



# ABSTRACT BOOK



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## **SYMPOSIUM 1**

# **RENEWABLE ENERGY SHIFTING STRATEGIES THROUGH POLICY, SOCIAL AWARENESS, AND ECONOMIC MODEL**

# Factors Affecting E-Scooter Sharing Purchase Intention: An Analysis Using Unified Theory of Acceptance and Use of Technology 2 (UTAUT2)

Belinda Azzahra, [Belindaazzahra22@gmail.com](mailto:Belindaazzahra22@gmail.com)

**Abstract.** Transportation uses a significant amount of energy and burns most of the world energy consumers. As a result, it gives effect to the environment, such as air pollution in the forms of carbon dioxide, carbon monoxide, nitrogen oxide, hydrocarbons or volatile organic compounds, and particulate matter. Those compounds contribute a phenomenon called global warming. Within the transportation sector, road transport is the largest contributor to global warming. To cope with global warming, environmental regulations in developed countries are trying to reduce the individual vehicle's emissions. However, this has been counterbalanced by an increase in the number of vehicles and increased use of each vehicle. Therefore, micro-mobility may alleviate several challenges facing big cities today and offer more sustainable urban transportation. This research utilizes the framework of the UTAUT2 to identify and build a quantitative approach to identify factors related to the purchase intention factors of e-scooter sharing. The 200 respondents' field data were collected in Jakarta Metropolitan Area (Jabodetabek) as a rapid increase in pollution level. The linear regression study revealed that the consumers' purchase intention of e-scooter sharing is shaped by seven main factors: performance expectancy, effort expectancy, social influence, facilitating condition, hedonic motivation, price value, and habit. Those factors can explain 81 percent of the field data. Moreover, a brief recommendation for related stakeholders based on the research result is proposed to increase the adoption of e-scooter sharing. The practical implication resulted from this analysis are suggested policy measures the e-scooter sharing environmentally impact potency and strengthening circular economy as a part of green economy achievement in the communities.

**Keywords :** Behavioral Intention, Circular Economy, E-Scooter Sharing, and Jakarta

# Energy Transition: A Study Of Shifting Strategies Through Policy For Renewable Energy In India

Juhi Jain

Young Professional, NITI Aayog, Govt. of India

[juhijain044@gmail.com](mailto:juhijain044@gmail.com)

**Abstract.** India is on a rapid growth trajectory supported by its diverse demographic, technological intelligence and innovation ecosystem. It boasts of a 1.3 billion strong population, a GDP of 3 trillion USD, and ranks 48th on the global innovation index. The growth of this scale has a major impact on the use of natural resources and carbon emissions, and India is the third- largest emitter of greenhouse gases, behind China and United States. In 2021, India accounted for 3 giga tonnes of carbon or 6.8% of the total global emissions. For a vast nation like India, it is key to harmonize economic development with sustainable environmental development. The government has continuously strengthened the nation's commitment to renewable energy sources by setting up institutions as well as by formulating policies for solar, wind and alternate fuel sources. This paper is a study of the numerous shifts in the energy policy of India from fossil dependent to a producer and consumer of renewable energy sources. The research is done through extensive literature review, abstraction of qualitative data, insights using secondary data sources and data analysis. The author critically examines the relevant Indian institutions, schemes and policy initiatives to create sustainable development through alternative energy sources. The paper also sheds light on the innovations in the field. The paper concludes with a focus on ethanol, methanol and hydrogen, and how the country is harnessing the latent potential in these fuels of the future.

**Keywords :** Renewable energy, Policy, Sustainable, Alternate Fuels, Carbon emissions

# Barriers and Opportunities Of Bio-Pellet Fuel Development In Indonesia: Market Demand And Policy

Indira Pradnyaswari, Jeremy Nugraha Pongrekun, Pandu Ridhana, and Ibnu  
Budiman

[indira.pradnyaswari@gmail.com](mailto:indira.pradnyaswari@gmail.com),

**Abstract.** Bio pellet is a type of biomass that has excellent prospects to be developed in Indonesia. The potential for developing biomass energy is estimated at 50 GWe, while the installed capacity using biomass energy in Indonesia is around 1600 MW by 2018. This study analyses barriers and opportunities of bio-pellets development in Indonesia. We used a systematic literature review (SLR) that resulted in 28 papers and interviews with multiple related stakeholders such as academics, policymakers, NGOs, and bio pellet industries. We found that lack of market demand is one of the main barriers to bio pellet development. 90% of the market demand for Indonesian bio-pellet originates from Japan, Korea, and China. This export is supported by production in Java, Sumatra, and Borneo. Only 10% of the demand comes from the national market. The highest demand in Indonesia comes from Java (70%) for power plants and other industries such as food, cosmetics, ceramics, and furniture industries. To increase national demand, over the past year, the Indonesian government started implementing a co-firing policy to increase biomass (including bio-pellets) utilization in coal power plants. This paper summarizes the current situation and policy regarding the (low) market demand for bio-pellets in Indonesia.

**Keywords :** Bio-Pellet, Market Demand, Policy, Barriers and Opportunities, Indonesia

# Market and Financial Scheme Analysis of Residential Rooftop Solar PV Based on Payback Period from Available Business Models in Jakarta, Indonesia

Renewable Energy  
International Youth Summit of Renewable Energy

Alifya A. Khairany  
(alifya.ananda@ui.ac.id)

Yohanes M. Septianus  
(yohanesseptianus.205011@mhs.its.ac.id)

Fikui Siami  
(fikui.siami@ui.ac.id)

**Abstract.** Indonesia is well-known for its abundance in solar energy potential. This is also supported can be seen through Ministry of Energy Mineral Resources' ambitious target in reaching 6.4 GWp of installed capacity by 2025. The cost-effectiveness/cost reduction in recent years of the technology and at the same time increase in environmental awareness had also led to the positive growth of its application in the residential sector especially in the capital city of Indonesia, Jakarta. Despite that, the expected market penetration still seems to be not optimal compared to the forecasted potential; the State Electricity Company had only identified 703 solar PV rooftop residential users until the first semester of 2020. Main reason to this trend might be due to the perception of local communities on this particular technology being expensive or in other words a not worthy investment due to its long payback period. This paper therefore focuses on analyzing the aforementioned factor/measure under the prevailing net-metering scheme with the site-specific attributes of the city. Comparison on the latest financial models such as the traditional host-owned and lease system offered by the local developers with the combination of market analysis will also be elaborated further throughout the study. The results can be useful for both the communities and PV developers with their future strategic decision making.

**Keywords :** Business model, PV Market Analysis, Payback Period, Jakarta PV Market.

# Analysis of Payback Period on Residential's Rooftop Solar Photovoltaic Installation in Surabaya, Indonesia

Made I. Yashwanta, Jonathan M. S. Atmaja, Reisyia

Nabila, Email: [madeizwar2@gmail.com](mailto:madeizwar2@gmail.com)

**Abstract.** Despite the fact that Surabaya is a city with one of the highest average irradiance in Indonesia, its solar photovoltaic (PV) market penetration appears to be slow or even stagnant. This trend can be clearly seen from the number of on-grid PV connections that are currently dominated by customers residing in Jakarta and the West Java region instead. Perception on the technology as an expensive product and unsatisfactory regulations might be a root cause to this trend. Therefore, the objective of this paper is to investigate the current amount of time for the local customers in Surabaya to break even on their investment - or payback period - under the current net metering scheme with the combination of the site-specific condition. Sensitivity analysis based on expected yearly increase of electricity tariff as well as change in compensation mechanisms will also be assessed in this paper. The results of the modelling and simulation are then to be compared with the payback period of neighboring countries that had shown successful massive deployment of residential PV even though the economic and geography conditions are quite similar. This study provides a comprehensive bottom-up approach and thus can serve as a basis for other succeeding city-level assessment.

**Keywords :** Net Metering, Payback Period, Residential, Solar PV and Surabaya

# **The REPaperclip-Ophelimity-Bank Project, A Novel Combinatorial Renewable Energy National Bank To RampingUp Throughout Predicting Financial, Resiliency Investment And Clean-Energy Feasible National Response**

**Mellin Hasna Nurfadhila, Email: [mellin.hasna@ui.ac.id](mailto:mellin.hasna@ui.ac.id)**

**Abstract.** Since its inception in the 1987 Brundtland Commission Report, its impact on the Renewable energy industry has scaled up to a size to imagined by its inventors, in contrast to most engineered systems, which fall apart when pushed beyond their design limits. In part, the renewable energy and cleaner power investments achieve this scalability because they can regulate the mandatory itself, deciding on the best routes to send product depending on traffic conditions. Like the brain, the economic system has a circadian rhythm. How would we know if the economy were to become aware of itself? The problem is that we do not even know if some of our fellow creatures on this planet are self-aware. The Renewable energy bank is already aware of itself. The REPaperclip-Ophelimity-Bank Project to economic fulfilment based on the battle for maximum ophelimity in terms of cyclic economic phenomena is a database of the primary resources of natural and industrial systems and their interaction with energy containing information on experimentally determined renewable energy industry sustainability, blueprint, maintainer and developer of the national business handler to evaluated from the aspects of economic viability and investment risks, energy efficiency and airborne emissions. Protecting minority investors, enforcing contracts, resolving insolvency, registering renewable energy property and urban planning to business regulations and present quantitative indicators to the ecology of the economic process and Management of Renewable Natural Resources.

**Keywords :** REPaperclip-Ophelimity-Bank, Management, Economy

# Study of College Students Perceptions about Geothermal Energy as Initial Step to Solve Social Acceptance Problem

Rifky W. Saputra, Rizma Halimatusadia, Wan Tjhen

[rifkywahyusaputra8@gmail.com](mailto:rifkywahyusaputra8@gmail.com)

**Abstract.** Renewable energy has captured the world's attraction due to environmental issues caused by fossil-based fuels. One of the biggest renewable energy resources in Indonesia is geothermal. Indonesia is one of the biggest countries whose 40% geothermal energy resource in the world but the utilization still 8,9% from the potency yet. One of the big bottlenecks of geothermal energy development in Indonesia is social acceptance. In this case, college students as agents of change and social control have the potential to solve the social acceptance problem of geothermal energy in Indonesia. But, before college students take action to solve the problem, their perceptions and knowledge about geothermal energy should be known. In this research, we focus on college student's perceptions about renewable energy especially geothermal energy. Data collection in this study was carried out by survey about how the college student's level of knowledge about climate change, renewable energy, and geothermal energy and also their perception about geothermal energy. For a while, in this paper, we distributed questionnaires to 48 Indonesian's students from various universities and major backgrounds. To analyze the result, we use the quantitative method. From the temporary result of the study, it was found that students have a positive perception of geothermal energy development in Indonesia. However, they still have weak knowledge about climate change, renewable energy, and geothermal energy. Therefore, students still need education about those topics before they solve the social acceptance problem in geothermal energy development in Indonesia.

**Keywords :** Geothermal, Perception, College Students

# Feasibility and Economical Analysis of OTEC Implementation in Indonesia

Jason J. A. Palenewen, Arkaan R. Usman, M. Hashfi R. Nur, Ardy Gamawanto

[jason.jimmy@ui.ac.id](mailto:jason.jimmy@ui.ac.id)

**Abstract.** Indonesia is overwhelmed with many potential renewable energy sources. One example that maximizes Indonesia's island structure is OTEC or Ocean Thermal Energy Conversion. OTEC is a power plant that utilizes the temperature difference in seawater to create energy. Researchers estimate that OTEC in Indonesia has a potential of up to 240000 MW, with the only project planned is to test and build a pilot plant in Bali with the help of Japan. At this moment, a few studies from Indonesia and foreign countries show that Indonesia has many potential sites for developing OTEC plants. Furthermore, there is not enough research conducted that is able to project OTEC use as a power supply at a large and profitable commercial level with the needed parameters. In addition, there are limitations to the current plant models and uncertainty around the technical requirements required to invest in OTEC that leads to the lack of development and progress in terms of research and planning in Indonesia. Therefore, this paper focuses on calculating a feasible economic model and plan of OTEC in certain locations in Indonesia. The methodology used to conduct this research studies the geographical conditions such as temperature differences and required technical specifications such as the type of liquid used for the closed OTEC cycle model. With the topic being the economic model, a lucrative point of view is covered, which takes into account electricity tariffs and discount rates with the output of a comparison between the NPV, IRR, and LCOE of different OTEC models.

**Keywords :** Renewable Energy, Ocean Thermal Energy Conversion, Indonesia, Economic Potential

## **SYMPOSIUM 2**

# **GREEN URBAN SYSTEM AND CITY DEVELOPMENT**

# Development of Smart Window Technology using Electrochromic-DSSC (Dye-Sensitized Solar Cell) Combination

Author, Email: Laurentius Kevin Hendinata<sup>1</sup>, Ahmad Ilham Rokhul Fikri<sup>2</sup>  
<sup>1</sup>kevinhendinata@mail.ugm.ac.id, <sup>2</sup>ahmad.ilham.rokhul.fikri@mail.ugm.ac.id

**Abstract.** The building sector is one of the largest contributors to energy consumption when compared to other sectors to provide a comfortable living for the occupier. The high energy consumption in this building is caused, among others, to regulate air temperature, ventilation, and artificial lighting. The development of window technology that is developing now has led to adaptive smart windows technology that has energy-saving features, one of which is electrochromic windows. The use of this electrochromic window is interesting because it can adjust the optical conditions by regulating the voltage between the two electrodes. The use of electrochromic windows in buildings has also been shown to save 30~40% of the building's total energy consumption, through reducing HVAC loads and providing natural light. However, in today's technology, its performance still requires external power to match the optical conditions. The development of electrochromic window technology combined with transparent or semitransparent photovoltaic layers is then proposed as one way to improve the energy performance of smart windows. Photovoltaic technology based on dye-sensitized solar cell (DSSC)  $\text{TiO}_2$  was chosen to be used in the configuration with  $\text{WO}_3$  electrochromic material because of its potential to provide more convincing energy benefits than other semitransparent photovoltaics. In addition, the optical performance of the smart window with this configuration arranged on a glass substrate can still provide performance like electrochromic technology, with a transmittance change up to 34.2%. Given the photoelectric modulation and optical properties of electrochromic photovoltaic windows that can function as solar cell modules as well as self-powered smart windows, this technology has great advantages in applying sustainable energy to buildings.

**Keywords :** smart windows, electrochromic, photovoltaic, dye-sensitized solar cell

# Tactical Urbanism Implementation as an Approach to Sustainable Cities in Surabaya

Author, Email: Cecilia Tandri<sup>1</sup>, Tiago Costa<sup>2</sup>  
<sup>1</sup>ceciliaactandri@gmail.com, <sup>2</sup>tiagocosta@mail.ntust.edu.tw

**Abstract.** “Sustainable Cities and Communities” is one of the United Nations Sustainable Development Goals, in which in its specific goal is to make cities and human settlements inclusive, safe, resilient, and sustainable. Majority of the cities in the world are facing the challenge of population growth, Indonesia is no exception. The rapid urbanization results in that half of Indonesia’s population are concentrated in Java Island. The cities in Java Island are struggling with traffic congestion, pollution, and continued shortages in access to basic services. While larger scale approaches done by governments and city planners seems inefficient, a small-scale approach using Tactical Urbanism can make substantial changes. Tactical Urbanism is a strategy for revitalizing and activating neighborhoods that focuses on short-term, low-cost, and scalable interventions and policies. Some cities in the United States like New York are already successfully using Tactical Urbanism. As a result, the area being subjected to Tactical Urbanism become less congested, accidents incidents drop, air pollution level drops and pedestrian traffic increases which directly boosts retail sales. This paper aims to implement Tactical Urbanism approach methods in Surabaya. Surabaya, one of the biggest cities in Indonesia, has already urban potential (unplanned or traditional practice) like car free day, food markets, wedding receptions, amongst others, that occur in the public street. By using Tactical Urbanism approach theories, this paper will try to demonstrate some possible street scenarios in case Tactical Urbanism would be implemented in Surabaya.

**Keywords :** sustainable cities, tactical urbanism, Surabaya, street

## **SYMPOSIUM 3**

# **ENERGY TRANSITION IN AGRICULTURAL, FISHERIES, AND RURAL AREAS**

# Fish Caller Equipment Using Microcontroller-Based Automatic Sound, Light, and GPS Module Settings with Solar Panels as Alternative Energy

Fauzan Rafi Miraj<sup>1</sup>, Email: [fauzanrafim@gmail.com](mailto:fauzanrafim@gmail.com)

Gifhar Rahman<sup>2</sup>, Email: [gifharrahman@gmail.com](mailto:gifharrahman@gmail.com)

Shania Mustika Ari<sup>3</sup>, Email: [shaniamustikaari@gmail.com](mailto:shaniamustikaari@gmail.com)

Alyssa Hayfa Zalsabila<sup>4</sup>, Email: [zalsabilaalyssa@gmail.com](mailto:zalsabilaalyssa@gmail.com)

Izzatun Nuha<sup>5</sup>, Email: [izzatun2001@gmail.com](mailto:izzatun2001@gmail.com)

**Abstract.** Indonesia is a maritime country with 5.8 million km<sup>2</sup> of sea and capture fisheries potential of up to 12.54 million tons per year. However, fishing activities in Indonesia have not been optimal and sustainable. The use of destructive fishing gear and traditional nets has threatened the existence of juvenile fish. These activities can result in a decrease in fish catches and fishermen's income. On the other hand, as a country with a high potential for global solar insolation in the range of 4.6 kWh/m<sup>2</sup> and 7.2 kWh/m<sup>2</sup>, sunlight has tremendous potential as a renewable energy source. Therefore, “Fish Caller Equipment Using Microcontroller-Based Automatic Sound, Light, and GPS Module Settings with Solar Panels as Alternative Energy” is an innovation to help in catching fish. This research uses the study of literature, visual data mining, and waterfall methods. The work system of this innovation uses a microcontroller of Raspberry Pi3 to cultivate and display received data from installed sensors. This tool will work by detecting the fish using a temperature sensor and GPS module. After an indication of the fish turns up, the fish caller will turn on with light output and frequency that has been set based on the size and species of the fish. Therefore, this tool has the potential to realize sustainable and environmentally friendly fishery activities.

**Keywords :** Fishing, Light, Microcontroller, Sound

# The Potential of Cocoa Nibs Shell Waste for Bioethanol to Support Energy Transition in Cocoa Plantation Central Sulawesi

Safira Nurul Izzah, [safiranzah@student.ub.ac.id](mailto:safiranzah@student.ub.ac.id)  
Christabel Putik Blessya, [christabelputik@student.ub.ac.id](mailto:christabelputik@student.ub.ac.id)  
Eldo Iriyo Chamida Madina, [eldoircm@student.ub.ac.id](mailto:eldoircm@student.ub.ac.id)  
Agriculture Faculty, Brawijaya University

**Abstract.** Energy as the fundamental element in our social life certainly increases, the higher population in one country are followed by the higher energy needed. Total energy consumption in Indonesia reached 875 million barrels which is dominated by fossil fuel. As the main source of energy, fossil fuel causes negative impacts especially in the environment, it also influences the health problems, economic, and social system effect. The exploitation of fossil fuel resources could significantly increase the earth temperature and accelerate the pace of climate change. On the other hand, Indonesia has high abundance of natural resources that can be implemented on renewable energy. One of the resources is biomass which should be utilized to fulfil the energy consumption in Indonesia. Bioethanol is one of the products derived from biofuels that can be used to replace fossil fuel energy which more environmentally friendly. The main component of bioethanol should contain high number of lignin cellulose and starch as its materials. Cocoa nibs shell (CNS) has high content of lignin cellulose and starch. Indonesia is one of the top 3 cocoa producing countries in the world, especially in Central Sulawesi. There is 283.000 ha of cocoa land area in Palu, this indicates that cocoa plantations produce a lot of agricultural waste and have not been utilized. Meanwhile, around 13% of 769.000 tons of cocoa production in Indonesia produce CNS waste. In this paper explained the potential of the CNS waste for bioethanol production. The production of bioethanol was carried out by physical pretreatment (rough and fine grinding), hydrolyzed using acid solution HCl (0,5 M/dm<sup>3</sup>), fermentation using varying yeast concentration (0,01 to 0,05 mg/g) 24 hours fermentation and distillation process. The result showed the CNS is prospective to use as the main source for bioethanol as renewable energy to reduce the environmental problems.

**Keywords :** Biomass, CNS, Environmental, Prospective

# Innovative Way to Generate Electricity by Using Microbial Fuel Cell from Palm Oil Mill Effluent for Implementation of Indonesia's SDGs7 Program

Monika Pasuria Rumapea, Arya Fitra Jaya, Noor  
Kharismawan Akbar, Email: [monikarumapea34@gmail.com](mailto:monikarumapea34@gmail.com)

**Abstract.** According to data from the United States Department of Agriculture, Indonesia is the largest producer and exporter of palm oil worldwide, which produces 85-90% of total palm oil production. Palm oil industry produces liquid waste called POME (Palm Oil Mill Effluent) about 190.06 million ton in 2021 which can have a serious impact on the environment. The utilization of the POME reduces the volume of effluent therefore significantly reducing methane gas emission which is categorized as greenhouse gas and also reducing our carbon emission by approximately 50,000 Ton CO<sub>2</sub>. One of the utilizations of POME is to make an alternative renewable energy by using eco-friendly Microbial Fuel Cell (MFC) technology that can support environmental sustainability. MFC is a bio-electrochemical technology that produces electricity by using the electrons derived from biochemical reactions catalyzed by bacteria. This paper was conducted using the literature study method which collects data from various literatures to be compared and then analyzed to achieve the maximum electrical energy output generated from the MFC. *Klebsiella variicola* was investigated using Dual Chamber MFC with carbon brush as electrodes and separated using cation exchange membrane Nafion 117. POME wastewater with Chemical Oxygen Demand (COD) 28,18 mg/L with further sterilization was subjected as substrate for MFC operation. *K. variicola* was isolated from municipal wastewater as well as from biofilm of MFC as inoculum. Microorganism type was identified using BIOLOG gene III analysis. This paper covered the comparison of performance between single and dual chamber MFC. Result of power density from microorganisms inoculated from municipal wastewater and controlled inoculum was also studied. MFC showed maximum performance with power density of 4.5 W/m<sup>3</sup> calculated using a digital multimeter. Coulombic efficiency 63% and COD removal efficiency 58% was achieved by continuous feeding of sterilized POME.

**Keywords :** POME, MFC, Crude Palm Oil, Renewable energy

# Biofarm: Smart Monitoring for Lettuce Hydroponic Plants Powered by P&O MPPT Solar Energy System in Karang Joang Village

<sup>1</sup>Kelly Venia Lepa, <sup>2</sup>Muhammad Iqbal Sugiharto, and  
<sup>3</sup>Yosefiana Aba Wowoseko

<sup>1</sup>[kellyvlepa@gmail.com](mailto:kellyvlepa@gmail.com), <sup>2</sup>[iqbalscout11@gmail.com](mailto:iqbalscout11@gmail.com), and  
<sup>3</sup>[yosefianabawowoseko@gmail.com](mailto:yosefianabawowoseko@gmail.com)

**Abstract.** Karang Joang is one of the villages in Balikpapan City, East Kalimantan Province, Indonesia that produce various vegetables for city's supply. This village has a very diverse potential of natural resource, such as dragon fruit, papaya, and lettuce. Even for the lettuce, the demand per week is around 60 kg. To fulfill this demand, lettuce cultivation with the hydroponic is developed where the hydroponic is a plants cultivation by utilizing water without using soil media and emphasizing the fulfillment of nutritional needs for the plants. Using this hydroponic method, the given nutrients at the lettuce result that always fresh and keep the lettuce leaves from wilting easily. However, harvesting process takes a long time to monitor the hydroponic area (3 hectares), which is 30 minutes. To ease the harvesting process for farmers to monitor the nutrient levels in hydroponic water, a Smart Monitoring system is proposed. Using the smart monitoring system, the farmers can check the nutritional information (PPM), pH level, the humidity level, the temperature in the nutrition water and also in the hydroponic area only takes a second. All information are obtained by using Arduino Uno microcontroller that commands the existing sensors. Smart Monitoring system is connected via IoT enabling this system to monitor using a smartphone that is synchronized to esp8266 and can be operated on the Blynk applications. Based on climatological data, the average length of sunshine in Balikpapan City in 2014 was 50.09%, which figure an enormous potency to apply a solar energy system that can cut the monthly electricity costs of hydroponic farmers for the hydroponic water pump system. This Biofarm hydroponics will be powered by a solar energy system that used an MPPT (Maximum Power Point Tracking) with PnO (Peturb & Observe) method to get maximum power conversion on solar photovoltaic.

**Keywords :** Microcontroller, MPPT, PNO, PPM.

# Temperature and Radiation Intensity Changes Impact to Solar Power Plant Output in Kalimantan Barat in Achieving General National Energy Plan 2050

Alessandro Putra, William Rasendriya, and Nathaniel Lincoln,  
Email: [aleputra7@gmail.com](mailto:aleputra7@gmail.com)

**Abstract.** Indonesia has set a carbon-neutral target by 2060. This target causes electricity production using coal to be converted into renewable energy. Based on the General National Energy Plan, solar power has a high potential. West Kalimantan is the province with the largest potential, amounting to 20,113 MW. In practice, there are natural factors that will change the results of this capacity, one of which is climate change. Therefore, the power generated by solar in 2050 will be calculated after experiencing the climate change factor. Climate change has two main factors, radiation intensity, and temperature changes. As the main source of solar energy, the intensity of solar radiation is an important factor. The greater the radiation intensity, the higher the power generated. In addition to the intensity of the sun, the temperature can also affect the performance of PLTS. The role of temperature is in the calculation of the PLTS power output as a temperature factor variable. The higher the temperature around the PLTS, the more power produced by the PLTS will decrease. The temperature change data used in this study is the projection of the average annual change in air temperature for the period 2020-2049 to 1976-2005 using the RCP8.5 scenario in the West Kalimantan region, which is obtained from the BMKG. Using an equation from the Journal of Electrical Engineering, Tanjungpura University, the output power of PLTS in West Kalimantan in 2050 is estimated to be around 3.94 kWh/m<sup>2</sup> after experiencing a temperature change of 1.1°C. Based on the calculation, the output power is significantly decreased by climate change.

**Keywords :** Climate Change, Temperature, Radiation, Power Output.

# Effect from Climate Change to Water Supply and Hydropower in Java

Muhammad Rahmadito and Muhammad Senna, Email :  
[ramadit00@gmail.com](mailto:ramadit00@gmail.com)

**Abstract.** Hydropower is a renewable energy which exist since ancient times. Hydropower depends on rainfalls as its water supply for energy generation. But, rain precipitation expected to change due to climate change. This paper analyzing effect of rain precipitation change from climate change to hydropower generation in Java, Indonesia. We use rain precipitation change data from Indonesia's Meteorology, Climatology, and Geophysical Agency. Rain precipitation change estimated according to RCP 4.5 and RCP 8.5. This paper used simplified model of hydropower generation which limit water input to rainfalls only. We found that climate change will affect negatively to hydropower generation in Java.

**Keywords :** Hydropower, Climate Change, Java, RCP 4.5, RCP 8.5.

# HHO-LPG Optimization Using Solar Panel With 60°-70° Tilt Angle Reflector In Agricultural, Fisheries, and Rural Areas

Gandi Prasetyo, Email: [gandipras36@gmail.com](mailto:gandipras36@gmail.com)

**Abstract.** Oxyhydrogen gas (HHO) is an energy that formed by electrolysis process of the water using DC current. Water is a renewable and cheap energy, because it have a lot of reserves in our world. Moreover, it can be obtain for free. Liquefied petroleum gas (LPG) is a main needs in cooking activities in the most Indonesian people. High demand for LPG can lead to product scarcity (because of LPG is non-renewable energy) and a significant price increasing in society. Using HHO-LPG combination is expected as one of the ways to reduce the consumption of non-renewable energy and increase society's economic especially in rural areas . But, in another side, increasing consumption of non-renewable energy may be happened if electrolysis process is using non-renewable electricity power resources. Therefore, the HHO-LPG combination need to be optimized by using solar panel with flat reflector, to obtain a reduction in non-renewable energy consumption. This research aims to determine the effect of embedding a flat reflector in solar panel to output power that bring an impact on increasing HHO gas producing used in HHO-LPG combination by literature study method. The result show that embedding reflector can increase the output power by 32.89% than the normal solar panel. This condition cause pure LPG saving by 36.24%. The economic calculation show that this technology can save money by Rp340.720 /year for 3 kg LPG and Rp523.120/year for 12 Kg LPG. Total investment for this technology is only Rp600.000 which can be got back in 2.97 years (2 years and 354 day) for 3 Kg LPG, and 1.56 years (1 years and 205 day) for 12 Kg LPG based on payback period method.

**Keywords :** HHO, LPG, Solar Panel, Reflector

# Designing of Ocean Current-Solar Hybrid Generation System for Green Boat in Jepara to Achieve Affordable and Clean Energy

Afriza N Sa'Adah, Galih W. Agung, Maureen Y. Tiurma,  
Raga Bimantoro, Email: [afr312000@gmail.com](mailto:afr312000@gmail.com)

**Abstract.** Sea transportation has a significant contribution to the release of CO<sub>2</sub> gas into the atmosphere. Therefore, efforts to reduce CO<sub>2</sub> gas emissions and energy savings in sea transportation are needed. This effort can be made by utilizing renewable energy as a generating system for boats. Various renewable energies that can be utilized include ocean current and solar energy. This paper aims to overview ocean current and solar as energy for power generation on boats, integrate ocean current and solar energy, design a green boat model, and determine the best location for this green boat application. This paper recommends the use of a Gorlov turbine as an ocean current energy generation unit due to its relatively high efficiency (up to 35%). The use of perovskite solar cells (PSC) is also recommended in this paper. Perovskite solar cells can absorb most of the sun's spectrum and work in various atmospheric conditions. The generation system of this green boat includes a perovskite solar cell energy generation unit, a Gorlov turbine, Maximum Power Point Tracking (MPPT) for controlling and stability, a battery storage system, a diesel generating set, grid-tied/stand-alone controlled inverters, a rectifier AC-DC, and a battery management system (BMS). This paper recommends Teluk Awur Beach in Jepara Regency as a location for green boat applications. This green boat innovation is expected to achieve Sustainable Development Goals number 7 (affordable and clean energy).

**Keywords :** Perovskite solar cell, Gorlov turbine, Green Boat

## **SYMPOSIUM 4**

# **MECHANICAL, ELECTRONIC, INFORMATICS, AND MECHATRONICS IN INDUSTRY 4.0 FOR FUTURE DEVELOPMENT OF RENEWABLE ENERGY**

# Design and Optimization of Concentration Ratio through a Parabolic Dish Reflector with non-metal Polymeric Film Material on Concentrating Solar Power (CSP)

Author, Email: Naufal Baihaqi Al Afkar  
baihaqinaufal@students.unnes.ac.id

**Abstract.** Concentrating Solar Power (CSP) technology applies the principle of concentrating solar heat, which is directed at the receiver, namely the surface of the stirling engine by the concentrator in the form of a mirror. The stirling engine applies the concept of converting heat energy to kinetic energy through heating and cooling of the working gas or fluid in the vacuum cylinder chamber. This technology is suitable to be implemented in Indonesia due to intense solar radiation, the potential of solar energy that can be generated at 3.41-4.47 kWh/m<sup>2</sup>/day. CSP design applied in this study using a model parabolic dish with a formula calculated by a researcher. The polymeric material non-metal film used in this design due to its characteristics has a reflection ratio of 98%, this value is greater than the material generally used as a Highly polished stainless steel mirror. Testing the design using the Finite Element Analysis (FEA) method through COMSOL Multiphysics Software with calculation settings on Physics Interfaces Ray Tracing. Obtained from the simulation of an increase compared to the current model, namely an increase in the accuracy of the reflection of light to the receiver, the radiation power potential, and the value concentration ratio. Non-metal Polymeric Film material provides a minimal level of light absorption and can reflect light in a focused manner so that it has an impact on increasing the temperature received by the receiver. Increasing the surface temperature of the receiver has the effect of increasing the radiation power produced, this is because more heat energy can be converted into electrical energy in the stirling engine. In the modeling before optimization, the maximum radiation power point generated is 41.55 W/mm<sup>2</sup>, the average radiation power is 5.39 W/mm<sup>2</sup>, and the total radiation power is 167276 W/mm<sup>2</sup>. After the optimization process, an increase in the maximum radiation power point is 53.31 W/mm<sup>2</sup>, average radiation power of 6.73 W/mm<sup>2</sup>, and total radiation power of 199479 W/mm<sup>2</sup>. The increase in the efficiency of CSP performance can be shown by increasing the concentration ratio. The maximum concentration ratio is obtained from the optimization results at a value of 25.693 in the radial shift of the receiver position as far as 0.549 mm. The model before optimization only got a maximum value of 15.666 in the radial shift of the receiver position of 0.179 mm.

**Keywords :** Stirling Engine, CSP, Optimization, Reflector, Finite Element Analysis

# A Comparative Study of Paper-Based Microfluidic ( $\mu$ PAD) Miniaturization

Author, Email: Badril Azhar<sup>1</sup>, Faisal Amir<sup>2</sup>, Aditya Sukma Nugraha<sup>3</sup>  
<sup>1</sup>d10906832@mail.ntust.edu.tw, <sup>2</sup>faisalamir.umb@gmail.com, <sup>3</sup>adit003@lipi.go.id

**Abstract.** In recent years, paper-based analytical devices gained more attention for development of low-cost point-of-care diagnostic tools in many fields, such as point of care diagnosis, environmental testing, and food analysis. In the present study, we introduce a new paper substrate (Xuan paper) and compare to commercial filter paper (Whatman Great 1 and 2) with three hydrophobic materials (polydimethylsiloxane, wax, and Nail oil oil). The Xuan paper can be used for paper-based microfluidics analytical devices ( $\mu$ PAD) and that flow rate is reliant on many factors affecting fluid flow inside the channels. The free screen-printing method is used to fabricate hydrophobic channels by patterning hydrophobic materials onto paper substrate with the patterned channels reaching a minimum width of 0.2 mm and maximum 5 mm. The first task was to find the minimum channel width that could be obtained in the paper matrix with different hydrophobic materials and temperature setting. The fabricated channels were tested by using water with different paper types and different channel widths. The experimental results were compared with commercially available filter paper (11 and 21  $\mu$ m pore size). The results of this study are the smaller channel widths, the higher temperature that we need to apply and blocking materials are not influence to water speed, but the channel widths give more effect to water transport. The other influence of water flow is contact angle, so the higher contact angle of paper will achieve the lower water speed otherwise the lower contact angle reach higher water speed. Xuan paper and filter paper (21  $\mu$ m pore size) obtained a similar water speed, while filter paper (11  $\mu$ m pore size) was a little bit slower. On the other hand, jinghe and cotton Xuan paper displaced the least amount of water because of their fiber orientation and water being absorbed by it.

**Keywords :** Channel width, Fluid transport, Microfluidic, Xuan paper, Scratch time

# Portable Fluid Hybrid Generator

Author, Email: Madan M N<sup>1</sup>, Dhathresh M<sup>2</sup>

<sup>1</sup>madanmn1999@gmail.com, <sup>2</sup>dhathreshmohan1@gmail.com

**Abstract.** Possibility of manufacturing a portable hybrid power generator is being discussed. Generator would be able to make use of wind as well as hydro energy to generate electrical power. The principle is based on converting the kinetic energy of fluids into usable electrical energy. Design parameters and considerations are being investigated through relevant formulas and calculations. All of this, in an effort to improve the output and efficiency of the generator. Generator to be portable and small in size; to facilitate movement from one point to another. Feasibility of connecting multiple such generators in series to increase power output are also discussed. Aim to decrease dependency on conventional energy sources for power generation.

**Keywords :** Portable, Generator, Conventional

# Precise and Integrated System of Electricity in Indonesia : Integration of Electricity System to Solve the Problem of Renewable Energy Intermittent

Author, Email: Ilham Muhammad<sup>1</sup>, Nanda Febriyana<sup>2</sup>, Vicko Taniady<sup>3</sup>

<sup>1</sup>hanifsyahdansidiq2@gmail.com, <sup>2</sup>nandafebriyana31@gmail.com, <sup>3</sup>taniadivicko5@gmail.com

**Abstract.** The Indonesian government targets the renewable energy mix by 2025 to be 23%. However, the energy mix has not yet been achieved due to stagnant growth. This is because the investment cost of renewable energy is 15.13% more expensive than fossil energy, so it is not attractive to investors. This problem occurs due to the intermittent nature of renewable energy, as well as electricity distribution which is still manual so that it becomes inefficient and expensive. The purpose of this research is to design an integrated and precise system of electricity to answer the target of the renewable energy mix in 2025. The writing method used is Electricity Subject Headings, namely renewable energy, weather data, intermittent, machine learning. Inclusion and exclusion criteria were used to eliminate unrelated journals so that there were 25 journals. Based on this method, an integrated and precise electricity system design is obtained from upstream, midstream, and downstream. In the upstream, this system will predict the amount of power based on weather and geological data from BMKG as the supplied calculation variable. In addition, machine learning systems will be utilized so that the data supplied can be precise according to the variables obtained. Then, in the midstream, this system determines the shortest path in electricity distribution and manages the output of renewable energy. In midstream there are complementary applications for producers to monitor electricity production, and consumers to find out how much electricity is used. Finally, at downstream, a smartmeter will be used to harvest electricity consumption data in real-time from house in one area. The benefits of using this system are; First, it can automate the distribution of electricity. Second, reduce operational downtime in the event of an accident. Third, overcome the intermittent of renewable energy. Fourth, reduce the price of electricity production.

**Keywords :** Intermittent, Machine Learning, Renewable Energy, Weather Data

# The Effect of $((\text{NH}_4)_2\text{CO}_3)_n$ as Additives on the Electrochemical Performance of $\text{Na}_2\text{Li}_2\text{Ti}_{5,9}\text{Zr}_{0,1}\text{O}_{14}$ for Lithium-Ion Battery Anode

Author, Email: Natalin Elsa Maria<sup>1</sup>, Muhammad Rauf Usman<sup>2</sup>, Ryan Aziz<sup>3</sup>, Rasyid Sahirul Masjidi<sup>4</sup>, M. Fath Alwi Siregar<sup>5</sup>

<sup>1</sup>natalin@ui.ac.id, <sup>2</sup>muhammad.rauf@ui.ac.id, <sup>3</sup>ryanaziz2020@gmail.com, <sup>4</sup>rasyid.sahirul@ui.ac.id, <sup>5</sup>fathalwisrg@gmail.com

**Abstract.** Sodium Zirconium Doped Lithium Titanate Oxide ( $\text{Na}_2\text{Li}_2\text{Ti}_{5,9}\text{Zr}_{0,1}\text{O}_{14}$ ) is a promising candidate as a lithium-ion battery anode material. In this study, a liquid containing ammonium polycarbonate,  $((\text{NH}_4)_2\text{CO}_3)_n$  was added as a dispersant in the grinding process of anode wet material. Three variations of content change  $((\text{NH}_4)_2\text{CO}_3)_n$  in percent by weight relative to the weight of the anode, namely 0, 10, and 20 wt%. The anode material is synthesized with sol-gel method then characterized using X-Ray Diffraction (XRD) and Field Emission Scanning Electron Microscopy (FE-SEM). These tests are carried out to investigate the effect of  $((\text{NH}_4)_2\text{CO}_3)_n$ , on the structure, morphology, and surface area of the anode sample produced. The anode material is also subject to the Cyclic Voltammetry (CV) and Charge-Discharge (CD) tests, to investigate the electrochemical performance of  $\text{Na}_2\text{Li}_2\text{Ti}_{5,9}\text{Zr}_{0,1}\text{O}_{14}$  for lithium-ion battery anode after the addition of  $((\text{NH}_4)_2\text{CO}_3)_n$ . XRD characterization gives the result that the additives did not react with the main phase  $\text{NaLiTi}_3\text{O}_7$ . FE-SEM shows that the addition of  $((\text{NH}_4)_2\text{CO}_3)_n$  additive can prevent agglomeration of particles of active materials. Addition of 10%  $((\text{NH}_4)_2\text{CO}_3)_n$  additive gives the largest increase in capacity, from 10 – 12 mAh/g to 84.3 mAh/g. However, the working voltage range decreased from 1.1 - 1.5 V to 1.18 - 1.35 V. This indicates that the battery has increased electrochemical performance, but the battery is more susceptible to failure due to the decrease in the working voltage range.

**Keywords :**  $\text{Na}_2\text{Li}_2\text{Ti}_{5,9}\text{Zr}_{0,1}\text{O}_{14}$  Anode,  $((\text{NH}_4)_2\text{CO}_3)_n$  Additive, Electrochemical Performance, Lithium-Ion Battery

# Feasibility Study of Electric Vehicle (EV) Batteries Waste Treatment as Shipping-container Healthcare Facility's Microgrid Electrical Supply for Indonesian Rural Areas

Author, Email: Dicky Setianto<sup>1</sup>, Rafi Ramadhan Seba<sup>2</sup>  
<sup>1</sup>dickysetianto1@gmail.com, <sup>2</sup>rafi.seba@gmail.com

**Abstract.** As Electric Vehicle (EV) become more famous each day in Indonesia, there will be much more issues to solve. One of them is the batteries waste issue. Battery is not an everlasting technology because it could be degraded from the reduction of electro-mechanical reaction's efficiency. So, when it reaches 70-80% of its residual capacity then it couldn't be use anymore as an EV's energy storage. Yet, as we know, EV uses Lithium-ion type of battery which contain many toxic materials, such as cobalt, nickel, and manganese. That's the main reason why EV's batteries waste treatment is important in the first place. One of the strategy that we want to discuss is to maximize the potential of second life batteries as a microgrid electrical supply. From our study, we found that Indonesia have so many rural area with 119,115,844 population based on 2019 survey data and at the same time there are more than half of them are still having health issues there. When we consider this COVID-19 pandemic situation in 2021, it's even worse to imagine. the utility and the health services are really limited to they who don't have access to healthcare facility in rural areas. By Applying this shipping-container healthcare based facility, it could reach even in the deep forest from our territory. The thing is that strategy wouldn't be possible without any electrical supply. There is where the microgrid form second life EV's batteries have the main role of this strategy.

**Keywords :** Electric Vehicle, Healthcare, Waste Management, Rural Area, Indonesia

## **SYMPOSIUM 5**

# **GREEN AND ENERGY FOR NATIONAL SECURITY AND DEFENCE**

# Solar-Powered LALE UAV as an Early Wildfires Detection System

Author, Email: Yehuda Kristo Subiakto<sup>1</sup>, Faisal Akmal Ramadhan<sup>2</sup>, Muhammad Naufal Taqi<sup>3</sup>

<sup>1</sup>yehudakristo@gmail.com, <sup>2</sup>faisalaramadhan@gmail.com, <sup>3</sup>naufaltaqi.official@gmail.com

**Abstract.** Wildfires are one of the environmental problems that occur in several countries, including Indonesia. More than 942,000 hectares of Indonesian forest was burned in 2019. It cost about USD 5.2 billion from the damages it caused (World Bank, 2019). Furthermore, these problems can lead to health problems, such as respiratory infections and asthma. Moreover, wildfires can affect climate change because of carbon dioxide and other greenhouse gases emitted by the wildfires which will continue to raise the temperature of the planet. To solve this problem, we propose a solution to use a solar-powered, low altitude and long endurance (LALE) UAV as an early detection system. The purpose of this research is to determine specifications and develop a UAV design to prevent wildfires. In the preparation of this paper, we used the literature study and simulation methods using aerodynamic analysis software, specifically XFLR5 and ANSYS. Simulations are carried out to obtain the optimal design, which has minimum drag and weight as well as long endurance, to carry out its mission effectively. The result of this paper is the VTOL-Fixed Wing hybrid UAV design capable of flying for 11.07 hours, so that in terms of endurance and accuracy, this UAV can detect certain forest and land areas. It is hoped that this UAV can be used as an alternative solution which is environmentally friendly to prevent wildfires problems so that damages and losses can be minimized.

**Keywords :** wildfires, UAV, aerodynamic, design

# Geothermal Brine-Based Soda Ash: A Preliminary Study of Soda Ash Production Through Modified Solvay Process

Author, Email: Gerardus Rilo Nugroho Putranto<sup>1</sup>, Khabib Abdul Aziz<sup>2</sup>, Veronika Nathania Maharani<sup>3</sup>,  
Raden Mas Satryo Dewanto Suryohendrasworo<sup>4</sup>, Annisa Safitri Rifnaputri<sup>5</sup>  
<sup>1</sup>gerardusrilo@gmail.com, <sup>2</sup>khabib.a.a@mail.ugm.ac.id, <sup>3</sup>veronika.n@mail.ugm.ac.id,  
<sup>4</sup>rmsatryo00@mail.ugm.ac.id, <sup>5</sup>annisarifnaputri@mail.ugm.ac.id

**Abstract.** The world annual CO<sub>2</sub> emission has increased at an alarming rate in recent years resulting in rapid global warming and climate change. By 2021, the concentration of CO<sub>2</sub> in the atmosphere had increased by 48% above pre-industrial levels in 1850. To avoid more severe climate change, countries all over the world have agreed to limit global warming by signing the Paris Agreement. As one of the parties, Indonesia needs to contribute by reducing its annual greenhouse gases emission, especially CO<sub>2</sub> emissions. Therefore, Indonesia needs to transition toward renewable energy i.e., geothermal energy. From geothermal power plants, the geothermal brine contains 6% NonCondensable Gas (NCG) mostly CO<sub>2</sub> and 3% NaCl, thus can be a good raw material provider for soda ash plants, a novel industry in Indonesia. One of the potential locations in Indonesia is Geothermal Power Plant 'Wayang Windu', West Java with a production capacity of 80,000 tons of soda ash/year using a modified Solvay process. The primary processes are geothermal brine purification, ammonia absorption and carbonation, ammonia recovery, and calcination. From the economic calculation, this overall process requires an investment of \$48,036,981.79 for Capital Expenditure and \$7,474,850.9 for Operating Expenditure with an ROI value of 23.98% and POT in 3.13 years. Furthermore, the development of the soda ash industry using geothermal as the raw material also applies the circular economy principle that is in line with the Sustainable Development Goals (SDGs).

**Keywords :** soda ash, geothermal, carbon dioxide