Neutrality

Paper ID: 15 *Economic Viability and Investment Decision-Making for Hydrogen Infrastructure: An Empirical Analysis Using Real Options Approach*

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Hydrogen infrastructure is increasingly viewed as essential to national decarbonization efforts, yet investment in this sector remains constrained by signiicant policy and market uncertainty. While Malaysia's Hydrogen Economy and Technology Roadmap (HETR) outlines long-term ambitions, private-sector involvement has so far been limited. This may partly relect the use of traditional valuation tools like Net Present Value (NPV), which assume ixed inputs and overlook the lexibility needed in uncertain policy environments. To address this, the study adopts a Real Options Approach (ROA), viewing investment as a series of adaptive choices rather than a single commitment. Using data on hydrogen costs, carbon pricing, and iscal incentives, the model explores several policy scenarios. Results suggest that ROA can raise project value by up to 40% under supportive measures such as carbon taxes or subsidies. Timing also proves highly sensitive to cost and policy shifts, reinforcing the strategic value of waiting. These insights may help inform more lexible and effective policy design for hydrogen development.

Paper ID: 19 *Review of international standards adopted for metering in Hydrogen Refuelling Stations (HRSs): Focusing on Malaysia context*

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Malaysia ambitiously seeking a transition to hydrogen energy, given its heavy dependence on fossil fuels due to abundant natural resources and a commitment to join the global hydrogen economy. The long-awaited launch of the nation's Hydrogen Economy Technology Roadmap (HETR) has reignited interest in hydrogen as a primary fuel, despite slower progress of the nation's hydrogen transition. By exploring the gaps, this paper surveyed the prospects and current circumstances of hydrogen metering in the Malaysian context. Experiences from international applications of hydrogen energy have been analysed. This study provides insight into the public and private awareness of hydrogen metering and the adoption of international standards into a national regulatory framework.

Paper ID: 26 *Bioplastic Films from Spirulina and PVA: Mechanical and Biodegradation Properties of Biodiesel-Derived Glycerol vs Natural Latex Plasticizers*

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The increasing environmental concerns associated with petroleum-based plastics have driven the global interest toward biodegradable and sustainable alternatives. Bioplastics, that are biodegradable and/or produced from biological materials/renewable feedstock, have gained attention over the past few decades. Among the renewable resources, microalgae, such as Spirulina have been merged as promising candidates due to their rapid growth rates and no arable land usage (as compared to terrestrial feedstock). However, its limited mechanical performance restricts broader application. This study addresses that challenge by incorporating natural-based plasticizers, the glycerol and natural

latex, into Spirulina-polyvinyl alcohol (PVA) films. Results showed that Spirulina improved tensile strength and biodegradation but reduced elongation. Latex-plasticized films exhibited the highest tensile strength (70 MPa) and elongation (17%), indicating stronger interfacial bonding and film integrity. Glycerol-plasticized films achieved 59 MPa tensile strength and 15% elongation. In biodegradation tests, glycerol-based films degraded faster, with 54.3% weight loss by day 15, while latex-based films showed 35.5% degradation, both outperforming pure PVA films. The findings demonstrate the potential of these algae-PVA composites, particularly those plasticized with latex, for replacing petroleum-based plastics in applications requiring moderate flexibility and high tensile strength.

Paper ID: 42 *Greenhouse Gas Accounting Methodology for Downstream Oil & Gas (Retail and Marketing) Business*

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An organization engaged in the retail, distribution and marketing of downstream refined petroleum products typically operates in various business segments including retail fuel, commercial fuel and gas, lubricants, and a range of non-fuel convenience services such as convenient shops, cafe s and mobile payment. Tracking and accounting for greenhouse gas ("GHG") scope 1 and scope 2 emissions for such a diversified range of business activities can be complex and challenging due to the thousands of operated assets nationwide with numerous emission sources from electricity, fuel and refrigerant use in the course of operating such assets. To estimate certain GHG emissions, where complete data such as electricity and refrigerant usage cannot be obtained in a timely manner, an extrapolation approach was applied. This approach which also included linear regression, is supported by technical justifications, criteria, and valid assumptions. The resulting GHG emissions were disclosed in the company's Annual Integrated Report, with scope 1 and 2 emissions comprising approximately 10% and 90% of total emissions respectively. Nonetheless, when scope 3 emissions that are material in nature also considered in total emissions, it was determined that the company's scope 1 and 2 emissions constitute less than 0.2% of the total emissions. To enhance credibility and trust with investors and other stakeholders, an external Independent Assurance Statement was obtained, verified in accordance with ISO 14064 – Part 3 for greenhouse gas emissions.

Paper ID: 51 *Improved Thermophysical Properties and Stability of Al_2O_3–CuO–Yb_2O_3 Hybrid Nanofluids for Heat Transfer Applications*

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This study presents the synthesis and comprehensive characterization of novel hybrid nanofluids incorporating aluminum oxide (Al_2O_3), copper oxide (CuO), and ytterbium oxide (Yb_2O_3) nanoparticles. Initially, the individual metal oxide nanoparticles were synthesized via the hydrothermal method and characterized using appropriate techniques to confirm their particle size, morphology, and phase purity. Following synthesis, nanoparticles with optimized concentrations were dispersed into various combinations of water and ethylene glycol base fluids to formulate stable hybrid nanofluids. Different nanoparticle ratios were explored to evaluate the influence of composition on thermophysical behavior. To enhance dispersion stability, a two-step method involving magnetic stirring followed by ultrasonication was employed. The thermophysical properties of the prepared nanofluids—including viscosity, density, and thermal conductivity—were systematically measured over a temperature range of 25°C to 65°C. Viscosity and density were determined using a viscometer, while thermal conductivity was measured using a KD2 Pro thermal analyzer. Specific heat capacity was then calculated using standard thermophysical relations based on the measured properties. Results revealed that the hybrid nanofluids exhibited superior thermophysical properties compared to the base fluids alone. Stability assessments were conducted using dynamic light scattering (DLS), UV–VIS spectroscopy, and visual sedimentation analysis. The synergistic interaction among Al_2O_3, CuO, and Yb_2O_3 nanoparticles contributed to marked improvements in both thermal performance and colloidal stability, underscoring the potential of these hybrid nanofluids for advanced heat transfer applications.

Paper ID: 62 *How CSR Committee and Independent Assurance Effect to ESG Performance in Indonesia Firms?*

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The Environment, Social, and Governance (ESG) topic is gaining a lot of attention because of the climate change impact to industries, stakeholders could take several actions to reduce negative impacts. Researchers investigate the effect of governance mechanism, namely CSR committee and independent assurance on ESG performance. There are 350 observation data from 35 companies' listed in IDX period 2015-2024. Researcher used Eikon Refinitiv as source data. This study shows that the presence of CSR committee and independent assurance enhanced ESG performance.

Paper ID: 67 *Accelerating Southeast Asia's Energy Transition: Synergies between Renewable Energy Policy, Carbon Management, and Sustainable Development*

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Southeast Asia now stands at a critical turning point where energy needs keep rising and an urgent move toward low-carbon supply is non-negotiable. Against that backdrop, this paper contends that real speed will come only when policy blueprints combine renewable targets, carbon-management tools, and wider sustainable-development aims. Although leaders usually treat each pillar as a standalone agenda, letting them work together can open the door to big gains-more investment, faster rollout of new technologies, and stronger energy security. When nations intentionally pair growth in renewable capacity with strict emission cuts inside a unified development framework, they clear hurdles and edge closer to social and economic goals. This article reviews the main facets of that integration and closes with policy tips for clearer national plans and deeper regional teamwork. Such a joined-up approach is vital for speeding Southeast Asia's move toward a cleaner, tougher energy system while keeping the shift fair, swift, and lasting.

Paper ID: 69 *The Transition of Thai's Automotive Industry Toward the Next-Generation Automotive*

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Thailand's automotive industry is undergoing a significant transition from internal combustion engine (ICE) vehicles to electric vehicles (EVs). This research develops a comprehensive roadmap to guide the transformation toward a next-generation automotive industry. It provides strategic guidelines to enhance workforce capabilities over the next 3–5 years, aiming to upgrade both entrepreneurs and workers to adapt to industrial transition and remain competitive. Key components include a gap analysis, selection of target automotive parts groups, and an assessment of corporate strategies to inform policy recommendations. The roadmap is based on an in-depth analysis of current trends and future EV demand. The strategic selection of key automotive parts groups was conducted to identify competitive opportunities. It was found that the transition from ICE to EV vehicles, driven by China's growing EV presence and technological advancements, presents challenges for Thailand's supply chain, particularly for local suppliers. Additionally, the adoption of automated manufacturing may lead to job displacement, highlighting the urgent need for workforce reskilling and supportive policy measures to facilitate a smooth industry transition. Moreover, emphasis is placed on common ICE-EV parts, such as tires, brake systems, suspensions to help maintain supplier competitiveness, and on Research and Development in battery and electronic systems to strengthen workforce capabilities and ensure long-term industrial resilience.

Paper ID: 87 *China's Response to Carbon Neutrality*

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Climate change and carbon dioxide emissions reduction are attracting an increasing attention among policymakers globally. Many developed and emerging economies have committed to reducing carbon dioxide emissions and have implemented climate change policies in recent years. The relationship between environmental regulations and market performance has been widely discussed in existing literature. However, limited research is undertaken to examine the market response to environmental protection initiatives. In September 2020, China announced its carbon neutrality initiative that the country, which is the second largest economy in the world, will peak its carbon dioxide emissions before 2030 and achieve carbon neutrality by 2060. Our study investigates the impact of this event on China's stock market by using both the constituent stocks of the CSI 300 Index and those of the later established SEEE Carbon Neutral Index. Results indicate that stocks with a carbon-neutral concept respond positively to the Government's climate change commitment.

Paper ID: 96 *Removal of Amaranth Dye from Water by Magnetically Active Silica Nanoparticles*

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The objective of the study is the development of an in expensive adsorbent having improved adsorption capacity using renewable resources. This study focusses on extraction of silica nanoparticles from rice husk ash (RHA) and further the development of magnetically active silica nanoparticles by iron oxide. The silica nanoparticles were investigated by FTIR. Scanning electron microscope was utilized to ascertain shape and particle size (400-600nm). Adsorption of amaranth dye onto both pristine silica and magnetically activated silica nanoparticles was investigated utilizing established factors such as contact time, pH, shaking speed, adsorbent dosage, initial dye concentration, and temperature. The outcomes of the experiments revealed that silica coated magnetic nanoparticles have removal efficiency of 86.3% at 30mins, pH = 4 at speed of 150 rpm. Isothermal and kinetic analysis were conducted utilizing Langmuir, Freundlich, pseudo 1st order, and 2nd order models. The findings endorsed that adsorption best fits the Langmuir model and follow pseudo 2nd order kinetics.

Paper ID: 107 *Data-Driven Sustainability in Higher Education Institution: Analysing Carbon Emissions, Absorption, and Reduction Strategies for Achieving Carbon Neutrality*

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Higher education institutions (HEIs) are very important for fighting climate change and promoting sustainability. Universities all over the world are using the United Nations Sustainable Development Goals (SDGs) as a guide to start efforts to cut carbon emissions and promote sustainability. These goals include SDG 13 (Climate Action), SDG 7 (Affordable and Clean Energy), and SDG 11 (Sustainable Cities and Communities). This study was done to find out how much carbon Universiti Malaya (UM) emits, which is in line with Malaysia's goal of having net-zero emissions by 2050. The study's main goals are to examine at the Universiti Malaya campus energy use, energy sources, emissions, carbon emissions, and carbon sequestration. A quantitative approach was used, with a focus on important areas like the use of electricity and thermal energy, transportation, waste generation, and campus greenery. The Finding show that electrical consumption is the biggest part of UM's carbon footprint and different faculties utilize energy at very different rates. This is followed by emissions from transportation, LPG-based thermal systems, and waste generation. In contrast, UM's green and forested areas contribute significantly to carbon absorption, with over 13,000 tonnes of CO_2 stored and approximately 251 tonnes sequestered annually through trees. The study highlights the significance of accurate emissions measurement, innovative carbon absorption approaches, efficient carbon trading plans, and technological and policy measures. Achieving UM's carbon neutrality objectives and setting an example for sustainable campus development worldwide will require enhancing low carbon mobility solutions, improving efficiency, and strengthening the integration of renewable energy.

Paper ID: 109 *Japan-ASEAN for a Sustainable Future through Proactive Energy Management: An Initiative for Accelerating the Transition to Fully Renewable Energy*

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The transition to a renewable energy future in Japan and ASEAN demands a fundamental paradigm shift in energy management. This paper leverages Proactive Energy Management (PEM), emphasizing anticipatory operations, consumer participation, and decentralized optimization. We present the pioneering Japan–ASEAN for a Sustainable Future through Proactive Energy Management (JASFPEM) initiative, a first-of-its-kind multilateral collaboration explicitly designed to drive this proactive energy transition across the Japan ASEAN region, supported by JASTIP, AUN, AUN/SEED-Net, and JICA. A key novel strategy within JASFPEM is Future Load Profile Nomination (FLPN), alongside advanced Artificial Intelligence (AI) for enhanced forecasting and adaptive control. This initiative uniquely leverages coordinated science, technology, and innovation (STI) to accelerate renewable energy integration and reduce fossil fuel dependence. JASFPEM aligns with

the ASEAN Power Grid (APG) vision and contributes significantly to key United Nations (UN) Sustainable Development Goals (SDGs): SDG 7(Affordable and Clean Energy), SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 17 (Partnerships for the Goals), serving as a scalable model for a proactive and collaborative regional energy transformation.

Paper ID: 114 *The Prospective of Bacterial Cellulose as Green Material for Wound Healing*

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Bacterial cellulose (BC), a biopolymer produced by several bacterial species, is becoming increasingly popular as a green material for biomedical applications, notably wound healing. This mini review aims to explore into the prospects of BC as a green material for therapeutic applications, focusing on wound healing. Produced via microbial fermentation, BC generates an ultra-fine nanofibrillar network with excellent crystallinity, tensile strength, and water retention capacity. Its distinctive biocompatibility, flexibility, and permeability make it an excellent wound dressing material, allowing for cell adhesion, moisture management, and gas exchange while reducing pain and infection risks. Compared to traditional dressings, BC has significant environmental advantages: it is totally biodegradable, generated under moderate circumstances without harmful reagents, and sustainably sourced including agro-industrial or organic waste, promoting a circular bioeconomy.

Paper ID: 124 *Pathways Towards Low-Carbon and Climate Resilient for Public Transport: A Case Study of Northern Bangkok Metropolitan Region, Thailand*

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This study aims to develop integrated pathways for low-carbon and climate-resilient public transport in the Northern Bangkok Metropolitan Region, Thailand. Public transport in this rapidly urbanizing area plays a crucial role in regional mobility but faces major challenges, including greenhouse gas (GHG) emissions, aging infrastructure, and climate vulnerability. Using a mixed-method approach consisting of policy review, focus group discussions, and qualitative content analysis, the study applied a function-based framework to identify synergies and trade-offs between mitigation and adaptation. Key findings emphasize the importance of resilient infrastructure, clean energy technologies, and intelligent mobility systems for achieving dual climate goals. However, significant trade-offs, including investment needs and institutional coordination, must be addressed. Policy integration, financial incentives, and public–private collaboration are recommended to support a sustainable transition. These insights inform policy-oriented strategies for transforming urban transport systems under climate constraints. The findings contribute to ongoing discussions on policy-driven solutions for urban transport transformation under climate change constraints.

Paper ID: 137 *Robust Power System State Estimation Using Future Load Profile Nominations with Weighted Least Absolute Value Optimization*

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Conventional power system state estimation heavily depends on SCADA measurements, which are often limited in resolution and coverage especially in distribution networks. This paper introduces a robust estimation framework that integrates synthetically generated Future Load Profile Nominations (FLPN), forward-declared consumer load expectations, into a Weighted Least Absolute Value (WLAV) optimization model. Unlike traditional pseudo-measurements based on historical data, FLPNs include user-declared accuracy levels, enabling confidence-weighted estimation. The framework is evaluated on the IEEE 14-bus test system and extended to the IEEE 57-bus test system to assess scalability across 16 simulation scenarios defined by varying FLPN participation rates and declared

accuracy levels. Results show that WLAV maintains estimation robustness under data uncertainty and sparse observability, particularly when moderate participation is paired with high accuracy. Root Mean Square Error (RMSE) analyses for voltage magnitude and angle confirm the estimator's resilience, supporting the viability of the FLPN-WLAV framework for future participatory state estimation in smart grid environments. This approach further contributes to advancing United Nations (UN) Sustainable Development Goals (SDG) 7, 9, and 11 by promoting resilient, participatory, and data-driven power system monitoring in emerging smart grid environments.

Paper ID: 138 *Future Load Profile Nomination (FLPN) Based Anomaly Detection in Power Systems Using a Modified CUSUM Algorithm under Varying Nomination Accuracy and Participation*

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The dynamic nature of power consumption at the distribution level presents a persistent challenge for efficient anomaly detection, particularly under limited measurement availability. Traditional CUSUM-based methods often misinterpret normal fluctuations as faults due to their reliance on static baselines and lack of scale adjustment. This study proposes a Modified CUSUM algorithm that integrates Future Load Profile Nominations (FLPNs) with residual normalization and drift compensation to improve anomaly detection sensitivity and reliability. The method was implemented on the IEEE 14-bus system and evaluated across 16 sensitivity scenarios varying FLPN participation (25%–100%) and accuracy (25%–100%) using Monte Carlo simulation. Results from the 14-bus system showed that the Modified CUSUM consistently maintained a False Alarm Rate (FAR) below 4.5% and a Missed Detection Rate (MDR) of 0.0% across all scenarios. In contrast, the Traditional CUSUM with FLPN exhibited FARs between 53.8% and 57.5% and MDRs from 49.0% to 52.6%, while the Traditional CUSUM without FLPN performed worst with FARs above 84% and MDRs ranging from 65.5% to 69.7%. To assess scalability, the method was also applied to the IEEE 57-bus system, where it maintained an average FAR of 3.87% and MDR of 0.0%. These results confirm the Modified CUSUM's robustness under degraded data conditions and its suitability for real-world deployment in smart grids where FLPN availability and quality may be limited.

Paper ID: 139 *Sensitivity Analysis of Future Load Profile Nomination (FLPN) Accuracy and Participation in PV-BESS-EV Microgrid Dispatch*

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This study investigates the impact of Future Load Profile Nominations (FLPN) on optimal energy dispatch in a microgrid integrating photovoltaic (PV), battery energy storage systems (BESS), and electric vehicles (EV). A sensitivity analysis was conducted across varying levels of FLPN participation and declared accuracy, evaluated under three operational scenarios: (i) baseline dispatch with no FLPN or EV flexibility, (ii) FLPN-enabled dispatch with flexible EV charging, and (iii) FLPN-enabled dispatch with bidirectional EV support (V2G). Each configuration was simulated over a 168-hour horizon using 100 Monte Carlo runs. Results show that while Scenario i remains insensitive to FLPN quality, Scenario ii exhibits modest gains, and Scenario iii demonstrates significant improvements in dispatch cost, grid dependency, and EV contribution as participation and accuracy increase. These findings contribute to the achievement of United Nations (UN) Sustainable Development Goals (SDG) 7 and 13 by promoting clean energy integration and climate-resilient dispatch strategies through proactive, user-driven energy management.

Paper ID: 141 *Enhancing Crowdsourced Load Forecasting with Future Load Profile Nomination (FLPN)*

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Accurate load forecasting in power distribution networks remains a constant challenge, particularly due to the high variability introduced by renewable energy sources. Traditional ensemble forecasting methods are effective, but they rely heavily on historical data. This study proposes a novel two-stage crowdsourced forecasting framework that enhances prediction accuracy by incorporating a model-generated Future Load Profile Nomination (FLPN). The framework was evaluated using a 31-day hourly load dataset from the NGCP Luzon grid. Two forecasting approaches were compared: Scenario A, which used only historical data as the baseline, and Scenario B, the proposed two-stage method. Results showed that the new framework significantly improved forecast accuracy, reducing the

Mean Absolute Error (MAE) by 15.2% and lowering the Mean Absolute Percentage Error (MAPE) by 15.8% for the best-performing ensemble. These findings demonstrate that combining historical data with model-generated future profiles enhances both the accuracy and reliability of short-term load forecasting.

Paper ID: 144 *A Review of Power System Inertia Estimation under Incomplete Observability: An Opportunity for Integrating Future Load Profile Nomination*

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The reliable operation of modern power systems is increasingly challenged by declining system inertia, primarily due to the growing integration of inverter-based resources (IBRs) and distributed energy sources. Estimating system inertia under these evolving conditions is critical for maintaining frequency stability, yet traditional methods often rely on high-resolution data from Phasor Measurement Units (PMUs), a resource that remains scarce in many parts of the world. This review investigates existing of line and online inertia estimation techniques and their limitations under incomplete observability. To address these gaps, the paper introduces the potential role of Future Load Profile Nomination (FLPN)—a novel, user-driven approach where consumers voluntarily nominate anticipated load profiles. Unlike traditional forecasting, FLPN offers a proactive layer of situational awareness that could complement or enhance existing estimation methods, especially when PMU data is limited. The paper explores various techniques for generating synthetic FLPN data, including clustering and probabilistic modelling, and discusses their integration into inertia estimation frameworks. Ultimately, the study positions FLPN as a promising direction for improving inertia estimation in low-observability environments and supporting broader smart grid objectives through enhanced demand-side engagement. This review supports the United Nations Sustainable Development Goals, particularly Goal 7: Affordable and Clean Energy and Goal 13: Climate Action, by advancing more resilient and intelligent energy systems that encourage cleaner generation and active participation from energy consumers.

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