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ASEAN Centre for Energy
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Conference Book of

The 2nd ASEAN INTERNATIONAL CONFERENCE ON ENERGY AND ENVIRONMENT (AICEE)

In Collaboration with:

The 8th International Conference on Sustainable Future for Human Security (The 8th SUSTAIN)

Sokha Hotel, Phnom Penh - Cambodia
14 - 15 September
2022

Conference Book

2nd ASEAN International Conference on Energy and Environment (AICEE)

in collaboration with the 8th International Conference on the Sustainable Future for Human Security (The 8th SUSTAIN)

Hybrid Conference

Cambodia & Virtual

September 14-15, 2022

Conference Book

The 2nd ASEAN International Conference on Energy and Environment (AICEE)

in collaboration with the 8th International Conference on Sustainable Future for Human Security (The 8th SUSTAIN)

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About

The 2nd AICEE is hosted by the **ASEAN Centre for Energy (ACE)** and **Institute Technology of Cambodia (ITC)**. The 2nd AICEE is in partnership with **Kyoto University, Japan**, **Japan-ASEAN Science, Technology, and Innovation Platform (JASTIP)**, and **International Society for Sustainable Future of Human Security (SustaiN Society),** and support of **National Energy Technology Center (ENTEC), Thailand**. This year, the 2nd AICEE was held in collaboration with the 8th International Conference on Sustainable Future for Human Security (The 8th SustaiN).

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Any correction/revision on the book could be addressed to: aiceeinfo@aseanenergy.org

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Foreword

1. ASEAN Centre For Energy

The 2nd ASEAN International Conference on Energy and Environment (AICEE) is held by the ASEAN Centre for Energy (ACE) and the Institute of Technology of Cambodia (ITC) as an academe partner. The event in conjunction with the ASEAN Energy Business Forum (AEBF) 2022 and the 40th ASEAN Ministers on Energy Meeting (AMEM), in collaboration with the 8th International Conference on Sustainable Future for Human Security (SUSTAIN), Kyoto University, and the Japan-ASEAN Science, Technology, and Innovation Platform (JASTIP) which take place Hybrid (Cambodia and Virtual Conferences) on 14-15 September 2022. This signifies commitment to accelerating the energy transition, improving intersectoral collaboration and connecting academia with ASEAN and global policymakers and business sectors.

For this second edition, we took the theme "*Accelerating the Clean Energy Transition to Increase Energy Security and Sustainability in ASEAN*". The theme directly showed in the ASEAN blueprint, namely the ASEAN Plan of Action for Energy Cooperation (APAEC) 2016-2025 Phase II 2021-2025, regarding energy cooperation which is one of the key elements to achieve regional energy security and environmental sustainability.

Therefore, concerns about energy security and sustainability require collaborative planning and action from all stakeholders: policymakers, academia, and business, to find

common ground and ensure success in both areas. A bridge is needed to pave the way forward between energy and climate experts in implementing the short- and long-term targets of energy security. The energy transition's framework must be reconciled immediately to optimize the roadmap for decarbonization and shifting to low-carbon energy.

In our response to these challenges, and to fulfill our role as a regional think tank, catalyst, and knowledge center, ACE designed and hosted the 2nd AICEE. In this endeavor, we are very grateful to have the Institute of Technology of Cambodia (ITC) as the academia partner and co-host of the event. Their inexhaustible initiatives and their relentless efforts are very important in the 2nd AICEE.

Our efforts have been met with enthusiastic responses, as we have received more than 144 extended abstract submissions, most of which are chronicled in this Proceeding. The consolidated extended abstracts are divided into thematic sub-topics, namely: (1) Energy Transition, (2) Energy Security, Accessibility & Sustainability, (3) Economy of Energy and Environment, (4) Environmental, Social and Governance Policy, (5) Sustainable Forest and Agriculture, and (6) Sustainable Built Environment. We are pleased to announce that the full paper of the presented papers of the 2nd AICEE will be published in the IOP Conference Series: Earth and Environmental Science Journal in January 2023.

The second AICEE was supported by My highest appreciation goes to the Scientific Committee led by ITC, which guarantees the scientific quality of this conference. With such a rigorous process, we are proud to have high quality novel ideas to share with the AICEE audience. My highest appreciation goes to all the authors who contributed. I would

also like to express my sincere thanks to the ITC and Events Committee as the co-organizer of the event.

It is my sincere hope that the proceedings will become a valuable reference material and knowledge-sharing platform in advocating for multi-sectoral synergies between energy and environmental experts, academia, policy makers, and the business sector. Through this collaboration, we believe we are closer to accelerating an energy transition in ASEAN that is safe, accessible, affordable, and sustainable.

Thank you.

Dr. Nuki Agya Utama

Executive Director, ASEAN Centre for Energy

Chair, Steering Committee of AICEE 2022

Message from Scientific Committee

Welcome to the 2nd ASEAN International Conference on Energy and Environment (AICEE)!

AICEE is held on 14-15 September 2022, in Sokha Hotel, Phnom Penh, capital city of Cambodia, under the theme of Accelerating the Clean Energy Transition to Increase Energy Security and Sustainability in ASEAN. The conference is conducted in the form of hybrid, onsite and online, and it is hosted by the ASEAN Centre for Energy (ACE) and the Institute of Technology of Cambodia (ITC).

ITC is one of the leading universities in STEM (Science Technology Engineering Mathematics) education and research. It was founded in 1964 with the continuously strong support from Cambodian government and development partners. The support from our line Ministry, The Ministry of Education Youth and Sport, provides ITC with great opportunity of working with other partners including AUF (France), AUN/SEED-Net (ASEAN), JICA (Japan), Ares-CCD (Belgium), World Bank, Asian Development Bank, and so on. The institute has been well-recognized nationally and globally with the up-to-date alternative change in terms of educational system from one regime to another.

With the revolution of the economic development of Cambodia, ITC has an obligation to support the Rectangular Strategy of the Government to achieve industrial development policy and national 2030's and 2050's visions. ITC has two important mandates which are to produce the qualified human resources to fulfil the country's needs and to support the

sustainable development of Cambodia by improving the research and innovation in Science, Technology and Engineering. Currently, ITC has approximately six thousand students who are pursuing PhD, Master, Engineering, and Associate Engineering degree. Five faculties are running such as Faculty of Electrical Engineering, Faculty of Civil Engineering, Faculty of Hydrology and Water Resources Engineering, Faculty of Geo-resources, and Geotechnical Engineering, Faculty of Chemical and Food Engineering, and Faculty of Applied Sciences.

Besides the education mandate, ITC has also committed to promote the research activity by gathering the alumni and graduates from overseas, networking and collaborating with industries and local enterprises as well as implementing the joint research projects with both local and international universities. The first research centre called Research and Innovation Centre (RIC), was established at ITC in 2015 with support from JICA. RIC has five research units namely Energy Technology and Management research unit, Food Technology and Nutrition research unit, Material Sciences and Structure research unit, Mechatronics and Information Technology research unit, and Water and Environment research unit. In addition, RIC also has Techno-research journal where students and researchers can submit their research papers for local publication.

ITC has hosted and cooperated hosting many regional and international conferences with our partners. Our team in Energy Technology and Management research unit is working closely with ACE team to make AICEE happen. It is one of the special conferences which is held at the right time of ASEAN meeting. So AICEE brings together from Academic sector, Private sector, and Policy maker to network and discuss about the clean and sustainable

energy to reach the ASEAN vision in 2025. More than thousand extended abstracts have been received from Cambodia, ASEAN, Japan, and others.

With the clear and shared vision mingle together with potential and qualified human resources, the institute has always received the strong support from local and international members. Currently, research and innovation has been one of the main priorities pillars to increase the relevant impacts and visibility. The vision of ITC is to stay stand as one of top engineering research institutions in the country, regions, and the globe, particularly the positive impact of research and innovation to society has been our goal. To achieve the vision, ITC has put the best efforts to strengthen and advance infrastructure and to endlessly build the capacity of the researchers and everyone of ITC including both soft and hard skills.

With hundreds of researchers, many research projects are being implemented in cooperation with local and international partners. Such huge grant of Higher Education Improvement Project funded by Ministry of Education Youth and Sport and grant from Science and Technology Research Partnership for Sustainable Development (SATREPS) funded by Japan Science and Technology Agency and JICA are being progressively conducted and these grants will surely produce significant impact on the economy, society, and environment.

It is another experience of our team working with ACE team for cooperation hosting AICEE 2022. We sincerely thank Dr. Nuki Agya Utama and ACE team that give us an opportunity to work out this conference. Our team not only just improve the capacity of hosting conference but also a part of extended abstract submission. We strongly believe that

AICEE will accelerate to reach the ASEAN vision and bring more network on research and business of Energy sector in ASEAN. The proceedings of the conference will be the benchmark of the current research on Energy and Environment in ASEAN which is helpful for further research and business. Finally, on behalf of ITC, I would like to sincerely thank to the organizers either ITC team or ACE team for hardworking to organize AICEE 2022.

Dr. OR Chanmoly

Director of Research and Innovation Center

The 2nd AICEE Scientific Committee

Keynote Speakers

1. **Professor Keiichi N. Ishihara**

Dr. Keiich N. Ishihara graduated from the Department of Metal Science and Technology, Faculty of Engineering, Kyoto University, and received Ph.D. in metastable materials. After moving to the Graduate School of Energy Science, he started working on energy system analysis and planning. He led a team of zero-emission scenarios from 2008 to 2013 and published the world zero-emission scenarios. Since then, he has studied the development of new materials for energy and environments. He has also been engaged as the dean of the Graduate School of Energy Science between 2017 and 2021.

Abstract Presentation:

The Japanese government has set a goal of carbon neutrality by 2050. In this regard, the Team at Kyoto University researched the situation of achieving carbon neutrality from 2008 to 2013 and published scenarios for achieving it in 2100. According to population projections, it will reduce to about 60 million in 2100, almost halving. If per capita energy consumption is constant, Japan's energy demand would be nearly half. At that time, it was considered possible to achieve carbon neutrality in 2100 from the viewpoint of renewable energy potential. The barriers to the early achievement of the 2050 goals will be discussed in this presentation.

2. Professor CHHEM Kieth Rethy

He is a medical doctor, science diplomat, educator, and historian with extended experience in Digital Science & Technology, Global Health Diplomacy, Nuclear Technology. Policy, and Executive Education. He holds a MD, a PhD in Education, and a PhD in History. He has published more than 100 scientific articles, edited 17 textbooks and has been invited as a keynote speaker in more than 70 countries. He was a Professor of Radiology in Canada (McGill), Singapore (NUS), Austria (Vienna Medical University) and Japan (Hiroshima, Nagasaki, Fukushima Medical University) for 30 years. He was the Chair of the Radiology and Nuclear Medicine Department of University of Western Ontario. He was the Director of the Division of Human Health at the International Atomic Energy Agency (IAEA) from 2008 to 2014.

Invited Speakers

1. **Dr. Sumittra Charojrochkul (Executive Director, National Energy Technology Center (ENTEC))**

Dr. Sumittra joined National Metal and Materials Technology Center (MTEC), NSTDA, Thailand as a researcher in 1998. After Cabinet Approval to establish ENTEC, NSTDA, she became Director of Energy Innovation Research Group. On 1 May 2022, NSTDA Board chaired by Minister of Higher Education, Research, Science, and Innovation (MHESI) appointed her as Executive Director of ENTEC. Further from fundamental research, she has also collaborated with industry to work on near-market research including recent Thailand Hydrogen Consortium. Other than research work, she has also served as technical reviewer in several international journals related to hydrogen, electrochemistry and material science and engineering and as technical committee of conferences and symposiums. Her main areas of research are hydrogen production, Solid Oxide Fuel Cells, catalysis and adsorbents, fabrication of ceramic film and materials characterization. She has over 50 publications in international journals, 23 patents (pending/filing), and 6 trade secrets.

Abstract Presentation:

Towards Energy Resilience in ASEAN: How STI Community Can Enhance Climate Adaptability of Energy Infrastructure

Sumittra CHAROJROCHKUL

Executive Director, National Energy Technology Center (ENTEC)

National Science and Technology Development Agency (NSTDA)

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Energy resilience is gaining interest in scientific community and public domain as a concept to enhance adaptability of energy infrastructure against climate change and disasters. National Energy Technology Center (ENTEC) is promoting energy resilience in ASEAN by (1) catching global trend, (2) conducting research, (3) engaging local stakeholders and communities, and (4) collaborating with international partners. Energy resilience aligns well with the global trend towards energy decarbonization which contributes to the national leaders' commitment at the 2021 United Nations Climate Change Conference (COP26) and the achievement of United Nations' Sustainable Development Goals (SDGs), Goal 7: Affordable and Clean Energy and Goal 13: Climate Actions. Energy resilience synchronizes climate mitigation and adaptation in energy sector by ensuring that renewable energy infrastructure can adapt to impacts of climate change. In terms of research activities, ENTEC explored research landscape of energy resilience that would guide ASEAN research direction on the topic and performed qualitative analysis which revealed the relationship between site selection and climate adaptability of solar power plants. ENTEC engaged local stakeholders by performing series of energy resilience assessments in on-grid and off-grid solar

power plants, commercial biomass power plants, and biogas plants. ENTEC made use of the outcomes from the assessments by promoting energy resilience to be one of the ASEAN COSTI 2021 Annual Priorities and conducted three energy resilience workshops attended by over 140 participants from 11 countries. Based on the experience, ENTEC is proposing ASEAN Energy Resilience Assessment Guideline to be endorsed by ASEAN SCSER and ASEAN COSTI in October 2022. The guideline will be used to perform the assessment at 50 MW UiTM Gambang Solar Power Plant in Malaysia. ENTEC will continue to promote realization of the concept of energy resilience and support energy resilience assessments in ASEAN Member States.

2. **Dr. S Khoirul Himmi (Senior Researcher, Research Organization for Life Sciences and Environment – National Research and Innovation Agency (BRIN))**

Dr. Himmi earned his bachelor's degree in Chemistry from Universitas Islam Indonesia, Yogyakarta, Indonesia. He completed his master's and Doctoral degree from Kyoto University, Kyoto, Japan in the field of Forest & Biomaterials Science, studied nesting biology of drywood termite using a non-destructive monitoring technique, X-ray computed tomography.

He joined the Indonesian Institute of Sciences (LIPI) in 2008 and was assigned as a researcher focusing on wood science and bioecology/management of wood-attacking insects. In late 2021, he joined the National Research and Innovation Agency (BRIN), a merger of LIPI and other national research institutions.

Dr. Himmi received the HOPE-Fellowship from the Japan Society for the Promotion of Science (JSPS) in 2016. Since 2017, he is actively involved as a Project Leader in the Japan-ASEAN Science Technology Innovation Platform, a collaborative program between LIPI–BRIN and Kyoto University that is fully supported by the Japan Science and Technology Agency (JST). Currently, he is serving as the Secretary-General of the Pacific-Rim Termite Research Group (2020 – 2022) as

well as the Executive Director of the International Society for Sustainable Future of Human Security (SustaiN Society) since 2019.

Abstract of Presentation:

Climate change impacts on urban pests: A global perspective

S Khoirul Himmi

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Abstract

Climate change and urbanization are the two most important issues in the recent global environment, that have severe direct and indirect consequences. From an urban entomologist perspective, those two phenomena are now being considered as the important driven factors that affect the spread of exotic urban pests. Slowly but steadily, the rising temperatures are also affecting the survivability and breeding ability of urban pests and vectors. Recent reports suggested that substantial economic and health costs are likely to increase in the future, driven by dramatic climate change, rapid urbanization, and globalization.

Keywords: Climate change, urban vectors, urban pests, invasive species.

3. Dr. Ir. Hatma Suryatmojo, S.Hut., M.Sc.

Dr. Hatma Suryatmojo is a lecturer and researcher in Laboratory of Watershed Management, Department of Forest Resource Conservation, Faculty of Forestry, Universitas Gadjah Mada, Indonesia. He earned his bachelor's degree in Forestry from Universitas Gadjah Mada, Yogyakarta, Indonesia. His master's degree in Geography from Universitas Gadjah Mada, and complete Doctoral degree from Graduate School of Agriculture, Kyoto University, Japan, in the field of Forest & Biomaterials Science, studied watershed hydrology in the Indonesian tropical rainforest.

His researcher interests are forest hydrology, erosion control, ecosystem services, and watershed management. Active in research and community development at Center for Disaster Studies, and Center for Watershed Conservation, UGM. He managed the International Journal of Sustainable Future for Human Security as chief editor. Since 2015, he has been appointed as the Director of Center for Academic Innovation and Studies UGM to manage the learning innovation and academic development.

Abstract of Presentation:

Hydrological Response of Intensive Forest Management System in the Indonesian Tropical Rainforest

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Abstract

Tropical rainforests in Indonesia are currently managed by Intensive Forest Management System (IFMS), characterized by selective timber harvesting and intensive line planting to enrich standing stock. When IFMS treatments are implemented in headwater areas, it is important to understand the heterogeneity of processes within a catchment, and thus, the vulnerability of different areas to land disturbance. This research investigates the hydrological impact of IFMS on runoff and soil erosion characteristics in the landscape and catchment levels. Runoff and erosion characteristics were measured in tropical rainforests of the Bukit Baka Experimental Catchments, Central Kalimantan, Indonesia.

The calculation results using the water balance method found that in the natural condition, 50% of the surplus water is available as streamflow in any given month, and the rest becomes detention water to supply soil moisture and groundwater. It is also found that 50% of detention water is available as streamflow in the next month. The annual evapotranspiration ranged from 1246 to 1519 mm (31.9%–41.2%

of the rainfall), and annual runoff ranged from 1242 to 2244 mm (39.9%–54.6% of the rainfall). A total of 13.5%–18.1% of rainfall was detained in the catchment as detention water and stored as soil moisture or groundwater supply. In the initial stage after selective logging, the ratio of rainfall-runoff increases in the range of 76.3 – 87.4%.

In the different forests, the recovery period resulted from the percentage of annual rainfall that became runoff in the virgin forest, 10-year-old site, and 1-year-old site were 27, 30, and 41%, respectively. The annual suspended sediment yields in the same site and same order were 0.15 t ha^{-1} y^{-1}, 3.6 t ha^{-1} y^{-1}, and 14.9 t ha^{-1} y^{-1}, respectively. Direct runoff, peak discharge, and sediment yield increased dramatically during the early years after IFMS implementation. 10 years after forest operation, forest cover has recovered close to a natural condition, but still, there are differences in hydrological response.

In the different stages of IFMS, during the post selective logging period, total runoff in the conventional IFMS and modified IFMS increased by 68.8% and 47.3%, respectively, in comparison with natural catchment. The combination of the great surface disturbance by skid trails, large tree extraction ratio, and high slope angle brought the greatest suspended sediment yield in the conventional IFMS. Modified IFMS with an intensive contour-line planting method is effective in reducing direct runoff and peak discharge. ILP was not effective to decrease SS discharge in the initial stage of the post-operation period. The magnitude of runoff and soil erosion depends on the interaction between the rainfall, forest cover changes, surface disturbance from treatment applied, and catchment characteristics.

Forest management practices should consider and attempt to minimize disturbance during each IFMS stage to control runoff and sediment yield. Underlying climatic and geographic factors that increase runoff and soil erosion risk, even without human intervention, such as steep topography, soil vulnerability, and rainfall characteristics, should also be taken into consideration. Adequate protection of the forest floor with strict control over logging activities, combined with intensive contour-line planting, might also reduce the impacts of logging on runoff and sediment yield.

4. Dr. Nino Viartasiwi

Dr. Nino Viartasiwi obtained her master's and doctoral degrees in International Relations from the Graduate School of International Relations, Ritsumeikan University, Kyoto-Japan. Her research interests are in conflict studies, forced migration, and transnationalism. As a researcher, Dr. Nino has completed academic works such as: "Nonstate agents' and actors' practices and agencies on refugee protection in Southeast Asia" (forthcoming 2022), "Advocating the Temporary Rights to Work for Refugees and Asylum Seekers in Transit in Indonesia" (2022); "Café in Small Towns: A Picture of the Weakening Social Engagement" (2020); "Secondary Cities and Forced Migration: Accommodating Refugees and Asylum Seekers in Indonesia" (2019); "Advocating for the Role of Women in Countering and Preventing Violent Extremism in Indonesia" (2018); "The West Papua Imagined Community: A

Bondless Plural Society" (2018); "The Politics of History in West Papua - Indonesia Conflict" (2018); and others.

Dr. Nino is also a Senior Research Fellow at the Resilience Development Initiative (RDI), an Indonesian think tank on resilience studies. She is a co-founder of the Urban Refugee Research Group under RDI. As a certified conflict mediator, Dr. Nino engages with many human rights NGOs in Southeast Asia. Currently, she is actively supporting an Indonesian civil society coalition in advocating the right to livelihood for refugees and asylum seekers in Indonesia.

Abstract of Presentation:

Post-COVID-19 Migration and Mobility: Persistent Challenges and New Opportunities

Nino Viartasiwi

Senior Research Fellow at the Resilience Development Initiative (RDI) & Lecturer at President University

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Abstract

International mobility, both migratory and non-migratory, has been gradually resumed during 2022, when the COVID-19 pandemic has been increasingly tamed. Do the patterns of both international migratory and non-migratory mobility change in comparison to the situation before the pandemic? What remains and has changed? The study, based on literature reviews and migratory data, finds that mobility patterns have changed. The changes in mobility patterns have also cre ated

changes in the migratory challenges in the sociopolitical contexts. Several challenges persist, such as the diversity or even superdiversity in megacities and societies that trigger the issues of nationalism, identity, and integration. Another persistent issue is "global apartheid," which occurs when mobility and migratory restrictions are imposed more severely on people from the Global South. However, new opportunities emerge from the changes. As countries learn that migration is an autonomous process that has its own momentum, the government should also recognize the momentum to be able to moderate it. While currently, national migration governance is the exclusive right of the government, the post-COVID-19 age calls for government cooperation with other actors such as private sectors and civil society. Secondly, even though mobility is inevitable as part of global change and the push-pull factors of development, the post-COVID-19 pandemic shows that mobility patterns are still discriminatory toward 86% of the world population. Therefore, the realization of the situation should be a turning point to develop more just global mobility governance based on values such as equality, cooperation, collaboration, inclusion, and sustainability.

Host University Profile

Institute Technology of Cambodia (ITC)

Institute of Technology of Cambodia (ITC) was found in 1964 with the continuously strong support from Cambodian government and development partners. The support from our line Ministry, The Ministry of Education Youth and Sport, provides ITC with great opportunity of working with other partners including AUF (France), AUN/SEED-Net (ASEAN), JICA (Japan), Ares-CCD (Belgium), World Bank, Asian Development Bank, and so on. The institute has been well-recognized nationally and globally with the up-to-date alternative change in terms of educational system from one regime to another.

Source: ITC website (https://itc.edu.kh/)

With the revolution of the economic development of Cambodia, ITC has an obligation to support the Rectangular Strategy of the Government to achieve industrial development policy and national 2030's and 2050's visions. ITC has two important mandates which are to produce the qualified human resources to fulfil the country's needs and to support the sustainable development of Cambodia by improving the research and innovation in Science, Technology and Engineering.

Currently, ITC has approximately six thousand students who are pursuing PhD, Master, Engineering, and Associate Engineering degree. Five faculties are running such as Faculty of Electrical Engineering, Faculty of Civil Engineering, Faculty of Hydrology and Water Resources Engineering, Faculty of Geo-resources, and Geotechnical Engineering, Faculty of Chemical and Food Engineering, and Faculty of Applied Sciences.

Besides the education mandate, ITC has also committed to promote the research activity by gathering the alumni and graduates from overseas, networking and collaborating with industries and local enterprises as well as implementing the joint research projects with both local and international universities Besides the education mandate, ITC has also committed to promote the research activity by gathering the alumni and graduates from oversea s, approaching the industries and local enterprises, and collaborating research both local and international universities. The first research centre called Research and Innovation Centre (RIC), was established at ITC in 2015 with support from JICA. RIC has five research units namely Energy Technology and Management research unit, Food Technology and Nutrition research unit, Material Sciences and Structure research unit, Mechatronics and Information Technology research unit, and Water and Environment research unit. In addition, RIC also has Techno-research journal where students and researchers can submit their research papers for local publication in addition, RIC also has Techno-Research Journal serving for publication of the research work made by researchers and students.

With the clear and shared vision mingle together with potential and qualified human resources, the institute has always received the strong support from local and international members. Currently, research and innovation has been one of the main

prioritized pillars to increase the relevant impacts and visibility. The vision of ITC is to stay stand as one of top engineering research institutions in the country, regions, and the globe, particularly the positive impact of research and innovation to society has been our goal. To achieve the vision, ITC has put the best efforts to strengthen and advance infrastructure and to endlessly build the capacity of the researchers and everyone of ITC including both soft and hard skills. To achieve the vision, ITC has put the best efforts to improve both hard and soft infrastructure to endlessly build the capacity to researchers and everyone of ITC members.

With hundreds of researchers, many research projects are being implemented in cooperation with local and international partners. Such huge grant of Higher Education Improvement Project funded by Ministry of Education Youth and Sport and grant from Science and Technology Research Partnership for Sustainable Development (SATREPS) funded by Japan Science and Technology Agency and JICA are being progressively conducted and these grants will surely produce significant impact on the economy, society, and environment.

ITC as well as RIC is always welcome the collaboration from local and international partners, especially industrial sector for either academic purposes or research collaboration. It is always our great pleasure to be a co-host of the academic or scientific event with the ASEAN or international partners. **Visit us at: https://itc.edu.kh/**

SustaiN Society

The international society of Sustainable Future for Human Security (hereafter, Sustain Society) was established in Kyoto on November 22, 2012. SustaiN Society is a professional organization consisting of experts, academics, practitioners, and bureaucrats who are motivated by the awareness of its social responsibility to achieve a sustainable future for Human Security. Sustain Society departs from an interdisciplinary approach and understands that the most serious problems affecting a sustainable future for human security cannot be discussed and solved by a "siloed" approach. The society focuses on 6 (six) main research-academic activities, such as Sustainable Renewable Energy and Environment, Sustainable Tropical Forestry, Sustainable Agriculture, Disaster Management, Sustainable Built Environment, and Social and Political Development.

One of the SustaiN Society's activities is organizing the SustaiN Conference. In the last four years, the conference had gathered more than 500 researchers, students, and scholars in more than 26 countries around the globe. The conference also successfully assembles either online or offline more than 30 reviewers from the multidiscipline background. These opportunities for continuing the communications and gathering will be upgraded to the next level. The community is willing to jump to the next level in the SustaiN Society. The society has the main vision that the activities will be beneficial to securing current and future human activities sustainably without jeopardizing the environment and inefficient use of natural resources. The Society also will enhance the new discussion and networking in the human security area.

All participants of the SustaiN Conference are invited to register as a member of the SustaiN Society.

Contact us

Website: sustain-conference.com

Secretariat email: secretariat@sustain-conference.com

J-SustaiN

The SustaiN Society publishes **the International Journal of Sustainable Future for Human Security (J-SustaiN)**. J-SustaiN originated from the need to provide an inter-disciplinary forum where the most serious problems affecting a sustainable future for human security can be discussed, in recognition of the fact that many future problems cannot be solved by a "siloed" approach. The emphasis on sustainable futures is in response to the general awareness of the need to solve numerous human-related problems resulting from the rapid growth of modern society. The topic of sustainable futures for human security needs to be discussed in an integrated way, in accordance with the principles of sustainability, considering energy and materials supply, economies and trade, technology, cities, agriculture, social and environmental aspects.

The JOURNAL will address problems of primary importance for human security, discussing and proposing a more constructive and progressive approach to ensure future societal sustainability. The JOURNAL will be published 2 times a year, open access and peer-reviewed, focusing on the development of the above-mentioned issues in developing regions such as Asia and Pacific, Africa, and South America, and how these regions can develop modern societies in a SUSTAINABLE manner, without jeopardizing the needs of future generations.

As we all know, current human development to provide human comfort shifted not only to serve the primary human needs but also secondary human needs. These needs are increasing in line with the economic development and increase of population. Many countries around the world have experienced rapid increases in their Gross Domestic Products (GDP) with these increases mainly taking place in the Asian and Africa region, where more than 5.2 billion population reside. China, India, and Indonesia are some examples of the countries in Asia that have experienced significant increases in their GDP. To continue providing adequate technology to cope with the thirst of human comfort requires intensive research and development from a multidisciplinary perspective. Research development in solving future human security problems should be carried out under a sustainability perspective. Development can negatively impact the environment and create an inefficient use of natural reserves, which may result in damage to nature by unnecessarily increasing the emission of greenhouse gases or releasing untreated hazardous substances that can jeopardize human health.

The approach on sustaining future of human security from the perspective of the developing world is important. To this end, we would like to ask your kind contribution for

sharing and disseminating your novel findings, research activities and critical thinking through the journal of Sustainable Future for Human Security or J-SustaiN.

The Journal consist of 7 main topics, namely:

1. Energy: This topic covers issues of sustainable Renewable energy, Low carbon energy system, Energy economics and planning and Energy related Biotechnology and Nanotechnology.
2. Environment: This topic covers issues of Sustainable municipal solid waste management, Sustainable consumption and production, Life cycle inventory and impact assessment in ASEAN nations, Water and waste Management and Biotechnology and Environmental Pollution.
3. Forestry: This topic covers issues of Sustainable Forest management, Community Forest management, Forest for water, food and energy, Forest Biodiversity and ecosystem services, Silvicultural technique for rehabilitation, Sustainable timber and non-timber forest product, Watershed management and Wetland management.
4. Food Security & Agriculture: This topic covers issues of agriculture for food security.
5. Built Environment: This topic encourages debate over the built environment for sustainable human activity and environmental system as well as its links to sciences, technology, and cultural aspects.
6. Disaster & Mitigation: This topic covers Disaster management exercise, Flood and Drought caused by extreme weather, Debris flow and sediment transport, Community based disaster management, Technology for disaster mitigation and prevention, Disaster caused by Extreme weather and Surveillance and early warning systems.

7. Social Politics: This topic discusses issues of Political science, international studies, Sociology, Human Security and Peace & Conflicts studies.

Contact us
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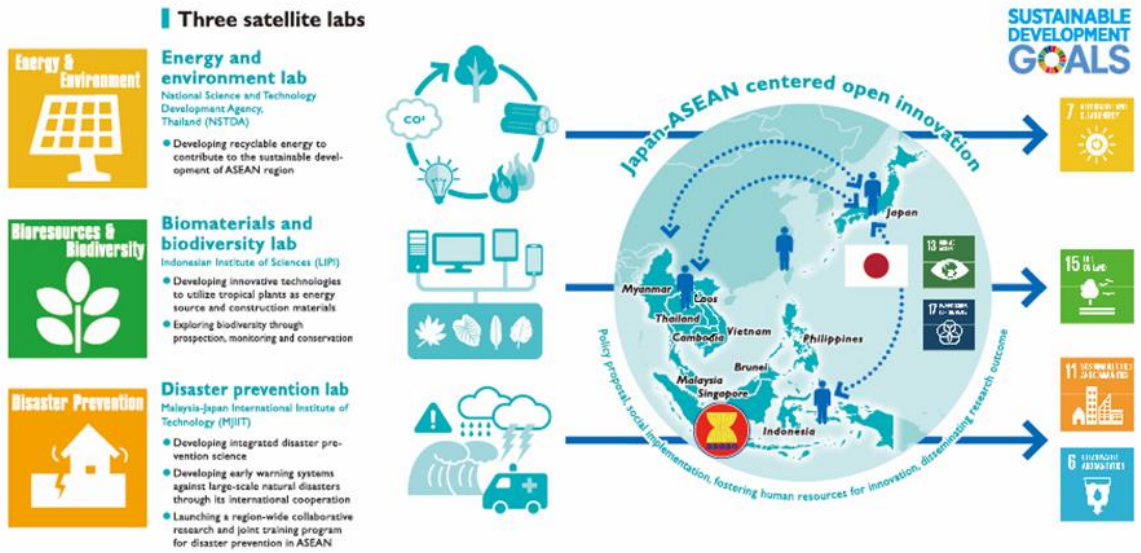
Japan – ASEAN Science, Technology, and Innovation Platform (JASTIP)
Promotion of Sustainable Development Research

JASTIP aims to contribute to achieving the Sustainable Development Goals (SDGs) in Japan and ASEAN through the collaborative research on science and technology in the field of energy and environment, biomaterials and biodiversity and disaster prevention.

Since 2015, Kyoto University has launched JASTIP within the framework of the Collaboration Hubs for International Research Programs (CHIRP) funded by the Strategic International Collaborative Research Program (SICORP) of Japan Science and Technology Agency (JST). JASTIP has been also endorsed by ASEAN Committee of Science, Technology, and Innovation (COSTI) as an ASEAN-Japan collaborative project (Phase 1:2015-2020, Phase 2: 2020-2025).

JASTIP
Japan - ASEAN Science, Technology and Innovation Platform



Executive Summary of the 1st Phase (2015 – 2020):

Mission of JASTIP Phase 2:

1. Advancing International Joint Research

   JASTIP advances interdisciplinary and solution-oriented collaborative research between ASEAN and Japan researchers through JASTIP's labs and network established since phase 1 to address societal challenges, contributing to attaining the ASEAN community building and SDGs.

2. Developing an Inclusive STI Platform

   By establishing on open and inclusive STI Platform between ASEAN and Japan, JASTIP will strengthen strategic collaboration among academia, research institutions, policymakers, private sectors, and the civil society to create an effective ecosystem for capacity building, knowledge and information sharing, technology transfer, and further use of STI for the global challenges and societal concerns.

3. Fostering the Next Generation Human Resources

   JASTIP fosters talented researchers as well as skillful STI Coordinators and administrators through the exchanges program and training sessions.

Contact: JASTIP Secretariat

E-mail: jastip-contact@cseas.kyoto-u.ac.jp

Website: http:// jastip.org/en/

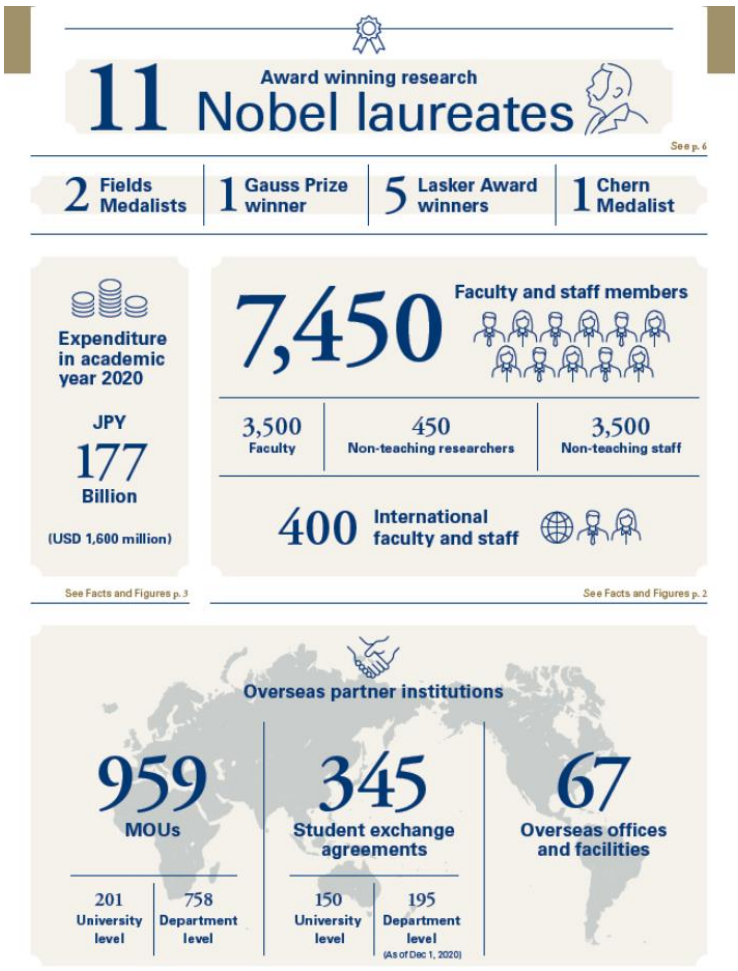
Kyoto University

Kyoto University was established in 1897 as Japan's second imperial university. It is in the historic city of Kyoto, which flourished as the nation's capital for over a thousand years until that status was transferred to Tokyo in the wake of the Meiji Restoration. Kyoto University is one of the most respected research universities in Asia. This is testified by the accolades conferred upon its researchers past and present.

京都大学
KYOTO UNIVERSITY

Kyoto University at a Glance

(Kyoto University 2021 – 2022)



Kyoto University ASEAN Center:

Kyoto University has been involved in wide-ranging research and educational activities in the ASEAN region for many years. The Kyoto University ASEAN Center opened in June 2014 to support research, education, and international collaborations in the region.

By effectively integrating existing research and educational activities and networks in the ASEAN region, as well as by expanding collaborative activities with ASEAN universities and research institutions, the Kyoto University ASEAN Center aims to accelerate the promotion of research, education, and international collaborations that lead to the demonstration and development of potential in the region.

Contact:

E-mail: staff-asean@kura.kyoto-u.ac.jp

National Energy Technology Center (ENTEC) of National Science and Technology Development Agency (NSTDA) under Ministry of Higher Education, Science, Research, and Innovation (MHESI)

National Energy Technology Center (ENTEC) was formally established on June 9, 2020, by Thai Cabinet Approval as a focal point for local and international research and development cooperation on energy. ENTEC R&D focuses aim for practical use in industries and social engagement. ENTEC is the fifth National Center under National Science and Technology Development Agency (NSTDA), which was established in 1991 under National Science and Technology Development Act (1991), under Ministry of Higher Education, Science, Research, and Innovation (MHESI). ENTEC mission is to carry out activities that support governmental policies including Sustainable Development Goals (SDGs), National Energy Plan (NEP), Strategic Plan to Move Thailand Forward with Bio-Circular-Green (BCG) Economy, and NSTDA Strategic Plan using energy technology know-how as a foundation for research, development, and innovation, and linking R&D works of MHESI, Ministry of Energy, Ministry of Industry, and related organizations.

Vision:

A leading organization and a focal point for Thailand's energy technology development.

Mission:

Developing and building energy technology capability for both private and government sectors. ENTEC's main activities are as follows:

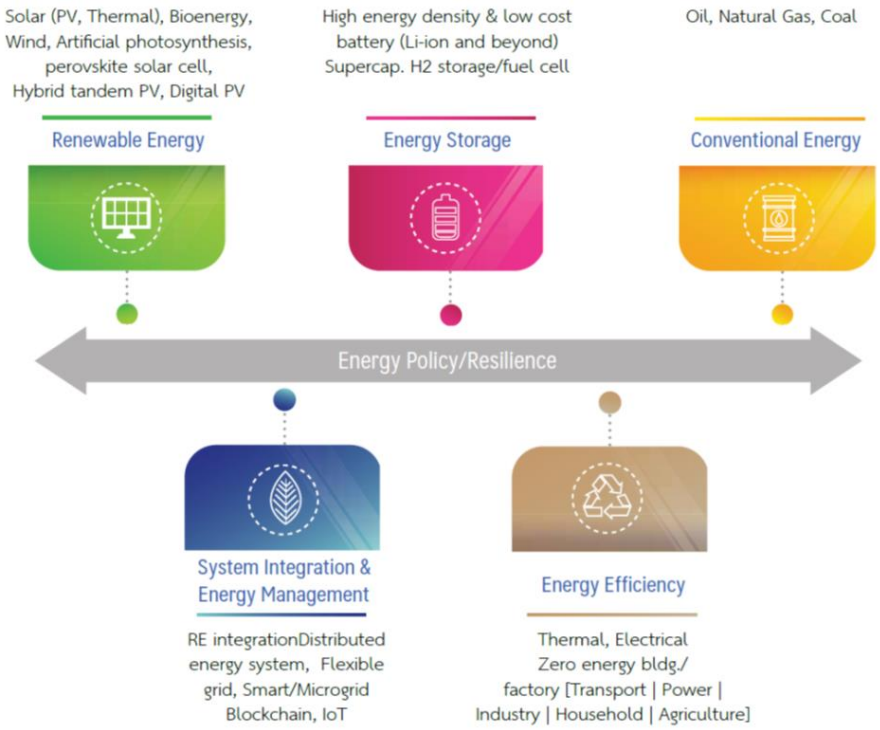
1. Conducting research and creating a body of knowledge to support National Energy Plan (NEP).
2. Generating and transferring high-quality energy technology know-how to relevant stakeholders towards palpable impacts.
3. Working together with both public and private partners, including international organizations, on research and development of energy technologies.
4. Integrating major resources from various channels for prompt actions and decisive accomplishment.

Operational Guidelines:

1. Excellence – carrying out work with expertise and professionalism to achieve high-quality outputs.
2. Relevance – complying with National Strategic Plan and the needs of target users.
3. Impact – creating an economic impact, improving the quality of life, and enhancing the country's competitiveness through research, development, and engineering.
4. Visibility – building trust and confidence in quality and expertise at national, regional, and international levels.

Research, Development, and Innovation

ENTEC focuses on conducting high-quality research and development and fostering innovation that is relevant to the needs of target users, achieving sustainable socio-economic impacts. Technology/Research S-curves have been developed as an assisting tool for research management, resource allocation, and work planning. In the first five years, ENTEC will place an emphasis on five areas of energy technology research and development: Renewable energy, Energy storage system, Conventional energy, System integration and energy management, and Energy efficiency.



Further information: http://www.entec.or.th

Conference Agenda

2nd ASEAN International Conference on Energy and Environment (AICEE)

In Collaboration with the 8th International Conference on Sustainable Future for Human Security (SustaiN)

Hybrid (Cambodia & Virtual Conference)

September 14-15, 2022

Date	Time	Agenda
		Main Hall (Ballroom 1)
Wednesday, 14 September 2022	09:00-10:15	Opening Ceremony in Conjunction with the 40th AMEM and AEBF 2022 Agenda
	10:15- 10:25	Keynote Speech from Prof. Keiichi N.Ishihara, Graduate School of Energy Science, Kyoto University, Kyoto, Japan
	10:25- 10:35	ACE- University MoU Announcement
	10:35- 10:45	Keynote Speech from H.E. Prof. Chhem Kieth Rethy, Minister Delegate Attached to the Prime Minister, Council of Minister
	10:45- 11:00	Keynote Presentation Business Model Innovation to Drive ASEAN economy towards clean energy transition
	11:00- 12:00	Hydrogen in Global Decarbonization: Championing Blue and Green Hydrogen Technologies
	12.00 - 12:15	Group photo of the 2nd AICEE Participants at Lobby of Sokha Hotel (participants could leave AEBF event/Main Ballroom)
	12:15- 13:20	Lunch Break at Lotus Restaurant

	All Parallel meeting are held in Under Ground Level	**Room 1 (Room name: Malisrouth)**	**Room 2 (Room name: Rumdoul)**	**Room 3 (Room name: Bompong Krolom)**
		Topic: Energy Transition	**Topic: Energy Security, Accessibility and Sustainability**	**Topic: Environmental, Social and Governance Policy & Sustainable Forest Management**
		Chair: Dr Kinnaleth Vongchanh	**Chair: Dr Sarin Chan**	**Chair: Dr Ambiyah Abdullah**
	Special Presentation from the Invited Speakers			
	13:30- 13:50	*Towards Energy Resilience in ASEAN: How STI Community Can Enhance Climate Adaptability of Energy Infrastructure* **Dr. Sumittra Charojrochkul** Executive Director, National Energy Technology Center (ENTEC)		*Climate Change Impacts on Global Urban Pest: Global Perspective* **Dr. S. Khoirul Himmi** Senior Researcher, National Research and Innovation Agency (BRIN), Indonesia; Executive Director of the International Community of Sustainable Future for Human Security (SUSTAIN)
	Participant's Presentation			

	13:50 - 14:05	*Modeling Energy Storage Systems and Its Roles in ASEAN Energy Transition* **Zulfikar Yurnaidi**	*Potential Integration of Waste to Energy (WtE) and Carbon Mineralization Technology in Indonesia* **Pradhipto Bagas Wicaksono, Purnaning Tuwuh Triwigati**	*Flow Simulation in Stung Sen River Using SWAT Model Forced by the Large-Ensemble Climate Simulation* **Heng Seangmeng, et al.**
	14:05- 14:20	*Cross-sectoral analysis on the implication of ASEAN road transport electrification policies on region's energy security and climate* **Alnie Demoral**	*Surface Modifications of Catalysts in Nanoscale for Improvement of Selectivity and Durability of Photoconversion of Environmental Pollutant and Biomass* **Kamonchanok Roongraung, et al.**	*Impact of Electric Vehicles toward Energy Reliability of the Jawa-Madura-Bali Electrical Power System* **Joshua Veli Tampubolon**
	14:20- 14:35	*Social Media Analysis on ASEAN Energy Transition Trends* **Rika Safrina**	*Predicting and Analyzing of Pressure Drop in Two-Phase Geothermal Fluids: Study Case Karaha Bodas Geothermal Power Plant* **Naufal Riyandi, Cukup Mulyana**	D*ecarbonization Program through an Implementation of 411 kWp OFFGRID PV Rooftop in reducing GHG Impact in Muara Karang Combined Cycle Power Plant* **Darma Samuel Hutajulu, Tania Revina Y, Muhammad Dede Dermawan**
	14:35-14:45	Coffee Break		

	14:45- 15:00	*Importance of Energy Efficiency in ASEAN Energy Sector: Modelling Analysis* **Zulfikar Yurnaidi**	*Reflection & Outcome Projection on the Impact of ASEAN Energy Transition to Regional Cohesivity* **Tristan Noa Araisya, Debora, Akbar Yudha Susila**	*Achieving COP26 Energy Transition Goal: The Status Quo and the Future of Renewable Energy Investment Incentive in Indonesia* **Mailinda Eka Yuniza, Muhammad Rafly, Daven Faustino Salim**
	15:00- 15:15	*Understanding the Characteristics of Energy Supply and Demand in ASEAN: Cluster Analysis* **Silvira Ayu Rosalia, et al.**	*Optimization and simulation of distributed generation systems using load forecasting methods: A case study* **Juan Glicerio Cartago Manlapaz, et al.**	*Maximum Demand Reduction (MDRed) modelling using MATLAB Stateflow®* **Dr. Gopinath Subramani**
	15:15- 15:30	*Tracking Potential Renewable Energy Jobs in ASEAN* **Amira Bilqis, et al.**	*Application of Demand-Side Management (DSM) for Evaluation & Optimization of Electric Vehicle's Charging Cycles* **Ngoc Huong Giang Vu**	*Assessment of Bioenergy in ASEAN Energy System for Energy Security and Sustainability* **Zulfikar Yurnaidi**

		Room 1 (Room name: Malisrouth)	**Room 2 (Room name: Rumdoul)**	**Room 3 (Room name: Bompong Krolom)**
		Topic: Energy Transition	**Topic: Environmental, Social and Governance Policy & Sustainable Forest Management**	**Topic: Economy of Energy and Environment**
		Chair: Rio Jon Piter Silitonga	**Chair: Dr. Reasmey Tan**	**Chair: Dr. Ambiyah Abdullah**
	Special Presentation from the Invited Speakers			
Thursday, 15 September 2022	09:00- 09:20		*Hydrological Response of Intensive Forest Management System in the Indonesian Tropical Rainforest* **Dr. Ir. Hatma Suryatmojo, S.Hut., M.Sc** Director, Center for Academic innovation and Studies, Gadjah Mada University	*Post-COVID-19 Migration and Mobility: Persistent Challenges and New Opportunities* **Dr. Nino Viartasiwi** Assoc Prof, President University, Indonesia
	09:20 - 09:35	*Preliminary Identification of Functional Decommissioned Solar Photovoltaic Modules from Solar Farms: A case study in Thailand*	*Spatio-temporal mapping and monitoring of mangrove forests changes from 1991 to 2021 in Panay Island, Philippines using machine learning*	*The Challenges of Nuclear Power Plant Development in Indonesia: A Case of Thorium Power Plant in Bangka Island, Indonesia*

		Amornrat Limmanee, et al.	**Genesis Laolao Daquinan, Gency Guirhem, Prof. Dominique Mediodia**	**Warih Aji Pamungkas, Nanang Indra Kurniawan, Mahesti Hasanah**
	09:35 - 09:50	*Local strategies towards 100% renewable cities and regions for climate change mitigation: West Nusa Tenggara, Indonesia* **Kanak Gokarn, Rohit Sen, Dr.-Ing.Annette Steingrube**	*The Relative Strength of Water Tenure Security for Oil Palm and Hydropower: A Preliminary Study* **Mohammad Mova Al Afghani, Budi Susetyo**	*Cost Saving Potential in Biomass Powerplant Operation by Fuel Switching in Northern Thailand* **Nakorn Tippayawong, Busamas Dangprok, Korrakot Yaibuathet Tippayawong**
	09:50 - 10:05	Study of Energy Transition and Multilateral Power Trade Towards Carbon Neutrality in ASEAN **Dr. Akanksha Singh**	*Monitoring Particulate Matters and Total Suspended Particles Along the Roadside and Public Area* **Pengsreng Ngoun, et al.**	*Revival of Nuclear Power in Philippines: Its Safety Design Feasibility using IVR-ERVC SAM Strategy* **Ralph Carlo Evidente, Michelle C. Almendrala**
	10:05 - 10:20	*Development of Modified Mesoporous Carbon from Palm oil Biomass for Energy Storage Supercapacitor Application*	*Total Suspended Particulate Matter (TSP) bound carbonaceous component in Makassar City, Indonesia*	*How much should provinces reduce greenhouse gas emissions for the national target achievement? Lessons from scientific approach using GCAM-Korea*

		Vituruch Goodwin, et al.	**Muhammad Amin, et al.**	**Seungho Jeon, et al.**
	10:20 - 10:35	*Projection of Carbon Emissions from the Diesel, Biodiesel, and Battery Electric Vehicle in Indonesia: A Policy Scenario Analysis for Decarbonization of Transportation Sector* **Muhammad Reza Rahmaditio**	*Size fractionated ambient particles down to nanoparticles (PM0.1) during a haze episode in Myanmar* **Worradorn Phairuang, et al.**	*Green bonds in the context of Cambodia* **Varabott Ho**
	10:35- 10:50	*Development of Gas Diffusion Electrodes for Electrochemical CO_2 Reduction towards C^{2+} Products* **Pongkarn Chakthranont, et al.**	*A Descriptive Results on Environment Affecting Pupils in Cambodia – Case Study Primary Schools in Phnom Penh* **Morn Mengly, et al.**	*Just' access to electricity: Energy justice in Indonesia's rural electrification (LISDES) program* **Ayu Pratiwi Muyasyaroh**
	10:50- 11:00	Coffee Break		
		Room 1 (room name: Malisrouth)	**Room 2 (room name: Rumdoul)**	**Room 3 (Room name: Bompong Krolom)**
		Topic: Energy Transition	**Topic: Environmental, Social and Governance Policy**	**Topic: Energy Security, Accessibility& Sustainability**
		Chair: Rio Jon Piter Silitonga	**Chair: Dr. Reasmey Tan**	**Chair: Dr. Kinnaleth Vongchanh**

	11:00- 11:15	*A Study on Media Coverage about Energy Transitions in Cambodia* **Rachna Tim**	*Precipitation Trend Analysis of Coastal Catchment of Cambodia* **Mey Mony Odoum**	*The Effects of Solar Home System on Rural Household Welfare in Cambodia: Evidence from Propensity Scores Matching* **SAN Sereyvathna, Huang Qiong, Yoshida Yuichiro**
	11:15- 11:30	*Overcoming the Fluctuating Curve from PV Power Generation by Modelling the Integration of Hydrogen Energy Storage into Electricity Microgrid* **Priyo adi Sesotyo, Rinaldy Dalimi**	*Preliminary discussion about the atmospheric aerosols and meteorological conditions using satellite data in Afghanistan* ***Sayed Esmatullah Torabi***	*The Future of Nuclear Power: A Philippine Perspective* **Shaina Macmac, et al.**
	11:30- 11:45	*Analysis of the impact of biofuel and electric vehicle policy in ASEAN on LEAP selected outputs: A case study of recent policy implementation in Thailand* **Khemrath Vithean**	*Size Segregated Carbonaceous Aerosol Down to Ultrafine Particle in Medan City, Indonesia* **Rahmi Mulia Putri**	*The Stimulus-Organism-Response (SOR) Model-Based Analysis on Appliances Acquisition in the Philippines: An Empirical Study on Consumers' Behaviour towards Purchasing Refrigerators* **Daniel Collin G. Jornales**
	11:45- 12:00			*Prospect and Challenge the Implementation of Green Hydrogen as the New Industrial Strategy for*

				Decarbonisation in Indonesia **Fadilla Miftahul Jannah**
	12:00 - 13:00	Lunch Break		
		Room 1 **(Room name: Malisrouth)**	**Room 2** **(Room name: Rumdoul)**	**Room 3** **(Room name: Bompong Krolom)**
		Topic: Sustainable Built Environment	**Topic: Environmental, Social and Governance Policy**	**Topic: Energy Security, Accessibility& Sustainability**
		Chair: Dr. Sarin Chan	**Chair: Alnie Demoral**	**Chair: Silvira Ayu Rosalia**
	13:00 - 13:15	*Analysis of thermal performance of naturally ventilated residential building in tropical climate: case study of Phnom Penh, Cambodia* **Taing Kimnenh, Philippe ANDRE, Pierre Leclercq**	*The Relationship between Sustainability Performance and Company Financial Performance with External Assurance as the Moderating Variable in Indonesian Listed Companies* **Aulia Dewi**	*Optimization of a Hybrid Renewable Energy System for a Rural Community Using PSO* **Erees Queen Macabebe**, et.al.
	13:15 - 13:30	*Enhancement of Hydrodearomatization Catalyst by*	*Rehabilitation Strategy for Restoration of Riverbank*	*Financing Green Buildings: barriers, policies, solutions*

		Brönsted Acid Site of Alumina Support for Clean Diesel Production **Suparoek Henpraserttae, et al.**	*Protection Function in the Merawu Watershed, Banjarnegara Regency* **Jalma Giring Sukmawati**	 **Dina Azhgaliyeva**
	13:30 - 13:45	*Decolorization of Synthetic Slaughterhouse Wastewater using Aerated Electrocoagulation-Floatation with Fe, Al, and Ti Electrodes* **Kit Vanny, et al.**	*National Industry Participation in Nuclear Power Plant Program to Support Indonesia's Net Zero Emission Target* **Djarot Sulistio Wisnubroto, et al.**	*Development of ASEAN Energy Resilience Assessment Guideline for Energy Infrastructure Climate Adaptability Enhancement* **Kampanart Silva, et al.**
	13:45 - 14:00	*Destabilization of Emulsion Oil Separation by using Chemical Coagulation Process: Preliminary Investigation for Effective Analysis* **Bou Kimhor, Saret Bun**		*Recovery of Silicon Wafers from End-of-Life Silicon-Based Solar Cells for Alternative Photovoltaic Applications* **Saravy Dum**
	14:00 - 14:15	*Optimization of Electrocoagulation Process for Color Removal from Synthetic Textile Wastewater using Response Surface Design* **Leap Phanith, et al.**		
	14:15 - 14:30	Coffee Break		

		Room 1 (Room name: Malisrouth)	Room 2 (Room name: Rumdoul)	Room 3 (Room name: Bompong Krolom)
		Topic: Sustainable Built Environment	**Topic: Environmental, Social and Governance Policy**	**Topic: Energy Transition**
		Chair: Sarin Chan	**Chair: Alnie Demoral**	**Chair: Silvira Ayu Rosalia**
	14:30 - 14:45	*Mapping Enablers for Sustainable Renewable Energy Implementation in ASEAN* **Apinya Puapattanakul, et al.**	*Relationship Analysis between Human Behavior and Air Quality - Effect of COVID-19* **Kento Shibata**	*Solar Cell Energy Sustainability in Indonesia: A Prospect or A Project?* **Anugerah Yuka Asmara**
	14:45 - 15:00	*Aligning Energy Culture as Part of Sustainable Tourism Ideas* **Novita Putri Rudiany, et al.**	*Pyrolytic analysis of chemical components from the bark of Eucalyptus pellita F Muell.* **Riki Andika**	*The Feasibility Study to Assess the Electric Charging Project as the Support to Transition of Clean Energy in Indonesia* **Septha Amelia**
	15:00 - 15:15	*On-Building Management System Architecture to Maximize Self Consumption in University Buildings: A Case Study* **Rezky Arif Mahesa Nanda**, et.al.	*Emissions Reduction Potential in Building sector in 2030: Gyeonggi Province case* **Muntae Kim, Jaeick Oh, Suduk Kim**	*Impact of lontar green power program on energy consumption and GHG emissions in Indonesia coal power plant* **Drajat Suseno, et.al.**

	15:15 - 15:30	*Enhanced power generation at Zn-air battery using plasma-treated carbon electrode* **Noriaki Sano, Haoting Xie, Atsuhiro Inomata, Kyuya Najagawa, Tetsuo Suzuki**	*Determination of Particulated Matters and Total Suspended Particles Emit from Increase Burning* **Chy Sopannha**	*Are we really prepared for the energy transition? Analysis of readiness for several major aspects. The Case of Indonesia* **Hanan Nugroho, Nur Laila Widyastuti, Dedi Rustandi**
	15:30- 15:45	*Hydrothermal Deamination of protein-rich algal biomass* **Armando T Quitain, et.al.**	*Ten Years Behavior of Airbone Particles in Phonm Penh* **Mitsuhiko Hata, et.al.**	*CO_2 Capture from Air by an Internally Heat and Cooled Temperature Swing Adsorption Packed with an Amine-supported Solid Adsorbent* **Heak Vannak**
	15:45-16:00	*Is Ground Source Heat Pump the Future of Space Cooling in Southeast Asia?* **Arif Widiatmojo**	*Fine and nano particles in the school environments and the respiratory deposition doses to schoolchildren in a middle city of Jambi, Indonesia* **Rizki Andre Handika, Masami Furuuchi**	*Considering environmental and social equity impacts in just zero carbon transitions* **Benjamin C. McLellan**

	16:00- 16:15	*Street dining: Lighting as co-producer of the performative event in Pasar Lama Tangerang* **Yandi Andri Yatmo, Ferry Gunawan, Paramita Atmodiwirjo**	*Workers' Perceptions of Occupational Heat Stress – A Survey Among Garment Workers in Phnom Penh, Cambodia* **Chea Vabotra**	*Commitment to Sustainability: A Case Study of University Sustainability Initiatives* **Zul Ilham, Jillian L. Goldfarb**
	16:15-16:30	*Performance Evaluation of Anaerobic Baffled Reactor and Filter for Treating Medium-strength Wastewater using Natural Sludge Growth and Different Hydraulic Retention Times* **Borith Pang, et al.**		*Accelerating the Paradigm Shifting Actions Towards Low Carbon Energy Transition in Indonesia* Citra Endah Nur Setyawati, Dian Lutfiana, Venkatachalam Anbumozhi
	16:15- 16:30	**Closing Ceremony**		

Energy Transition

Modelling Energy Storage Systems and Its Roles in ASEAN Energy Transition

Zulfikar Yurnaidi

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ABSTRACT

Energy transition towards renewable energy and other low carbon technologies poses challenge in providing sufficient reliability. This is largely due to intermittency issues in some of renewable energy options, such as solar and wind. Studies found that with higher penetration of renewable-based electricity, the power grid would require increasingly crucial upgrade, especially in term of flexibility. Balancing the supply and demand would also require both base generation and dispatchable power plants. Economically, availability issue and potential curtailment might diminish the benefit of those renewable options. Therefore, energy storage would be crucial in energy transition. Its role would allow a more efficient renewable energy generation while balancing supply and demand and alleviating some burdens from the energy system. This study aims to model the storage system into ASEAN energy system, and assess the potential roles of energy storage, especially within the framework of energy transition. Critical part of the energy transition is the achievement of regional energy target, which includes the achievement of 23% renewable energy share in primary energy supply in 2025.

Keywords: Energy storage, battery, pumped up hydro storage, renewable energy, Energy systems modelling

1. INTRODUCTION

The study used the Low Emission Analysis Platform (LEAP), a powerful, versatile software system for integrated energy planning and climate change mitigation assessment tool. The energy system of all 10 ASEAN member states (AMS) has been modelled, based on the latest energy balance table, socioeconomics data, and various detailed modelling parameters and variables. The energy system is driven by a full set of demand sectors, from residential and commercial to transport and industry. As this study will be focused on the storage system, a more detailed electricity generation system is to be explored. Optimisation is chosen as modelling methodology for the power system, utilising NEMO

framework. NEMO, the Next Energy Modelling system for Optimization, is a high-performance, open-source energy system optimization tool built to be run along LEAP. Several energy storage options are modelled, including battery and pumped-up hydro storage. Specific characteristics, including efficiency, cost, and capacity are modelled for the whole electricity generation system, including the storage options.

2. RESULT AND DISCUSSION (including conclusion)

The study showed that the energy storage will play increasingly important role in energy transition. This is especially true in the scenario that considers all components of social cost in electricity generation, including the externality cost. Even without that, a scenario in which regional target is achieved would also see penetration of energy storage into the system. The result also showed the interaction of battery with the overall electricity generation system. With its uniqueness in load shifting capacity, for example, hours/days for battery and weeks/months for pumped up hydro storage, various energy storage options can play into the mix, balancing the hourly demand within a year. Nevertheless, crucial in the increasing role of storage is the cost, efficiency, and the capacity of production and installation of the storage options themselves. For pumped up hydro storage, assessment of technical, economic, and financial availability is required. This should also include remoteness, proximity to grid and/or demand, and availability of renewable energy sources. For battery, while the efficiency and cost trend has been making battery option more and more available, potential bottleneck due to materials and end-of-life treatment need to be properly analysed. Beyond that, clear energy policy, especially in balancing the security, affordability and sustainability is required in energy transition.

ACKNOWLEDGEMENTS

This article is supported by the Ministry of Economy, Trade, and Industry (METI), Japan and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH through ASEAN-German Energy Programme. The findings herewith do not necessarily reflect the views of its funder.

Cross-sectoral Analysis on the Implication of ASEAN Road Transport Electrification Policies on Region's Energy Security and Climate

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ABSTRACT

Road fleet electrification is one of the key strategies of the ASEAN region in decarbonizing the transportation sector. Electric vehicles (EVs) are seen to be 3 to 6 times more efficient compared to their conventional counterpart. Moreover, reduce pollution and emission which results in negative externalities like respiratory deceases and global warming. This study aims to perform a cross-sectoral analysis on the implication of ASEAN road transport electrification policies on energy security, more specifically on estimating the energy demand reduction on the transport fleet and increase in electricity requirements in the power sector. Further analysis that estimates the implication of achieving their EV targets of countries in the region to the emissions and societal welfare through estimation of net GHG emitted and externality costs were also tackled in this study. This study used the Low Emission Analysis Platform (LEAP) tool and transport sector was modelled using a bottom-up approach. this study concludes that increased electric vehicle deployment in the ASEAN region could enhance energy security, sustainability, and societal welfare. Coupled with the use of clean technologies in power generation, these strategies could support national and regional energy and climate goals.

Keywords: Energy Transition, Energy systems modelling, Electric Vehicles, ASEAN, Energy efficiency

1. INTRODUCTION

Road fleet electrification is one of the key strategies of the ASEAN region in decarbonizing the transportation sector. Electric vehicles (EVs) are seen to be 3 to 6 times more efficient compared to their conventional counterpart. Moreover, reduce pollution and emission which results in negative externalities like respiratory deceases and global warming. ASEAN member states provided promising targets and strategies for increasing the uptake of the technology such as Indonesia's target of deploying 2 million four-wheelers and 13 million two-wheelers electric vehicles as stated in their Net-Zero Emission Roadmap. This study aims

to perform a cross-sectoral analysis on the implication of ASEAN road transport electrification policies on energy security, more specifically on estimating the energy demand reduction on the transport fleet and increase in electricity requirements in the power sector. Life cycle assessments show that despite the shift to electric vehicle use results in emission reduction in the operational life, continuous utilization of fossil-based power generation may offset the emission reduction potential of this strategy. Therefore, further analysis that estimates the implication of achieving their EV targets of countries in the region to the emissions and societal welfare through estimation of net GHG emitted and externality costs were also tackled in this study.

2. RESULT AND DISCUSSION (including conclusion)

This study used the Low Emission Analysis Platform (LEAP) tool, a scenario-based demand-driven modelling tool that can be used to track energy consumption, production, and resource extraction in all sectors of an economy. The energy demand of 10 ASEAN Member states' (AMS) transport sector was modelled using a bottom-up approach, which allows representation of the performance of existing and emerging modes of road transport and the shift to cleaner technologies. The model assumed the complete implementation of AMS stated policies on electric vehicle deployments, with historical power dispatch maintained. In the model, emission factors associated with specific sectors, processes, and fuels were incorporated as a multiplier to estimate emissions and other by-products generated upon utilization of technology. The resulting emission is then multiplied by a specific externality cost factor to quantify the impact on societal welfare in monetary terms. The preliminary findings of this study show that attainment of AMS policy on road transport electrification can significantly reduce the energy demand in the sector by 1.2% in 2025 to 4.13% by 2050 which translates to an energy savings of 3.5 Mtoe and 31.7 Mtoe of petroleum, respectively. The increase in EV share which can reach up to 100% of the transport fleet in some regions in 2050 would require 161.8 TWh. This demands the need for a cleaner source of power generation to fully harness the emission reduction potential of this transition. At present, the fossil fuel share in power generation accounts for three-quarters of the mix. But despite this, road transport electrification still results in cumulative GHG emission avoidance of 110 million Metric Tonne CO2e. This avoidance could even reach up to 300 million Metric Tonne CO2e with the use of clean technologies for electricity generation. Electric vehicle deployment could significantly improve urban health and welfare. It was observed that attainment of national targets could reduce Particulate Matter (PM) from being emitted by

6.9% in 2050. Numerous scientific studies are linking particle pollution exposure to a variety of problems, including heart and respiratory diseases. This reduction which is associated with the reduced combustion of petroleum in car engines, along with a reduction in other pollutants could result in cumulative social cost savings of 211 billion USD by 2050. Therefore, this study concludes that increased electric vehicle deployment in the ASEAN region could enhance energy security, sustainability, and societal welfare. Coupled with the use of clean technologies in power generation, these strategies could support national and regional energy and climate goals.

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Social Media Analysis on ASEAN Energy Transition Trends

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ABSTRACT

This study examines how controversies of the energy transition and climate change in Southeast Asia were portrayed in public perspectives using big data from the social media platform. This novel data source then can support mapping the emergence and predicting the acceptance of energy transition. It leads to the research question, "How can social media inform social controversy and expectations associated with energy-climate nexus in ASEAN?" This study is limited to ASEAN energy transition and climate change discussion on Twitter from January 2015 until December 2020. This case has been selected for several reasons: (i) Climate change is a complex interdisciplinary issue that has gained much global attention recently, (ii) Energy transition is considered a crucial action by the ASEAN Member States to enhance the regional energy security and sustainability as stated in the ASEAN Plan of Action for Energy Cooperation blueprint, and (iii) Twitter is one of the world's most popular social media platforms. The study relies on two theoretical frameworks as the base for building its research problem: socio-technical transition multi-level perspective and social construction of technology. A multi-quantitative method was performed for data collection and processing. The data was analysed using descriptive trend, sentiment, and co-word analyses.

Keywords: sentiment analysis, energy transition, climate change, big data, social media, multi-level perspective, social construction of technology

1. INTRODUCTION

ASEAN historically relied heavily on fossil fuels to secure its energy supply. By 2030, it is projected that combined oil, coal, and natural gas will account for about 83% of the region's energy mix, compared to 14% renewables, without any policy interventions [1]. ASEAN has been importing oil since before 2005, and the region will become a net importer of gas starting in 2025 and coal starting in 2035. Hence, energy security remains critical if the bloc is not transforming its energy sources from fossil fuels to renewable and alternative energy. The international pressure to address climate change also urges ASEAN policymakers to act and revise their energy policies to be environmental-friendly. In addition, energy equality

should be adequately addressed so that everyone can access reliable and affordable energy. Commonly known as energy trilemma, these conflicting challenges should be put in balance when framing the transition agenda to a low-carbon future. Extensive research has observed the energy transition emergence, including its capabilities and opportunities to achieve sustainable development goals. Energy transition involves social, political, cultural, and behavioural changes [2]. However, there is limited research exploring the role of society in accelerating or hindering the energy transformation process, especially in Southeast Asia. It is proposed that the misalignment between energy policy priorities and societal acceptance exists when using the traditional data source alone. These datasets include surveys, interviews, policy documents, and journal publications. As opposed to conventional data, the UNDP has introduced the term "data innovation", which means the adoption of non-traditional datasets and methods to gain entirely new insight into development challenges [3].

Data innovation is necessary to provide sufficient empirical evidence for policymakers in setting a data-driven policy agenda as expected by the public, as well as to guide the industries and universities to innovate more impactful technologies. The new dataset explored in this study refers to big data from social media platforms. Social network platforms can present opinions from different public perspectives and provide unprecedented insights. Together with the traditional data, it might be able to fill up the crucial gaps in energy policy. This novel data source then can support mapping the emergence and predicting the acceptance of energy transition. It leads to the following research question, "How can social media inform social controversy and expectations associated with the energy-climate nexus in ASEAN?" As a case study, this study is limited to focusing on the ASEAN energy transition and climate change discussion on Twitter between January 2015 and December 2020. The timespan was chosen to capture important moments during the Paris Agreement 2015 and the implementation of the ASEAN Plan of Action for Energy Cooperation (APAEC) 2016-2025 Phase I: 2016-2020. The APAEC is a series of guiding policy documents to serve as a blueprint for better cooperation towards enhancing energy security and sustainability [4]. The study relies on two theoretical frameworks as the base for building its research problem: socio-technical transition multi-level perspective and social construction of technology. A multi-quantitative method was performed for data collection and data processing. The data was analysed using descriptive trend analysis, sentiment analysis, and co-word analysis.

2. RESULT AND DISCUSSION

This study's results help explain how social media can inform controversies and expectations associated with the energy transition to tackle climate change in ASEAN. First, the trend analysis can measure the discussion of the ASEAN energy-climate and its phenomena in social networking sites over time. We can see whether the trend is rising, stagnant, or even slowing down at a particular time. In general, the number of the ASEAN energy-climate discussions increased from January 2015 until the end of 2020, especially during specific international events. The subsequent analysis was the sentiment. We can see if an important event is happening during specific times, whether good or bad. For the ASEAN energy transition, we could easily spot the spike in several important events related to energy, such as ASEAN Summit, Singapore International Energy Week, and ASEAN Ministers on Energy Meeting. However, the latest ASEAN Summit brought some controversies when the public looked negatively at a policymaker who presented about climate change following a climate-related disaster in his own country. Furthermore, the analysis can measure the portion of social attention for every energy transition effort: renewable energy (RE), energy efficiency, electric vehicle, and alternative energy. Renewables development was the most popular, with 82% of the total tweets. A considerable number of differences were observed between RE with other efforts. It suggests that more public awareness and technological innovation are needed to introduce and develop the other efforts' benefits. This method can also be applied to other emerging technologies. The study promotes a novel data source through social media to measure the potential innovation based on its social controversies and expectations. It is found that the public's controversies of ASEAN energy-climate were inclined towards more positive sentiment, although several negative statements emerged a few times when a disaster happened. The typhoon and other climate-related disasters trigger public attention to the climate change issue, and the policymakers could use this momentum to establish sustainable energy and climate policies.

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Importance of Energy Efficiency in ASEAN Energy Sector: Modelling Analysis

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ABSTRACT

Energy efficiency is well-known as the 'first fuel' or 'low hanging fruit' in energy transition. Noting that, ASEAN collectively set energy intensity reduction target to 32% based on 2005 level by 2025. In national level, ASEAN member states (AMS) have set their own energy efficiency targets and policies as well. This study aims to model the national and regional energy efficiency targets into ASEAN energy system. Specifically, its potential role in improving the energy system, including reducing emission, would be assessed. Depending on the targets, national energy efficiency measures can be implemented in all final end use sectors, including residential, commercial, industry, transport, agriculture and others.

Keywords: Energy efficiency, ASEAN, Energy transition, Sustainable development, Energy end-use sectors

1. INTRODUCTION

The modelling work in this study utilised the Low Emission Analysis Platform (LEAP), which is a software system for integrated energy planning and climate change mitigation assessment tool. For the purpose of the study, a model consisting of 10 ASEAN member states (AMS) has been created. The energy systems are based on the latest energy balance table, coupled with socioeconomics data and various detailed modelling parameters and variables. The demand sector is modelled in a bottom-up and disaggregated approach, depending on the availability of data. This would allow a better and more detailed energy efficiency modelling. For example, residential is modelled by various energy using appliances, transport is modelled by its modes, industry is modelled by sub-sectors, and commercial is modelled by building types.

2. RESULT AND DISCUSSION

The study showed that the energy efficiency has effectively reducing the energy demand, compared to the baseline scenario. Moreover, a stringent policy set for the regional target

scenario would result in a more efficient energy system in the future. The study also showed that the current national targets and policies need to be strengthened to achieve the regional targets.

Energy efficiency also important to environmental issues, as an efficient energy system would be translated into lower emissions. In energy transition, energy efficiency measures should also work with other strategies, such as shifting to a low-carbon options of energy consumption, including vehicle shifting to electric and biofuel-based ones.

Nevertheless, there are still challenges in fully unleashing the potential of energy efficiency measures. These include the development of bankable projects, supporting policies, availability of financing and business models, de-risking mechanisms, and capacity.

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Understanding the Characteristics of Energy Supply and Demand in ASEAN: Cluster Analysis

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ABSTRACT

ASEAN energy transition through green energy development is on the main agenda for sustainable pathways where the role of energy supply and demand is inevitable. Economic growth and population are two key factors that influence the increases in both energy demand and supply of AMS. The 6th ASEAN Energy Outlook [1] reported that the energy demand of ASEAN Member States (AMS) in 2025 has increased by about 40% from the total in 2017. The electricity sector is estimated to be responsible for the largest share of the increase in energy consumption. Moreover, the energy supply is estimated to increase for about 2.5 times in 2040 compared to its value in 2017. This study aims to understand the characteristics and key factors that influence the energy supply and energy demand of AMS during 2005-2020. Meanwhile, the research applied the K-mean cluster analysis which choosing the number of clusters for 10 AMS countries based on their closest similarities in terms of energy demand and energy supply patterns. This study finds that long-term energy plans of AMS should be integrated not only in terms of achieving regional targets, but also should considering the similarities and differences patterns among AMS energy supply and demand.

Keywords: Energy transition, panel data, K-mean cluster, Energy supply, Energy demand

1. INTRODUCTION

The 6th ASEAN Energy Outlook reported that the demand of ASEAN Member States (AMS) in 2025 has increased by about 40% from the amount total in 2017. The electricity sector is estimated to be responsible for the largest share of the increase in energy consumption. Moreover, the energy supply is estimated to increase for about 2.5 times in 2040 compared to its value in 2017. Economic growth and population are two key factors influence the increases in both energy demand and supply of AMS. The largest share of energy demand

in 2017 was dominated by industry (38%), followed by transport and residential sector. In other hand, the largest shares of total primary energy in 2020 are dominated by oil (33%), coal (28%), and gas (22%). Meanwhile, renewables contribute a share of 14.2%.

Against this background, this study aims to understand the characteristics (patterns) and key factors that influence the energy supply and energy demand of AMS during the period 2005-2020. Moreover, this study also aims to analyse the similarities and differences among AMS for the energy supply and energy demand in 2005-2020.

2. DATA AND METHODOLOGIES

This study applies two methodologies to answer the above-mentioned objectives (panel data and cluster analyses). The main data used in this study is the historical data of four variables: total primary energy supply (TPES) as energy supply, total final energy consumption (TFEC) as energy demand, gross domestic product (GDP), population, and urban population of AMS from 2005-2020 based on the ASEAN Energy Database System (AEDS). This study applied the K-mean cluster analysis which choosing number of clusters for 10 AMS countries based on their closest similarities in terms of energy demand and energy supply patterns. Furthermore, the most important step of the cluster analysis is deciding the number of clusters that will be chosen after calculating the K-mean algorithm with principal component analysis (PCA). This study chosen three clusters dividing 10 AMS countries according to their energy demand and energy supply during 2005-2020.

3. RESULT AND DISCUSSION

The preliminary findings of this study are as follows. First is panel data analysis result shows that GDP, population, and urban population affect both energy demand and energy supply of AMS at 0.01% significant levels. Interestingly, the panel data analysis also shows that the GDP affects more significantly the energy demand. In other hand, the urban population affects more significantly the energy supply of AMS during the period 2005-2020. Moreover, the mean of the K-cluster analysis is 0.41 and this study groups 10 AMS countries into three clusters (groups) which are based on TPES and TFEC. The results show that Malaysia follows a similar pattern to Brunei and Indonesia. Meanwhile, Thailand, the Philippines and Singapore are in the same cluster based on the K-mean cluster result. The last cluster is Myanmar has a similar pattern to Laos, Vietnam, and Cambodia. According to these findings, the next long-term energy, climate, and mitigation plans of AMS should be integrated not

only in terms of achieving each national and regional targets, but also should considering the similarities and differences among energy supply and demand (consumption) patterns of AMS.

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Tracking Potential Renewable Energy Jobs in ASEAN

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ABSTRACT

Job creation in renewable is among the most significant social impact of higher renewable penetration to the energy mix. Hence mapping the distribution and projecting renewable employment in the coming years in ASEAN will be crucial as it would support the policy ramifications and the economy. This research focuses on the trajectory of direct renewable jobs under the ASEAN Member States Targets Scenario (ATS) from 2020 up to 2050 with four technologies: Solar PV Utility-Scale, Onshore Wind, Hydro Dam, and Geothermal. It is limited to three job types: manufacturing, construction and installation, and operation and maintenance. The data was derived mainly from the ASEAN Energy Outlook (AEO) 2022 and processed using Low Emissions Analysis Platform (LEAP) software. The findings indicate RE Jobs in ASEAN will reach almost 5 million, with Indonesia and Vietnam dominating the jobs by about 42% and 26%, respectively. Hydro and solar will generate the most jobs with a total of 78%. As new plants are established during the early years, job creation will be relatively higher, especially in manufacturing and construction. Further refinement of methodologies and continuous data improvement allows the better projection to portray the region's workforce on energy transition.

Keywords: Renewable energy, green jobs, ASEAN, Employment, Energy transition

1. INTRODUCTION

One strategic approach for ASEAN to meet its increasing energy demand is deploying an unprecedented share of renewable energy (RE) as mandated by the ASEAN Plan of Action on Energy Cooperation (APAEC) Phase II: 2021-2025.[1] The social impacts of higher RE plants are employment; mapping the distribution and projecting renewable employment in the coming years in ASEAN will be crucial. The research provides an overview of the employment trends at the regional level up to 2050. It could serve as reference to analyse labour markets such as education and skills requirements.

This research projects only direct jobs leading up to 2050. The data utilised in this study will largely be curated from the ASEAN Energy Outlook 2022 combined with the latest data from the ASEAN Energy Database System (AEDS).[2] The model will adopt from Rutovitz et al. (2015) with complementary and updated factors from Manish et al. (2019).[3], [4] Due to data paucity, and this study tracks only four types of renewable technologies (Solar PV Utility-Scale, Onshore Wind, Hydro Dam, and Geothermal) and three types of jobs (manufacturing, construction and installation, and operation and maintenance). The model was processed using the Low Emissions Analysis Platform (LEAP) to project the year-on-year RE job creation.

2. RESULT AND DISCUSSION (including conclusion)

The study shows that ASEAN Member States are projected to generate nearly 5 million jobs, equivalent to 0.6% of the total ASEAN population, by 2050. The increasing growth of renewable energy in the Hydro field will result in the highest share in all scenarios with a minimum share account of 47%, followed by PV Solar at 31%. Vietnam has been named the country with the highest additional jobs per year between 2021-2050 around 111,000 jobs, followed by Indonesia around 107,000 jobs. Meanwhile, other ASEAN member countries are projected to generate approximately 1.6 million jobs. Similar to the projection trend in capacity added, job creation will be higher during the early years, especially in manufacturing and construction, as new plants are established. It is due to ASEAN incline to have labour-intensive supply chains where informal work is prominent compared to machinery. The study concludes RE will bring an economic spurt in employment. To create further enabling environments for higher RE penetration, refinement of methodologies and continuous data improvement allow the better projection to portray the region's workforce on energy transition and to overcome labour force-related barriers.

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Preliminary Identification of Functional Decommissioned Solar Photovoltaic Modules from Solar Farms: A Case Study in Thailand

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ABSTRACT

Some decommissioned solar photovoltaic (PV) modules from solar power plants are still well-performed and worth reusing. Test procedure and conditions to separate between functional and expired modules is thus key points. This study has proposed a 3-step process; 1) visual inspection, 2) insulation test and 3) outdoor current-voltage (I-V) curve measurement, to preliminary screen and divide modules into six groups: A+, A, B, C, D and F. The review criterion covers quality, safely and reliability aspects. All processes have been carried on-site and test results have been recorded in a software tool called" Solar Sure". 258 retired PV modules from six solar farms in Thailand has been surveyed. It was found that some multi c-Si modules showed very low insulation resistance. 74% of the total amount of modules in this study still have the maximum power output of above 70% of their initial value, suggesting a potential for second use. The observed results of this preliminary survey are informative for a further study on field-aged PV reliability in the tropics and also useful for a preparation of a guideline for promoting reuse of decommissioned functional PV modules in Thailand.

Keywords: Solar photovoltaic, Decommission, On-site test, Reuse, End-of-life

1. INTRODUCTION

In ASEAN region, solar booming had happened earlier in Thailand, which was driven by government's incentive policy. At present some solar farms in Thailand have been operating longer than 10 years and some began to replace PV modules to maintain their power generation. Some of decommissioned module are still working and reusable. A code of conduct for inspecting and grading used PV modules is significantly important since it will effectively distinguish between reusable and expired modules. Moreover, the inspection and grading processes will establish quality and safety controls for used PV modules. At

present, there has not yet been a regulation or code of conduct, the quality of modules sold on second-hand markets is therefore widely dispersed, and their price varies considerably. This study has purposed processes for inspecting and grading used PV modules. The test process was based on practical on-site measurements which provided benefits of cost saving and less time-consuming, compared to transportation of PV modules to a testing lab. 258 modules consisting of three different PV types; amorphous silicon (a-Si), copper indium gallium diselenide (CIGS or CIS) and multi crystalline silicon (multi c-Si) from six different locations have been evaluated, for the purpose of surveying their status after decommissioning and assessing the reuse potential. Test results have been recorded in NSTDA's self-developed software tool called "Solar Sure". The reuse opportunity of retired PV modules from solar farms was also considered and discussed.

2. RESULT AND DISCUSSION

1) Visual inspection

If severe degradation or failure mode such as broken glass, hotspot are found, the modules are divided into F (Failed) group. Only three modules in this survey had not passed the visual check. The degradation mode that was observed in every site is the permanent edge soiling, which is a sticky dirt with a width of about 2 cm at the bottom corner of the front glass. This kind of defect affected module performance with a low severity.

2) Insulation test

Thin film a-Si and CIS modules exhibited relatively low insulation (100 MΩ· m^2 or lower), with a narrow dispersion pattern, while the multi c-Si modules from four different sites showed significant differences in value and dispersion. Most of the multi c-Si modules indicated insulation resistance of higher than 400 MΩ· m^2, while some modules had low insulation resistance in the same level as the thin film PV type. This suggested deterioration of the crystalline Si PV modules, which possibly caused by potential induced degradation (PID). About 30 modules had not passed the insulation test (< 40 MΩ· m^2).

3) Maximum output power

According to the results, about half (53%) of these decommissioned modules still have the maximum power output of above 80% of the nominal value. The PV modules with the normalized power ranging between 60-79% occupied the total share of 35%, and the

modules with normalized Pm below 60% shared the last 12%. These revealed an opportunity for second-life utilization before these PV modules end up with landfilling or recycling.

According to the survey, performance of the decommissioned PV modules from solar farms tended to vary widely, even though they were the same PV type and had the same exposure duration. Some still showed the normalized power of greater than 80%, while some suffered from PID, being almost in failure mode. Supposing PV modules for reuse still need to have a power above 70% of their initial value, 74% of the decommissioned PV modules in this study are qualified. Promoting reuse will extend the life of PV modules, which increases their value and also should help to slow down the amount of waste. Setting the technical criteria to qualify modules for reuse is a must, as a first step, that can contribute to quality and safety control in second-hand market. Our purposed test procedure is now further extended to use as a guideline for inspecting used PV module availability in Thailand.

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Local Strategies Towards 100% Renewable Cities and Regions for Climate Change Mitigation: West Nusa Tenggara, Indonesia

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ABSTRACT

Energy systems modelling results show that it is possible for West Nusa Tenggara to achieve 100% renewable energy use locally, with the predominant use of solar energy as well as bioenergy, and contribute to Indonesia's net-zero ambitions. Several obstacles lie in the way, faced by many local governments, highlighting the need for effective multilevel governance and coordination in order to tackle the climate emergency. Lessons learned from West Nusa Tenggara's experience can act as a beacon for other local and regional governments interested in expanding the use of renewable energy in their territories.

Keywords: RE technologies, Energy storage, Energy systems modelling, local government, climate emergency, 100% renewables

1. INTRODUCTION

Limiting the rise in global temperatures to preferably 1.5°C from pre-industrial levels i.e., achieving the goals of the Paris Agreement, will require reaching net-zero emissions by 2050, and therefore an unprecedented energy transition towards renewables. Such an energy transition has to see the rapid phasing out of fossil fuels alongside a massive uptake of renewable energy. While the benefits are numerous, there are bound to be significant socio-economic impacts. Local and regional governments are ideally placed to help guide their respective communities through such a transition to ensure it is just, equitable and inclusive. For archipelagos such as the Province of West Nusa Tenggara in Indonesia, there is also the added benefit of improved energy security through a reduced dependence on imported fossil fuels and the associated volatility. Through the 100% Renewables Cities and Regions Roadmap project*, West Nusa Tenggara has chosen to commit to achieving one hundred percent renewable energy in its territory by 2050 and ultimately achieving net-zero emissions. The definition of 100% renewable energy endorsed for our work is from the IRENA Coalition for Action, and means meeting all end-use energy needs, thermal and

electrical, through renewable energy along with enablers such as storage, hydrogen, and grids [1]. *This project is funded by the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) through the International Climate Initiative (IKI).

2. RESULT AND DISCUSSION

The development of a local strategy towards 100% renewable energy use in West Nusa Tenggara in Indonesia followed a multi-step process, that involved identifying and convening key stakeholders, as well as extensive data collection and energy modelling efforts. The results of the energy systems modelling as well as a discussion of the process are presented in this paper and form the basis of further recommendations and ways forward for Indonesia. The first phase of the process involved bringing together political commitments and relevant stakeholders. This involved the creation of a shared vision, as well as core teams and institutional working arrangements that were most suited to the development of a roadmap [2]. The next phase involved an inventory of the data available related to West Nusa Tenggara's energy system, including energy demand and supply data, the potential of various renewable energy sources in the region, land usage and spatial planning using GIS, as well as data on policies and socio-economic data. Where local data was not available, it was inferred based on national-level statistics [2]. The final step involved modelling the energy system. The model used, KomMod but Fraunhofer ISE, is a cost-minimizing model that aims to find the system with the lowest overall costs, subject to certain constraints, assumptions, and boundary conditions as indicated through discussions with stakeholders. The model is sensitive to technology as well as fuel costs, indicating that the prices of alternate fuels can heavily influence the choice of which technology and transition pathway to follow [3]. Based on actual and projected energy demand and supply data, as well as information on costs and socioeconomic changes until the target year 2050, the results show that 100% renewable energy use is possible locally in West Nusa Tenggara. They also suggest that a coupling of the two largest islands' energy systems, Lombok, and Sumbawa, is a feasible strategy to adopt going forward. Several technologies have a role to play, including hydrogen, bioenergy, solar photovoltaics and also energy storage, as shown in Figure 1 below. Figure 1: Supply technologies implemented for different demand types in West Nusa Tenggara [3] The results show that a total of 31,134 GWh can be met through the above technologies, as shown in Figure 2. The challenge lies in the implementation, given Indonesia's electricity system and the limited role for other players besides the state-

owned utility. However, several recommendations can be given that take into account the reality of WNT's situation, including soft measures such as improving data and monitoring, as well as more concrete measures such as using municipal operations as a starting point for the transition. Figure 2: Energy flow diagram for the leading scenario (West Nusa Tenggara) [3]

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Study of Energy Transition and Multilateral Power Trade Towards Carbon Neutrality in ASEAN

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ABSTRACT

Today, most countries are not only investing in developing renewable energy infrastructure but also adopting legal frameworks to promote energy efficiency via the usage of green energies. States have started to integrate the use of green energy into their national strategies in a way that is redefining the whole concept of Energy security. The rapid development of renewable technologies and their extensive adoption by governments would undoubtedly impact the global and regional geopolitical dynamics. This article will be divided into two major sections; the first section discusses the historical pattern of energy transition and the geopolitical factors that would emerge and influence the intra and inter-regional energy cooperation of ASEAN. Therefore, this section will analyse the geopolitics of energy transition, how energy system transformation would impact geopolitics and the possible evolution of a "new energy order" in the era of net-zero. The second section will focus on the cross-border power systems and will present a framework for sustainable delivery of multilateral energy systems based on political, economic, social, technological, environmental, and legal (PESTEL) factors. Thus, this paper evaluates PESTEL opportunities that cross-border power systems offer to enhance clean energy penetration among ASEAN economies.

Keywords: Grid integration, International Cooperation, Energy Security, Regional Cooperation, Energy Collaboration, Geopolitics, Cross-border Energy Trade, Smart grids

1. INTRODUCTION

The global energy mix is going through a phase of fundamental transition to combat the threats associated with climate change. There had been various energy transitions in the past, for example, from woods to coal, from coal to petroleum, natural gas, nuclear power, and other energy sources. These energy shifts typically take 50 to 400 years to shift from one energy to another, depending on the type of energy, political will, economic possibilities, social acceptance, and technological advancement (Mottet and James, 2020; Fouquet,

2010). Behind the current energy transition is the motivation to avoid the catastrophic effects of climate change by reducing the share of greenhouse gases. The road towards carbon neutrality would require a complete manoeuvre of economic and global environmental governance and an unprecedented level of cooperation among countries to protect the planet earth. This energy transition will be majorly governed by policy than the market in comparison to past energy transitions. Today, most countries are not only investing in developing renewable energy infrastructure but also adopting legal frameworks to promote energy efficiency via the usage of green energies. States have started to integrate the use of green energy into their national strategies in a way that is redefining the whole concept of Energy security. The rapid development of renewable technologies and their extensive adoption by governments would undoubtedly impact the global and regional geopolitical dynamics. This article will be divided into two major sections; the first section discusses the historical pattern of energy transition and the geopolitical factors that would emerge and influence the intra and inter-regional energy cooperation of ASEAN. Presently, ASEAN is considered a vital pillar of the Indo-Pacific region, exerting its 'assimilative policy' to involve interested as well as competing actors and proposing dialogue over differences, thus impacting the regional geopolitics (Bhattacharya 2019). Therefore, this section will analyse the geopolitics of energy transition, how energy system transformation would impact geopolitics and the possible evolution of a "new energy order" in the era of net-zero. The second section will focus on the cross-border power systems and will present a framework for sustainable delivery of multilateral energy systems based on political, economic, social, technological, environmental, and legal (PESTEL) factors (Zalengera et al. 2014). Thus, this paper evaluates PESTEL opportunities that cross-border power systems offer to enhance clean energy penetration among ASEAN economies.

2. METHODOLOGY

This article will follow an exploratory and descriptive methodological approach and conduct a policy review of the institutional, economic, political, and regulatory mechanism of the multilateral power trade in the ASEAN with a special focus on ASEAN Power Grid (APG). The article recognizes that "international cooperation would be the key to achieve carbon neutrality in an affordable manner" (IEEJ and ERIA 2022), and multilateral power trade can act as an instrument that can nurture cooperation among states. Thus, this paper aims to present a framework and conduct a PESTEL analysis of the cross-border energy systems in the region. PESTEL analysis provides a multidimensional view of the complete environment

and helps to comprehensively evaluate all factors that may influence an institution's performance, policy, or regulation (Zalengera et al. 2014; Vasudevan 2021).

3. RESULT AND DISCUSSION

In the era of the energy transition, renewables will shape the geographical and geopolitical connections based on dependencies among states and regions. The transition to renewable energy will create new trade patterns, and when these energy trade routes amend themselves, the geopolitical chessboard will also be amended. It has been argued that "in a world in which energy can be produced at most locations, a single hegemon will be less able to exert influence by controlling the high seas or strategic checkpoints such as the Straits of Hormuz or Malacca" (IRENA 2019). There are predictions that, "countries that today import oil from the other side of the world, will seek to develop renewables at home and to integrate their grids with those of neighbouring countries" (ibid). In the given scenario, regional grids' importance will rise significantly compared to the global fossil supply market among energy-dependent states. Control over grid infrastructure will become vital for national security and for projecting global influence and power (ibid). Today, states are promoting new initiatives and forming cooperative alliances to boost renewable energy penetration. Multilateral power trading can bring multiple benefits, including reduced system costs, increased energy security, and an ability to integrate a higher share of variable renewable energy (IEA 2019). According to energy expert Fatih Birol, "Regional power system integration can enhance electricity security, improve the affordability of electricity and scale up the deployment of the region's abundant renewable energy resources" (IEA 2019). Grid infrastructure includes physical assets such as power lines, storage facilities, and virtual interconnections that will multiply as the sector digitalizes. (IRENA 2019).

The core argument of this article is that– regional cooperation can induce effective implementation of strategies adopted to combat climate change problems, and cross-border power systems can create opportunities to nurture regional cooperation. Following is some of the factors that will be addressed during PASTEL analyses:

1. Political: International cooperation, government policies, stability & instability
2. Economical: Reduced investment cost, green finance
3. Social: Social awareness and acceptance
4. Technological: Smart grids, Energy Infrastructure, technology sharing, power system flexibility

5. Environmental: Impact on the environment due to clean development mechanism · Legal: Institutional frameworks, regulatory mechanisms, and policies.

4. CONCLUSION

The chief objective of this study is to promote inclusive and sustainable development via cooperation. Regional cooperation not only enhances mutual trust among states but also promotes states' economic growth. Therefore, this study looks forward to expanding multilateral synergies available from energy collaboration among the ASEAN Member States. Furthermore, through the PASTEL policy review, this research article will contribute further in-depth analysis to the existing literature that will provide the multidimensional framework with a holistic approach to policymakers to assist them with policy recommendations for future courses of action.

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Development of Modified Mesoporous Carbon from Palm oil Biomass for Energy Storage Supercapacitor Application

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ABSTRACT

Energy storage system research including battery and supercapacitor devices has been studied to increase efficiency, lower their cost, and improve environmental friendliness. Supercapacitor (SC) device offer high transient response and power density which suitable for many applications. The electrodes in supercapacitor device usually produced from highly porous carbon materials. In this study, the modified mesoporous carbon was produced from Palm empty fruit bunch (EFB) biomass. The production of mesoporous carbon was done using a low-temperature hydrothermal carbonization process. The mesoporous carbon from EFB biomass has shown good properties in terms of high surface area. To improve the electrical conductivity of the carbon the modification by nitrogen doping with ammonium chloride and urea was studied. The effect of different nitrogen source on surface area and pore properties were reported. The modified mesopore carbon was tested in a symmetrical swagelok supercapacitor cell to evaluate the specific capacitance and efficiency using galvanostatic charge discharge method. The modified mesoporous carbon with urea-doped exhibits the highest specific capacitance of 121 F g^{-1} at current loading of 0.1 A g^{-1} in an aqueous 1M H_2SO_4 electrolyte and low internal resistance due to nitrogen enhance the electronic conductivity of the electrodes and thus increase the supercapacitor performance.

Keywords: Energy storage, Activated carbon, Hydrothermal carbonization, Palm oil biomass, Supercapacitor

1. INTRODUCTION

Thailand as the third largest palm oil producer which produces 3.9 million tons of palm oil in a year [1]. The palm oil industry in Thailand has large amount of biomass waste which is not fully utilized. Palm empty fruit bunches (EFB) are the most underutilize waste products from palm oil industry. The biomass such as EFB waste can be increased its value by carbonization process to produce high-value carbon materials such as activated carbon (AC)

or mesoporous carbon. In this study, hydrothermal carbonization process was used to produce mesoporous carbon from EFB because its advantages that use low-temperature, environmentally friendly and easy-to-handle for producing mesoporous carbon [2]. The EFB biomass was purchased from palm oil plantation in Pathumthani province, Thailand. Then, EFB was dried, ground and sequentially sieved for sizes 75-150 µm. The EFB powder was hydrothermal carbonization in a high-pressure autoclave reactor (Parr Instrument) at 200°C for 2 h. Followed by activation process with $ZnCl_2$ activating agent in the tube furnace at 800°C under CO_2 atmosphere for 2 h. The undoped mesopore carbon was denoted EFB-HWZ. The ammonium chloride or urea were mix with EFB and activating agent during activation process to produced modified mesoporous carbons doped with nitrogen. The modified mesopore carbon were denoted as EFB-HWZA and EFB-HWZU, respectively. The surface area and pore size distribution of modified mesopore carbon were analyzed using nitrogen adsorption-desorption technique and Brunauer–Emmett–Teller (BET) theory (Micromeritics ASAP 2460). The pore volume and pore size distribution were determined by non-local density functional theory (NLDFT). The modified mesopore carbon was electrochemically tested for supercapacitor performance using Galvanostatic charge–discharge measurement (GCD) performed at a currents range of 0.1–10 A g^{-1} with cut-off potentials from 0.0 to 0.6 V (Maccor 4000 battery analyzer). The specific capacitance values (Csp, F g^{-1}) were calculated from discharge curve. The internal resistance was evaluated from EIS measurement carried out in the frequency range of 10^{-2}–10^{5}Hz using an Autolab PGSTAT204 potentiostat/galvanostat.

2. RESULT AND DISCUSSION

The mesoporous carbon was produced via hydrothermal carbonization process with 2:1 weight ratio of $ZnCl_2$ activating agent: EFB hydrochar. The carbon modified with nitrogen doping method using ammonium chloride or urea as nitrogen source were produced using 2:1 weight ratio of nitrogen source: EFB hydrochar and activated at 800 °C under CO_2 atmosphere. All mesoporous carbon were analyzed for BET surface area to investigate the effect of nitrogen doping on surface area and pore properties. The nitrogen adsorption-desoption isotherm result indicates that all mesopore carbon samples exhibit the typical IV isotherms [3]. The surface area of mesopore carbon without nitrogen doping 1599 m^2 g^{-1} are higher than modified mesopore carbon with nitrogen doping (1497 m^2 g^{-1}). The results of pore size distribution plot suggest a combination between micropore–mesopore structures, which is desired for the electrode application. The percentage of mesopore of

carbon decreases with ammonium chloride and urea doping indicates that the ammonium chloride and urea could partially blocked some pores or interrupting an interaction between hydrochar and $ZnCl_2$ in activation process. The mesopore carbon was casted to from an electrode and assembled into Swagelok cells for GCD and EIS. The specific capacitance of modified mesopore carbon with urea-doped shows higher specific capacitance than undoped mesoporous carbon. The result of EIS measurement is plotted in the Nyquist plots show a semicircle continues with a 45^0 line, demonstrating the normal character of an electrical double-layer capacitor [4]. The modified mesoporous with urea-doped present a low internal resistance in an electrical double-layer than undoped mesopore carbon. This is the result of nitrogen addition which can improve the electronic conductivity in the internal structure of mesorporous carbon. The modified mesoporous carbon with urea doped exhibits the highest specific capacitance of 121 F g^{-1}. The production of modified mesoporous carbon from EFB biomass was achieved with suitable pore properties to be use as a supercapacitor electrode material. The nitrogen doping with urea combine with hydrothermal carbonization process was a low energy and environmentally friendly method to produce this value-added mesoporous carbon from palm oil biomass waste.

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Projection of Carbon Emissions from the Diesel, Biodiesel, and Battery Electric Vehicle in Indonesia: A Policy Scenario Analysis for Decarbonization of Transportation Sector

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ABSTRACT

In order to achieve the carbon emission reduction target, the Indonesian government is intensifying the mandatory biodiesel program. Although the use of biodiesel is lower in emissions than diesel, its production has a significant impact on other environmental components, such as deforestation, hydrological disturbances, and biodiversity. At the same time, the development of electric cars offers a new alternative to decarbonizing the transportation sector. Therefore, this study aims to compare carbon emissions and investment requirements between biodiesel policy scenarios and electric vehicles. The results show that the prospect of electric cars is much better than biodiesel which is predicted to lose demand in the future. In terms of carbon emissions, the projections show that the policy scenario for electric vehicles will result in lower total emissions in the long term. From a financial perspective, the electric vehicle scenario can save fuel subsidy spending and foreign exchange for imports of fuel.

Keywords: Biodiesel, Electric vehicles, Energy demands modelling, green transport, Greenhouse gas, Nationally Determined Contributions, Renewable energy

1. INTRODUCTION

To prevent climate change, Indonesia is targeting a 29% reduction in greenhouse gas (GHG) emissions by 2030. This target is stated in the Nationally Determined Contribution (NDC) document which is a derivative of the Paris Agreement. The NDC targets are divided into five sectors, namely energy, waste, industry, and product use (IPPU), agriculture, and forestry. Of the five sectors, energy has the second largest contribution to the achievement of the NDC target - 11 out of 29% to be exact. Various climate change mitigation actions in the energy sector have been formulated by the Ministry of Energy and Mineral Resources and the Ministry of Environment and Forestry. One of the main mitigation actions is the biodiesel program as a substitute for diesel fuel.

In the NDC Implementation Roadmap document issued by the Ministry of Environment and Forestry, it is stipulated that the use of biofuels dominated by biodiesel will be the main contributor to reducing GHG emissions in the transportation sub-sector. Substitution of fossil fuels to biofuels is estimated to result in a reduction in GHG emissions of around 20-30 million tons of CO_2/year in the range of 2021-2030. Besides being claimed to be effective in reducing GHG emissions, the biodiesel program is also believed to save foreign exchange, increase energy security, and maintain good CPO prices. Therefore, the government every year seeks to increase the use of biodiesel both in terms of volume and blending level.

At the same time, the trend of electric cars is growing rapidly. In 2020, the number of electric cars in the world has reached 10 million units and is predicted to reach 145 million units by 2030. Types of electric cars are also increasingly diverse, heavy vehicles such as trucks and buses which have been identical to diesel engines, now have the electric version. The trend of electric cars is getting stronger as the urgency of reducing GHG emissions is also getting higher. Many countries have set targets for Net Zero Emissions (NZE) and cessation of the use of conventional cars or the Internal Combustion Engine (ICE).

Recently, Indonesia has set its NZE target in 2060. One of the milestones in achieving this target is the cessation of ICE vehicle sales. As a result, there is a threat to the biodiesel program. The diesel power plant which is a biodiesel consumer apart from transportation is also planned to be replaced with RE. Thus, the consumption or absorption of biodiesel will be threatened to fall, and even disappear in the future. However, according to the National Energy Plan document, biofuel production is targeted to continue to increase, until by 2050 it will reach 52,3 million KL.

As far as this research is concerned, the government has not published a biodiesel roadmap that adapts the NZE plan. There are concerns that spending on subsidies/incentives and the current investment in the biodiesel program will be unproductive if viewed in the long term. Therefore, this study tries to explore more deeply the prospects for using biodiesel, the subsidies needed to run the biodiesel program, the comparison of the effectiveness of reducing carbon emissions between biodiesel and electric cars, as well as how to optimize the use of electric cars to reduce national carbon emissions.

2. RESULT AND DISCUSSION

Comparison of Carbon Emissions Between Diesel and Biodiesel

The use of biodiesel has been included in the list of climate change mitigation actions in the energy sector and is expected to be the largest contributor to reducing GHG emissions in the transportation subsector. In line with this, the Ministry of Energy and Mineral Resources stated that the B20 program in 2018 and 2019 has reduced emissions by 5,61 and 9,51 million tons of CO_2-eq. The follow-up program, namely B30, will reduce emissions by 14,34 million tons of CO_2-eq according to predictions in early 2020. When compared with the national GHG emission reduction target in the energy sector of 314 million tons of CO_2-eq, the percentage reduction in GHG emissions from the implementation of the biodiesel program is 1,8%, 3%, and 4,6%, respectively. This means that the contribution of biodiesel application to the GHG emission reduction target is relatively low. If the biodiesel production target in 2030 of 20.8 million kilo litters is achieved, the percentage will only increase to 9,9% of the national target for the energy sector.

The reduction in carbon emissions from the biodiesel program is the difference between the carbon emissions produced from diesel and biodiesel with equivalent use. However, volume cannot be an equivalent measure of use for the two fuels. This is because diesel, also known as B0, has a higher heating value than biodiesel with any mixed content. That is, with the same volume, diesel produces a greater energy output than biodiesel. In other words, the use of biodiesel will be more wasteful because it requires more volume to produce the same amount of energy.

Tests on the Specific Fuel Consumption (SFC) and Thermal Efficiency (TE) parameters also stated that biodiesel was more wasteful. This was conveyed in research by Hassan, et al. (2018) which compares the performance of diesel engines on the use of three different types of fuel, namely diesel, palm oil biodiesel of the B20 type, and a mixture of diesel, biodiesel, and butanol (called BU20). The study found that diesel fuel has a lower SFC value and a higher TE value than B20. The waste of biodiesel has also been recognized by the Ministry of Energy and Mineral Resources which said B20 increases fuel consumption by 1-3%. Likewise, B30 is said to be 1-3% more wasteful, while B100 can reach 7-10%.

The effect of the difference in calorific value, SFC, and TE is not significant at the individual user level, but at the national level, the difference is large. For example, in 2019, calculations show that biodiesel utilization (scenario 1) reached 23,21 million kilolitres of B20, equivalent to 880 petajoules. However, if the amount of energy is converted to diesel volume (BAU scenario), then the lower volume is 22,98 million kilolitres. So, there is a difference of 234,5

thousand kilolitres of fuel saved if there is no biodiesel program. This affects the calculation of the total reduction of GHG emissions from the implementation of the biodiesel program. This is because, although the GHG emission per litre of biodiesel is lower than diesel, the larger volume of biodiesel than diesel will add a lot of GHG emissions in total. Although the energy density of biodiesel decreases as the percentage of blending increases, the reduction in GHG emissions can be achieved due to the reduction in emission factors that have a greater effect. The change in energy density of biodiesel from type B5 in 2009 to type B30 in 2030 is 1,06%. In other words, the volume of biodiesel use is becoming more wasteful by 1,06%. However, the development from B5 to B30 resulted in a percentage reduction in the CO_2emission factor of 12%, so the increase in blending still resulted in CO_2emissions from the use of biodiesel. Even so, the total reduction in CO_2emissions resulting from the use of biodiesel only reached 3,13% of the nationally determined contribution (NDC) target of the energy sector by 2030, so it can be interpreted as the insignificance of the biodiesel program in efforts to mitigate climate change.

Comparison of Carbon Emissions Between Biodiesel and Electric Vehicles

Unlike oil-fuelled vehicles (biodiesel, diesel, gasoline, etc.) that emit GHG, electric vehicles are free of any emissions. However, power plants that supply power to electric vehicles may produce GHG emissions. Electric cars produce GHG emissions indirectly if the electricity they use comes from a power plant that involves the combustion process. In Indonesia, the energy mix for electricity generation is still dominated by fossil energy at 82,2%. The rest, about 17,79%, is an NRE mix consisting of various types of NRE power plants. However, not all NRE is clean of GHG emissions. Despite lower emissions, RE power plants of the type Biomass Power Plant (PLTBm) and Diesel Power Plant (PLTD) based on biodiesel still involve the combustion process as power plants with fossil energy. Thus, the implementation of the EV program in Indonesia does not necessarily make the transportation sector free from GHG emissions. Based on these considerations, GHG emissions from electric vehicles also need to be taken into account.

In this study, GHG emissions generated by electric vehicles are calculated for the same mileage as ICE vehicles that use biodiesel. For this reason, two scenarios are made: Scenario 1 is a condition when the biodiesel (B30) program runs according to the RUEN target in the range of 2020-2030, while Scenario 2 is a condition when all biodiesel vehicles are replaced with electric vehicles of the appropriate type. That way, GHG emissions and their reduction against the business as usual (BAU) scenario from the biodiesel program and electric

vehicles can be compared. The following is a comparison of GHG emissions produced by biodiesel vehicles with electric vehicles during the 2020-2030 period.

It is known that in the 2020-2030 period, the total GHG emissions from electric cars (Scenario 2) are higher than from biodiesel cars (scenario 1). The biggest difference occurred during the 2020-2024 period due to the too large emission factor for power generation (0,89-0,86 tons/MWh). New electric vehicle GHG emissions decline in 2025 when the NRE mix reaches its target of 23%. Achieving this target will result in a reduction in the emission factor to around 0,78 tons/MWh. The emission factor is projected to decrease to 0.752 ton/MWh in 2030. However, the reduction in the value of the emission factor is still not large enough. This is because the GHG emissions from scenario 2 are still higher than in scenario 1, which means that the use of B30-fueled cars has lower emissions than electric cars.

In addition, it can also be seen that from 2020 to 2027, scenario 2 produces higher CO_2 emissions than the BAU scenario. This indicates that the portion of fossil fuel generating capacity, especially the Coal Power Plant (PLTU), is still too large, resulting in a high CO_2 emission factor. In the 2021-2030 National Electricity Supply Business Plan (RUPTL), the government is still targeting the construction of PLTU in 2021-2027 with a total capacity of 13,82 GW. Moreover, the average coal emission factor in Indonesia is relatively high (99.718 kg/TJ) compared to other countries, such as the United States (92.993 kg/TJ). In addition to the mixing aspect, the magnitude of the emission factor for Indonesia's electricity generation is also influenced by efficiency. Most of the power plants in Indonesia are still using subcritical technology with an average generating efficiency of around 30%-40%.

Optimization of the EV Program to Reduce GHG Emissions

As a result of inadequate CO_2emission factors in the 2021-2030 RUPTL, an ideal national EF value of 0.6 tons CO_2/MWh is assumed that starts from 2025 and remains stagnant until 2030 (referred to as Scenario 2*). Scenario 2* starts in 2025 due to the momentum of the target of at least 23% NRE. The value of 0,6 tons CO_2/MWh itself is not much different from the FE in the 2019-2028 RUPTL, which is 0,7 tons CO_2/MWh. Meanwhile, the emission factor in 2020-2024 is considered the same as the RUPTL 2021-2030 because significant changes for that period are difficult to occur.

Reducing the generation emission factor in 2025-2030 will lower the total carbon emissions from scenario 2 than in scenario 1. If scenario 2* is not implemented in 2025, then Indonesia will lose the potential for reducing GHG emissions by 46.78 million tons of $CO_2$by 2030. This

will also happen even if Indonesia implements the mandatory B50 in 2025. If Indonesia chooses to implement the B50 program compared to scenario 2*, then Indonesia will lose the potential for reducing GHG emissions by 14,82 million tons in the range of 2025-2030.

3. CONCLUSIONS

The current biodiesel program can be the short-term solution to reduce carbon emissions in the transportation sector. Besides the lower emissions compared to diesel, biodiesel can also overcome the problem of energy security during decreasing national oil production. However, there is no urgency to ambitiously develop the biodiesel industry because of the emerging EV global trend. Moreover, this study shows that emission reduction from the biodiesel program is only 3,13% of the energy sector NDC target. On the other hand, the implementation of the EV program accompanied by a reduction of emission factors of electricity generation to 0.6 ton CO_2/MWh can produce two times the total emission reduction of biodiesel. The emission factors of electricity generation also have the potential to decrease along with the increase of renewable energy mix in the future.

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Development of Gas Diffusion Electrodes for Electrochemical CO_2 Reduction towards C2+ Products

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ABSTRACT

Cu is is the only transition metal capable of electrochemically reducing CO_2 to products containing two or more carbon atoms (C2+ products) because it possesses appropriate binding energies that enable C-C bond formation. Despite its unique capability, the Cu catalyst has numerous disadvantages, including a high rate of H2 production caused by the competing water reduction reaction, low selectivity towards a single C2+ product, and low stability at high current. The development of a Cu-based gas diffusion electrode will be given in this study, as will the strategies used to increase the rate of reaction, reduce the formation of H2 by-product, and improve the stability and selectivity of C2+ product formation.

Keywords: CCUS, electrocatalyst, CO_2 reduction, Gas diffusion electrode, Power-to-X

1. INTRODUCTION

As the largest industrial consumer of oil and gas, the chemical sector is responsible for 880 Mt CO_2 emissions in 2018, a 4% increase from the previous year due to the growth in global chemical production. While the energy and transportation sectors have been gradually decarbonized around the world, the decarbonization of the chemical sector, which relies heavily on fossil sources as feedstocks, has been more difficult. Combining the traditional petrochemical processes with carbon capture and utilization (CCU) technologies, which include capturing CO_2 from emission sources and converting it to valuable chemical feedstocks, is one paradigm-shifting innovation that can decarbonize global chemical production. This carbon recycling scheme could be a viable solution for the chemical sector to combat climate change while achieving long-term sustainability and growth.

2. RESULT AND DISCUSSION

The electrochemical CO_2 reduction reaction (CO_2RR) is promising CCU technology that uses renewable electricity to convert CO_2 and H_2O to high-value products. CO_2RR can be operated at low temperature and pressure without the need for explosive H_2 gas, making it suitable for small to medium-scale deployment at CO_2 *emission* sites. However, the CO_2RR technology is still in its early stages due to numerous obstacles such as limited selectivity for high-value products and low CO_2 conversion. To overcome these obstacles, advances in catalyst design and reactor development are required. Cu is one of the most intriguing CO_2RR electrocatalysts since it is the only transition metal capable of producing products containing two or more carbon atoms (C2+ products). Because Cu possesses appropriate binding energies for both CO* and H* intermediates, C-C bond formation is possible. Despite its unique capability, the Cu catalyst has numerous disadvantages, including a high rate of H_2 production caused by the competing water reduction reaction, low selectivity towards a single C^{2+} product, and low stability at high current. The development of a Cu^{-} based gas diffusion electrode will be given in this study, as will the strategies used to increase the rate of reaction, reduce the formation of H_2 by-product, and improve the stability and selectivity of C^{2+} product formation.

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A Study on Media Coverage about Energy Transitions in Cambodia

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1. INTRODUCTION

Media coverage plays an important role in any social phenomenon, including energy transitions. On a regime level, it is influenced as well as has the potential to influence public policy agenda, create awareness regarding the energy systems' landscape megatrends. On a grassroot level, it can disseminate information to motivate like-minded stakeholders to adopt new technologies and practices and discuss contextual-relevant challenges. However, even on a global level, the role of media coverage in energy transitions is addressed by a few studies. In Cambodia, the media focuses heavily on crimes, securities, accidents and closely followed by coverage on international and regional issues while such scientific topics barely make any headlines (Peou, Pin, & Sok, 2013, Table 6). However, for Cambodia to remain competitive for globalization, the country needs to work on its Science & Technology (S&T) capacity to produce more human resources (Koica & MoP, 2013). Media Content and Culture is recognized as a significant effort for the advancement of S&T (KOICA & MoP, 2013, p.70).

With historically expensive and unsustainable electricity generation along with a high compatibility for solar technology, Cambodia has always been a potential candidate for energy transitions. With the nation's recent commitment to greenhouse gas emission reduction, this scenario is now possible more than ever. The future of decentralized energy systems can be determined by the access to information, public perceptions, and expectations in which media coverage plays an important part. This paper aims to study the interest of media coverage on energy transitions in Cambodia by foreign and local journalists reporting about Cambodia.

2. RESEARCH QUESTIONS

1. How has the interest in energy transitions in Cambodia evolved in media coverage?
2. Which are the dominant media institutions covering energy transitions in Cambodia?
3. What kind of media framings used to cover energy transitions in Cambodia?

4. What types of opportunities and risks relevant for an energy transition are highlighted or omitted in the media framings?

3. METHODOLOGY

In order to find answers to the research questions, the qualitative individual interview will be employed for the research study. The individual interview is one of the most widely used qualitative methods of research with its ability to provide an undiluted focus on participants (Ritchie & Lewis, 2013). Ritchie & Lewis (2013) also noted that individual interviews are practical in generating in-depth details about personal accounts and attempting to understand their individual circumstances. Snowballing is most practical when the study population is hard to reach physically or not easily identifiable (Kumar, 2014). Interviews will be conducted until a saturation point is reached. Kumar (2014) further explains that when there is no getting new information or the information is negligible, it is assumed that data saturation point is reached, and data collection should be finished. Interview transcripts would be reviewed and compared for consistency of repetitive patterns, which would be organized into themes and subthemes, and they would eventually be rewritten into narratives. To emphasize, respondents' direct quotations would be extensively used for the finding's presentation and discussion section.

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Overcoming the Fluctuating Curve from PV Power Generation by Modelling the Integration of Hydrogen Energy Storage into Electricity Microgrid

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ABSTRACT

Integrating Hydrogen Energy Storage into Conventional Power Generation System may help build our National Energy Strength by reducing energy spending on Annual State Budget and preserve the environment by minimizing the use of non-base load power generation.

Keywords: Hydrogen Energy Storage, Distributed Generation, Flexible Load, Unit Commitment, Plant Operating Cost, Voltage Stability Margin

1. INTRODUCTION

It is known that 72% of the national basic electricity tariff (TDL), used for cost of electricity generation. Java Madura Bali (Jamali) system is the largest, which contributes around 61%, with the Coal Thermal dominates by 59% and followed by the New Renewable Energy (EBT) of 9%. Solar Photovoltaic Power Plants (PLTS) contribute only 1% from the NRE itself [1]. Low voltage customers (TR) are around 61% with the residential contribute about 42%. The rates of the national SAIDI are 12.72 hours / subscriber / year and the national SAIFI is 9.25 times per subscriber / year [1]. The disadvantages of the electrical system are the absence of energy storage facilities, when production is abundant, and the load is low. Hydrogen energy storage (HES) is an alternative to NRE-based energy storage technology with a projected implementation of 25 TWh in 2050 [2]. By integrating the costs of Hydrogen Energy Storage (HES), we expect it to reduce plant operating costs and maximize voltage stability margin. The capacity of the HES is determined based on the difference between the load curve (LC) base load (BL) and load follower and peaker (LFP) within unit commitment on the constraint of plant operating costs, spinning reserve, start-up and shutdown costs, uptime, and downtime costs [3][4]. The HES can function as a Distributed Generation (DG) and Flexible Load (FL) [4].

2. RESULT AND DISCUSSION

Integrating the costs of HES and BPP Generation can improve LC both outside the peak load time (LWBP) and peak load time (WBP) with decreased SAIDI - SAIFI rates and leads to a reduction in using LFP Generators. With the projected electricity demand in Indonesia in 2050, there will be an increase of 427% with an increase in coal prices in 2050 of 63.37%, natural gas by 38.72% and oil by 65.79% while the price of hydrogen production fell by 50.98%.

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Analysis of the Impact of Biofuel and Electric Vehicle Policy in ASEAN on LEAP Selected Outputs: A Case Study of Recent Policy Implementation in Thailand

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ABSTRACT

Electric vehicle (EV) is gaining interest in ASEAN Member States (AMSs). On the other hand, biofuel has been in the market long before the launch of EV. Suitable policy actions are necessary to balance both future targets to achieve carbon neutrality. Low Emission Analysis Platform (LEAP) is generally used to perform this kind of analysis to obtain quantitative results to inform decision making. However, the effects of each policy on the LEAP outputs are not easily comprehensible to the policy makers. Past studies have focused on how a series of policy actions would influence the output parameters. Therefore, the objective of this study is to compile the information of policy actions to promote biofuel and EV in the AMSs and analyze how they individually affect the number of vehicles, energy demand, and greenhouse gas (GHG) emissions. The results are shown in terms of increase (+) or decrease (-) of each LEAP output that could be attributed to individual policy actions. In addition, Thailand case study is selected to demonstrate the linkage between the analysis using the proposed framework and the LEAP results.

Keywords: electric vehicle, biofuel, policy implementation, LEAP, ASEAN

1. INTRODUCTION

The project entitled Strategic Integration of Electric Vehicle into ASEAN Biofuel Roadmap being supported by ASEAN-Republic of Korea (ASEAN-ROK) cooperation have introduced plenty intuitive information about the targets, statistics, and policy implications of each ASEAN Member State (AMS). The current work is a portion of the outputs of this project focusing on policy implementation to balance the usage of biofuel and electric vehicles in the region. There are various policy actions of electric vehicle (EV) and biofuel. Therefore, the road transport policies that are related to research and development (R&D) will be neglected. The information related to EV is well established in most of AMSs. However, there

are only five countries, specifically Indonesia, Malaysia, Thailand, Philippines, and Vietnam, that have significant utilization of biofuel. Hence, the consideration will only narrow down to only these five countries. Identification of the appropriate policy actions will identify the gaps between the status and the future target.

Low Emission Analysis Platform (LEAP) has been used extensively by scientific community. It can yield the forecast which provide insightful direction to fill the gaps and achieve the targets in the future [1]. Nevertheless, these data somehow are not entirely comprehensible to the policy makers. Thus, it is better to analyze the change of the LEAP's output parameters attributed to various policy actions for EV and biofuel. To the best of our knowledge, most research articles has grouped the policy actions together in the forms of scenarios and see how they influence the output parameters. The purpose of current research is to compile the policies information of each AMSs to see the influence of each policy action on the number of vehicles, energy demand, and GHG emission, while injecting both EV and biofuel policies into the market. Thailand case study is selected to show the linkage between the analysis using the proposed framework and the LEAP results.

2. Methodology

The research is started with the policy documents gathering, then, extract the policy actions for each country. The determination of the impacts of each policy action on respective parameters which is extracted from LEAP's outputs is done respectively. The policy actions of each country and the direction of the changes of the LEAP outputs (+ or -) are compiled into one table and compared with the LEAP results of Thailand case study. Finally, the discussion of policy implication is done at the end of the study.

3. RESULT AND DISCUSSION

Even though each country in ASEAN has various EV policy actions, they shared the same aim which is to increase the number of electric vehicles. The current policy actions on electric vehicle, in terms of charging station incentives [2], corporate tax incentives [3], exemption of tax on luxury goods [2], sales [2], import duty [2], fiscal incentives [4], income tax relief [2], production [4], purchase subsidies [3], and utilization mandate [5,6] will directly increase the number of electric vehicles in the current market of each country (+). At the same time, the energy demand will be increased according to the increase of number of the vehicles (+), and the overall energy consumption will be decreased as this type of vehicles come with

better energy efficiency due to the electrification (-). However, the GHG emissions will be increased if source of electric generation is still heavily on fossil fuels (+).

Biofuel tends to have sophisticated relationship as it involves various stakeholders ranging from farmers who produce the feedstock for various businesses, oil companies in the refinery stage, and the distributors. Therefore, the policy actions under this section somehow will not directly increase the number of vehicles in the market. Some of the AMSs have deployed several policies, e.g., biofuel refinery subsidy, biofuel pricing, and biofuel subsidy [7], to escalate the number of vehicles (+). On the other hand, the biofuel usage and biofuel export tax are not sure if it will increase the number of vehicle or not.

A case study of policy implementation in Thailand, is performed by using LEAP, is showed to support the above outcome analysis. In the business as usual (BAU) scenario of EV and biofuel, the existing policy actions will increase the number of vehicles. Motorcycles, passenger cars, and pickup trucks are the dominant players. In the scenarios 75% and 100% of zero-emission EV (ZEV), Thailand is successfully injecting the 30/30 policy [8] resulting in decrease in energy demand and greenhouse gas emission due to the better overall system efficiency. Similarly, with the scenario AEDP 2018-2037 [9] where the present E20 and B10 policy is maintained in the current market, the energy demand continued to be the same compared to the baseline scenario. However, the overall emission will be reduced if the green energy production is accomplished.

4. CONCLUSION

In conclusion, the main aim of policy actions for biofuel and EV are to enlarge the number of vehicles on the market. The analysis of the output the policy support for electric vehicle will result in less the energy consumption and reduce the GHG emission if the electricity generation is from renewable energy sources.

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Solar Cell Energy Sustainability in Indonesia: A Prospect or A Project?

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ABSTRACT

Prospect is defined as "the chance of something happening, the possibility of being successful, idea of something that will or might happen in the future" [1]. While project is defined as "a planned piece of work that is designed to find information about something, to produce something new or to improve something" [2]. Both terms have similarities such as there is a something to be dealt, there is a future goal, and there is a changing from idea to reality. The difference is, prospect is associated with good or increasing impact positively, while project is associated with two possibilities namely positive or negative impacts. This study uses both terms to analyze research findings about solar cell energy sustainability in Indonesia.

Keyword: Project, Prospect, Indonesia, Energy, Solar cell

1. INTRODUCTION

Prospect is defined as "the chance of something happening, the possibility of being successful, idea of something that will or might happen in the future" [1]. While project is defined as "a planned piece of work that is designed to find information about something, to produce something new or to improve something" [2]. Both terms have similarities such as there is a something to be dealt, there is a future goal, and there is a changing from idea to reality. The difference is, prospect is associated with good or increasing impact positively, while project is associated with two possibilities namely positive or negative impacts. This study uses both terms to analyze research findings about solar cell energy sustainability in Indonesia. Solar cell energy is part of renewable energy sources that confiscated much attention for governments in developing countries, especially those have equator line like Indonesia. For Indonesia, solar cell energy is potential as the main renewable energy sources because the potency of this energy is accounted by 4.8 KWh/m2 or 112,000 GWp, it is equal with 2000 h per year using solar cell energy [3]. In addition, the widespread geography area

consisting of outside, small and isolated islands, rural-hinterland areas surrounded with dense tropic forest, and urban areas with high pollution are large market for using solar cell energy. Thereof, Government of Indonesia has annual policy to increase electrification ratio by which solar cell energy as pivotal part in this policy [4,5]. It is the justified reason why solar cell is a prospect to be developed in Indonesia. A solar cell energy project was initiated long ago in 1970s in West Java Province, Java Island [6]. It is the first solar cell project in Indonesia to lighten villagers in that area. In current decade, solar cell energy projects are installed to nearly all islands in Indonesia, especially in rural areas, isolated islands, hinterlands, and frontier areas. There are two projects of solar cell namely, centralized solar cell energy or communal solar cell project and dispersed solar cell energy or solar home system (SHS) project [4,7]. Those projects are dominantly funded by governmental budget, and the rest is funded by private sector [8]. This project is continued and stipulated as yearly governmental project initiated by Ministry of Energy and Mineral Resources (Kementerian-ESDM). Though those projects can increase national ratio electrification in temporary period, but they also leaving unresolved issues year per year like unworking solar cell projects [7,8,9]. It is the justified reason why solar cell is a governmental project in Indonesia. It is like two-edged sword, solar cell energy installed in Indonesia is fulfilled by many interests in formulating and implementing its policy. Each actor plays a role to provoke solar cell as a compulsory component as a renewable energy source annually. Academician with its scientific justification, industries with offering long profit for users and government, communities with the luckiest beneficiaries of this energy, and government with socio-economy-politics considerations to agree this program. All of them have reasonable reasons to say that solar cell energy should be continued and funded by governmental budget. However, deciding to what is the rightest reason in this context is a very complex matter. Thereof, this study aims to elaborate solar cell energy sustainability between as A prospect or A project in Indonesia. It will be more scrutinized into the difference of two, the benefit of two, and the impact of two. Also, this study will provide alternative policies that will be proposed to make solar cell energy sustainable in Indonesia.

2. RESULT AND DISCUSSION

This study is a qualitative study with multiple case studies. According to Yin, multiple case studies are useful means to capture whole phenomena in different context. Each case will be analysed detachedly, and then it will be compiled in a holistic case. In the end, this method can yield conclusion from existing cases. Using this case is more fruitful if existing

cases are analyzed with time series consecutively [10]. This study uses multiple case studies of 10 sites of solar cell energy generators for 4 years, 2018-2019-2020-2021. All sites are in four different islands of Indonesia. Governmental budget is categorized as purely governmental funding and state-owned enterprises funding. Case of Indonesia, two main donors of solar cell energy are the Ministry of Energy and Mineral Resources (Kementerian-ESDM) and the state-owned electricity enterprise (PLN). Though, other ministries and local government agencies also allocate funding for installing solar cell energy generator in several rural areas. But Ministry of ESDM and PLN have constant and large budget allocation to install solar cell energy generator annually. Both are the most responsible actors in developing solar cell energy sustainability in Indonesia. This temporary study findings are that solar cell energy project faces many classic problems like broken solar panels without repair, no maintenance from enterprise after guaranteed time over, overhead use by local communities, and thievery of solar panel components. Most of them are installed as off-grid system separated from PLN's main electricity grid. Ministry of ESDM knows about this condition, but they cannot do more because this project is locked by annually governmental budget allocated to procurement solar cell projects, not to maintenance them. Besides, PLN is a distinct agency of Ministry of ESDM in terms of funding sources, authority, organization structure, and goal of organization. For PLN, solar cell projects are business units that yield profit for enterprise. Though, there are few of broken solar cell generators broken, PLN is responsible to repair and to maintain it. Most of them are installed as on-grid system connected to PLN's main electricity grid.

3. CONCLUSION AND OUTLOOK

Sustainable development goals (SDGs) issues are directed to make priority policies in renewable energy in Indonesia. Indeed, Indonesia is the host of G-20 conference in 2022 year inviting all countries in the world to discuss together related to climate change issue and the future energy. It is the new prospect for solar cell energy to be developed in Indonesia as future energy. Considering potency of wide geography in equator line, detached islands, hinterlands areas, and dense urban with high pollution, existence G-20 policy is large opportunity to implement solar cell energy policy more than annually governmental projects. Strength of local academician resources, globally-wide business network, current need of communities to friendly electricity energy for urban people and affordable electricity energy for rural people are the long-time prospects for installing solar cell energy project in Indonesia. Therein, solar cell energy is triggered by a prospect,

implemented by a project, and sustained by many prospects as well as various projects at once. An apt government policy is required to make both run simultaneously.

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The Feasibility Study to Assess the Electric Charging Project as the Support to Transition of Clean Energy in Indonesia

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ABSTRACT

The need for energy as a resource for daily human activities is growing. This is influenced by the year-to-year increase in population. The combination of high mobility and a large number of users results in a significant increase in energy consumption for transportation. On the other hand, using fossil fuels (non-renewable energy) can cause pollution and the greenhouse effect in the long run. Therefore, it is necessary to transition from non-renewable energy to renewable energy as the primary energy source for each mode of transportation to minimize this impact. Numerous policies implemented by the government to support this transition, coupled with the growing number of electric vehicle users in Indonesia, open opportunities to launch a new business, specifically a retail electric charging station. It also has the potential to increase its market share, especially in West Java, where the number of charging stations for electric vehicles is still relatively low. However, under the current circumstances, it is still required to assess the factors that can affect this retail charging electric business and evaluate through the feasibility study whether or not this business is viable, especially within the next 10 years, which be further discussed on this research.

Keywords: Green Investment, Transition Energy, Electric Charging Station, Feasibility Study, Electric Vehicle, Clean Energy

1. INTRODUCTION

The use of energy in daily human activities, along with the increasing number of populations around the world, especially in Indonesia, generates high energy consumption in Indonesia. One of its uses is for transportation. Population growth is also in line with the increase in vehicles. However, nowadays, people use private transportation more than public transportation. It can impact the environment and affect the amount of fuel needed, which is high, while the reserves of fuel are limited and predicted to decrease and even decline due to the maturation of oil refineries in Indonesia.

For this reason, Indonesia's efforts to minimize these impacts are by initiating the transition to using clean energy. Starting with the efficient use of fuel, then the use of mixed energy, and transitioning entirely to the use of renewable energy for transportation. This is as a form to demonstrate Indonesia's commitment to reduce the impact of emissions from CO2 as well as the effect of the greenhouse. In addition, through several policies, one of the government's efforts is to support the increased use of electric vehicles. Even the government has assigned a to one of the state-owned electricity supply companies in Indonesia (PT. PLN) to help realize the supporting infrastructure of electric vehicles. This assignment will undoubtedly provide an opportunity for the emergence of a new type of business, namely the retail electricity charging business, because through PT. PLN does not rule out the possibility for business actors to cooperate to improve the economy.

Although this new type of business looks attractive, it needs to be assessed and measure the potential of the electricity charging retail business first. So that through this research, various factors that are predicted to affect this type of retail electricity charging business will be discussed so that the feasibility study of this new type of business can be assessed for at least the next 10 years.

2. RESULT AND DISCUSSION

Based on market analysis using TAM SAM SOM, the demand growth for electric vehicles is still quite slow, especially in West Java (the province with the first largest population in Indonesia in 2020), whose coverage is smaller than the whole of Indonesia. Compared with the total number of vehicles, West Java is one of the provinces with constant growth every year. Although the projected demand for electric vehicles shows growth every year, due to limited historical data, the increase is still small. In the last year of projections for the market size of electric vehicles in West Java, in 2032, the total demand for electric vehicles was 1,949. However, because there are already competitors in this area, the assumption for the customer that can be achieved is only about 4.91%, so the number of final consumers that we can serve in 2032 is only 710 units of electric vehicles.

In the projection test to determine the financial analysis, in the income statement calculation, the net profit will be negative for the first 4 years of operation and become positive afterward. It is because the initial investment value for the charging device is expensive. It is in line with the demand that is not too much. Furthermore, it was found that the average for 10 years of

the ROA is 3.03%, with a ROE of 5.72%, which indicates the possibility for this project has not been able to generate profits as expected due to the inefficient production or operation of this project. Furthermore, it can be assessed based on several indicators to test the feasibility of this electric charging station business.

1. In the Payback Period, the result is 7-8 years, so this investment can only provide profit. Meanwhile, the Discounted Payback Period cannot be measured because the results are negative for 10 years of this business project.
2. On the Net Present Value, the result is Rp. (292,921,376.08) which indicates that this business needs further identification before investing.
3. In the Profitability Index, the result is 0.75, which can be concluded that this business project is still not very attractive to do at this time because the value is still less than 1.
4. On the Internal Rate Return, the result is 11%, which is also not too far from the WACC value, namely 14.03%, which indicates that this business is less attractive.

Because of the above factors, the author tries to do a sensitivity analysis of the factors that may have an effect. It indicates that the demand for electric vehicles accompanies the selling price per kWh, and the number of kWh sold is the most influential factor in this business. In addition, the risk analysis also shows that the probability of NPV < 0 for this business project reaches 82.77%, indicating that the risk of investing in this business is very high.

3. CONCLUSION

It can be concluded that the construction of a public vehicle electric charging station (SPKLU) can be attractive due to:

1. The impact of the volatility situation, the fuel retail business due to various external factors, both from within the country and outside, can be at high risk.
2. There is support from the government to support the acceleration of renewable energy by establishing various related policies and regulations, especially for the use of energy for transportation.
3. There is an increasing demand growth for electric vehicles in Indonesia.

So that the potential for the emergence of new businesses is in the retail business of electric charging stations, however, for the first 10 years, it was found that this business is still too

early to do because the risk for investment is high, making this business less attractive at this time.

4. RECOMMENDATION

Maybe this feasibility study can be extended for the next few years to see if the results are still not feasible or not. In addition, because this type of electric charging station retail business is still new in Indonesia, it is better to look first to invest in this project. Except this project is in line with the growth of the number of electric vehicle users in Indonesia, which continues to grow significantly, this is certainly a more viable business and may compete with the type of fuel oil retail business that already exists in Indonesia.

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Impact of Lontar Green Power Program on Energy Consumption and GHG Emissions in Indonesia Coal Power Plant

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ABSTRACT

According to Indonesian government target (after COP21) of GHG reduction as 29% by national effort relative to BAU in 2030, power plants are responsible for the environment by complying with applicable regulations and getting a national award for that compliance. Lontar Green project had already map out efforts in emission reduction with integrate sustainable manner in Corporate Social Responsibility programs to become a unity of company ESG that also support local community circular economy. There are several adaptation and mitigation goals that we have classified to scale up clean power generation efforts under Lontar Green project. Along with all of government policy, ministries, stakeholders; that respond COP26 which agreed to strong commitments in tackling climate change by finished mitigation actions such as: biomass cofiring and solar PV. Lontar Green Project also doing adaptation actions such as: EV transportation usage, EV charging station, digitalization in trees carbon offset dashboard and highest CO2e sequestration tree planting program. Those steps were our effort to reduce our carbon footprints. Through cofiring program, we have reduced CO2 emissions of ± 3,399.61 tons CO2 and ± 2,419.98 tons of CO2e per year through the sequestration of our registered tress.

Keywords: Energy and Sustainable Developments, Energy efficiency and conservation, Bio-source energy, biomass, cofiring

1. INTRODUCTION

PT Indonesia Power Lontar Power Station Operation & Maintenance Unit has often received awards and recognitions both nationally and internationally. Lontar Power Station, a generating unit operated by PT Indonesia Power, annually generates GHG emissions of approximately 6,084,000.00 (six million eighty-four) tons of CO2e (last 3 years APPLE-GATRIK avg. data). Based on Lontar business unit's long-term plan guidelines, Lontar Green project has been stated since preparation in 2020 and already implemented started in 2021. The project is an integrated platform as the responsibility of managing companies based on

ESG and as the resilience strategy to meet Indonesia's NDC targets in reducing carbon emissions. It is also our effort to achieve an ESG rated company.

Lontar Green project split the steps into adaptation and mitigation goals that we have classified, to scale up clean power generation efforts and meet national regulations compliance, with reference to the Decree of the Minister of Energy and Mineral Resources No. 188.K/HK.02/MEM.L/2021 of 2021, regarding ratification of the (RUPTL) Electricity Supply Business Plan for PT Perusahaan Listrik Negara (Persero) 2021-2030. Mitigation actions such as: biomass cofiring and solar PV. Adaptation actions such as: ash utilization for construction, EV transportation usage, EV charging station, digitalization in trees carbon offset dashboard and highest CO2e sequestration tree planting program.

We are going to continuously completing all reports of mitigation actions and adaptation actions to the MEF's SRN (Decree of the Environment and Forestry No. P.71/MENLHK/SETJEN/KUM.1/12/2017) since 2019, to get validated ICER (Indonesia Certified Emission Reduction). We will also continuously be participating in the emission trading system (Decree of the Minister of Energy and Mineral Resources No. 22 of 2019) organized by the government through the MEMR (Ministry of Energy and Mineral Resources) using Cap and Trade mechanism, trial activity started from 2021; as well as Cap and Tax mechanism in 2022 (Law Number 7 of 2021).

2. RESULT AND DISCUSSION

The SE4ALL is a world-wide initiative of the UN Secretary General for promoting universal energy access, energy efficiency and renewable energy. Nepal has opted in to this initiative in 2012. As a part of the SE4ALL process, a Rapid Assessment/Gap Analysis (RA/GA) report has been prepared [1]. The next phase in the implementation of the SE4ALL process in Nepal is to formulate the SE4ALL Nepal Action Plan (SNAP). SNAP will be a document that provides a clear roadmap for achievement of the SE4ALL goals, bringing together and reconciling relevant accomplishments to date, existing government targets and plans, completed, ongoing or planned sectoral master plans and ongoing and planned programmes and projects. It will be formulated in close consultation with Nepal Planning Commission (NPC) and UN Development Program, and with frequent interactions and under the guidance of the specific SE4ALL Coordination Group. Before the formulation of SNAP is begun; building from the findings of the SE4ALL RA/GA report, SNAP Scoping

Document is being prepared. Thus, this scoping study has been targeted to identify the existing government targets and plans, completed, ongoing or planned sectoral master plans and ongoing and planned programmes and projects related to each of the three SE4ALL goals.

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Are We really Prepared for the Energy Transition? Analysis of Readiness for Several Major Aspects. The Case of Indonesia

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ABSTRACT

Indonesia is determined to make an energy transition by preparing a road map of Net Zero Emissions (2060 NZE). The technologies particularly renewable, have been identified, with solar and hydropower as the main options. This paper examines the regulatory, institutional, financial, and labour challenges facing the plan. We conclude that those factors are far from sufficient to support the planned energy transition and provide recommendations to improve those aspects toward the future dominance of renewable energy use in Indonesia. Lorem Ipsum is simply dummy text of the printing and typesetting industry.

Keywords: Energy transition, RE technologies, Regulatory and institutional challenges, Financial and employment challenges, Indonesia

1. INTRODUCTION

In compliance with the 2015 Paris Agreement, Indonesia is determined to make an energy transition, lastly by preparing a road map of Net Zero Emissions (NZE) to be achieved by 2060. The technologies to realize the major change have been identified, particularly that of renewable energy. Solar power, followed by hydropower is the choice of renewable energy technology that will be developed the most, followed by geothermal and wind power. However, to be implemented, the road map is faced with a number of challenges. This paper examines the regulatory, institutional, financial, and labour challenges facing the plan. We describe the laws and regulations related to global climate change and energy management; especially renewable energy that has been developed in Indonesia so far. The question is whether the existing regulations are sufficient to support the energy transition movement toward the dominant use of renewable energy in the future? From an institutional perspective, it is questionable whether the existing institutions are strong enough to encourage a massive increase in the use of renewable energy. The analysis is carried out for the institution within the government (central and regional) as well as the private sector and

the community. From a financial point of view, we estimate the cost requirements to carry out the energy transition works. We ask questions about whether the huge funds needed will be easily provided, both by the government and other parties who will be participating in the development of Indonesia's renewable energy in the future. From the employment aspect, we try to map the workforce needed for the energy transition works by considering that each renewable energy technology has its specific workforce needs. Challenges were also identified for the supply of the required manpower, including aspects of education and training.

2. RESULT AND DISCUSSION

We conclude that Indonesia's current regulatory, institutional, financial, and labour forces are far from sufficient to support the energy transition works planned for the proposed NZE road map. We provide some initial recommendations for improving regulatory, institutional, financial, and labour aspects to support major energy transition efforts towards the future dominance of renewable energy use in Indonesia.

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CO_2 Capture from Air by an Internally Heat and Cooled Temperature Swing Adsorption Packed with an Amine-supported Solid Adsorbent

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ABSTRACT

Direct Air Capture (DAC) is one of several potential options for the global negative emission of CO2. Solid amine has been highly recommended as the adsorbent for DAC due to the high affinity between amine and CO2 and the low regeneration temperature. In this work, the thermal swing adsorption (TSA) process was applied to a functionalized polyamine adsorbent to concentrate CO2 from air with improved thermal response. By supplying humid air with a dew point of Td = 5 °C for the adsorption at 20 °C and regeneration at 60 °C, the maximum CO2 concentration at the desorption outlet was almost sixteen times higher than that of the raw gas; however, the CO2 recovery ratio was very low. Therefore, we proposed using the high and low concentration CO2 generation gases for product gas and refluxing feed gas to the adsorber, respectively, to achieve enhanced CO2 adsorption and recovery simultaneously.

Keywords: Direct air capture, Thermal swing adsorption, Amine based adsorbent, Carbon dioxide, Hydrogen and CCUS

1. INTRODUCTION

To challenge the concentrating CO2 in the atmosphere, policies on the scenarios of limiting CO2 discharge and the intention of reaching at least zero net CO2 emissions have been conducted globally [1]. In the meantime, Direct Air Capture (DAC), one of several potential alternatives for reducing CO2 levels in the atmosphere, has been increasingly debated and researched from a variety of perspectives [2-4]. Air capture allows us to address the CO2accumulation from outgassing in the past and the distributed emission sources such as residents, agriculture, and mobile exhaust. In theory, implementing DAC is possible in any location; thus, a DAC plant can be established at the sequestration or consumption area, which is critical for minimizing CO2 transportation [5]. Upgrading technologies for both aqueous and solid sorbents for DAC have been widely performed from various angles [6]. Aqueous sorbents have superior reactivity and noticeable CO2 uptake; however, several

downsides need to be considered including high temperature of regeneration, a large amount of absorber used, and equipment corrosion [7-9]. Therefore, low regeneration temperature of solid amine adsorbent has piqued the interest of researchers in dealing with the drawbacks of aqueous sorbent processes [10, 11]. Furthermore, the thermal swing adsorption (TSA) process is a recommended and feasible option that can be used for solid adsorbents with low regeneration temperatures using energy from waste heat or solar energy [12]. In this study, Thermal Swing Adsorption (TSA) process was applied for functionalized polyamine adsorbent (approximately particle size D = 0.6 mm) to capture the CO2 directly from the atmosphere. Two adsorption fixed-reactors (double-pipe heat exchanger) which the one can be operated as the adsorption step while another one takes the adsorption step were equipped with cool and hot water. 3.24 g (approximately 5 ml) of adsorbent sample was filled into the inner tube of reactor (internal diameter: 7 mm; external diameter: 8 mm), and the glass wool were placed above and below the adsorbent layer. Two filters were inserted into both ends of the glass wool for stabilizing the adsorbent. The adsorbent was indirectly cooled to 20 °C by cooling water and heated to 60 °C by hot water during the adsorption and the regeneration step, respectively. To avoid the backflow of condensate during the experiment with presence of moisture, the desorption outlet was placed at the bottom of reactor. The room air (CO2 concentration around 450 ppm) which was moisturized by membrane humidifier was used as the supplied gages. As well, the purpose of this work is to illustrate the influence of varying operational cycle time to the CO2 concentration of product gas and CO2 recovery ratio.

2. RESULT AND DISCUSSION

Humid air with a dew point of Td = 5 °C (approximately RH = 35%) was supplied to the adsorber as the feed gas at 9.3 L (STP)/min and the purge gas at 0.09 L (STP)/min. The pressures at the adsorption inlet and the desorption inlet were about 115 kPa and 1 kPa, respectively. After the quasi-steady state, the desorption outlet gas was collected into the aluminum bag for checking the CO2 concentration. Additionally, the CO2^ ^recovery ratio is computed as the volume of CO2 in the product gas divided by the volume of CO2 in the feed gas during an adsorption cycle. Figure 1 Figure 1. Influence of cycle time on the adsorption performance (a) time averaged desorption outlet CO2 concentration and the CO2 recovery ratio (b) time profile of desorption outlet CO2 concentration as shown in Figure 1(a), shortening cycle time considerably increases the desorption outlet CO2 concentration. When the cycle time was exceedingly short, the regeneration process was

terminated at the surrounding peak of CO2 desorption concentration. From Figure 1(b), a longer cycle time allows the regeneration process to extend and provide a higher peak of CO2 concentration; however, the CO2concentration rapidly goes down from the peak, and consequently the CO2 of the desorption gas is diluted. Moreover, greatly prolonging adsorption time lets the low adsorption ratio occurs prior to the end of the adsorption duration, and hance, the CO2 recovery ratio noticeably reduce. Otherwise, it is revealed that the amount of packed adsorbent was insufficient to adsorb completely the contained CO2 of the feed gas during the longer adsorption period. The CO2 recovery ratio of extremely short desorption period exhibits an inferior rank, although the CO2 concentration of product gas in these cases is high. When cycle time is shorter than 10 minutes, the increasing CO2 concentration of the desorption outlet is not high enough to overcome the reducing volume of product gas to keep a stable CO2 recovery ratio. Under these experimental conditions, the adsorbent material can generate a product gas with a maximum CO2 concentration almost sixteen times higher than the CO2 concentration of ambient air. Nevertheless, the CO2 recovery ratio result is not desirable.

3. CONCLUSION AND OUTLOOK

In this work, functionalized polyamine impregnated solid adsorbent was applied for air capture via the TSA process equipped with indirect heating and cooling. The result indicated that regeneration seems to be a control step of the cycle operation. Shortening the cycle time greatly concentrated the CO2 in the product gas, but CO2 recovery ratio decrease significantly. A recommended process that uses high and low concentration CO2 generation gas for product gas and refluxing feed gas to the adsorber, respectively, can simultaneously achieve enhanced CO2adsorption and recovery.

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Considering Environmental and Social Equity Impacts in Just Zero Carbon Transitions

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ABSTRACT

In moving towards net zero carbon energy systems, it is not just the techno-economic challenge of installing and replacing vast amounts of energy infrastructure but also the challenge of providing the materials for this infrastructure. In both the direct energy transition and its flow-on indirect transition in the supply chain, there are significant environmental and social impacts that need to be considered. How will the transition from coal to metals (for clean energy) affect mining communities? How will prices impact on households under different demographics? This paper will present recent work seeking to quantify these impacts in the framework of a just transition. The study will use the example of transition from coal to renewables and gasoline to electric and hydrogen vehicles for demonstration.

Keywords: energy, equity, just transition, resources, transport, renewables, hydrogen, electric vehicles

1. INTRODUCTION

To achieve a carbon neutral future energy system, it is necessary to both rapidly expand renewable energy capacity and to reduce the extraction and usage of fossil fuels. This requires a dramatic shift in the extraction of resources (mainly minerals) globally. Such a shift will involve the closing of coal mines and coal power stations, as well as the associated supporting industries, which would be expected to impact significantly on the surrounding communities through loss of jobs, income, and investment. There will be positive trade-offs most likely, with potential improvement in air quality and subsequent health benefits, but these may not be viewed as positively considering the economic loss. But as coal mines and power plants are closed, metal mines and processing facilities and manufacturing plants for clean energy technologies, as well as the cleaner power plants themselves, will increase, with the opposite socio-economic impacts expected in host communities. However, coal mining regions may not overlap with metal mining regions. There is a need to better understand

the specific location, quantitative and qualitative net impact of such transitions, to consider the social equity impacts of the transition that supports the energy transition.

It is not just direct supply chains that are impacted, of course. The downstream consumers will also be affected, primarily by the cost of energy provided. The cost changes will not just be an effect of operating and capital for new plants, but also include the effects of policy decisions, such as subsidies, feed-in-tariffs, and carbon pricing. In any case, the cost may differentially impact on the relative affordability of energy services for households in different socio-economic groups. This is a further important equity consideration that must be considered in the "just transition".

2. RESULT AND DISCUSSION

Equity is an important factor underlying the idea of a just energy transition. But it is important to consider this across the whole supply chain. This presentation will provide an examination of some of the quantitative and qualitative equity changes, using Japan and Australia as case studies, with the focus on transitions from coal to renewables and gasoline to electric vehicles.

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Commitment to Sustainability: A Case Study of University Sustainability Initiatives

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ABSTRACT

Research, teaching, and involvement at Cornell University in the areas of sustainability and climate change placed it at the forefront of international leadership. Cornell campuses serve as living laboratories for the creation, testing, and implementation of ideas that solve some of the world's most difficult problems. This article provides an overview of the sustainability initiatives that are currently being carried out at Cornell University in Ithaca. Some of the key components of this initiative include a realistic goal of Quadruple Bottom Line Sustainability Framework, Cornell University Radical Collaboration Priorities in Sustainability, Climate Action Plan, and various research and outreach projects. It was discovered that many relatively prominent institutional assets, such as a living laboratory for sustainability and campus activities on wellbeing, played crucial roles in the process of getting the initiative off the ground. In this particular path of development, the initial physical assets have been transformed into complementary potential for research, teaching, and institutional growth.

Keywords: Sustainability, Social intervention and community development in energy and environment, Environmental Education, Living Lab, Energy and SDGs, Policy

1. INTRODUCTION

The objective of this study is to highlight the primary components that are required to engage the community on university campuses in sustainability efforts. In recent years, there has been an increase in general awareness regarding concerns related to sustainability because of coverage in the mass media; nevertheless, this information does not always convert into actual sustainable behaviour. According to the findings of studies, there are a multitude of factors that may be done to engage the community in sustainable practises.

2. RESULT AND DISCUSSION (including conclusion)

First, a multidisciplinary literature analysis is conducted to identify the drivers of university sustainability programme participation. A case study illustrates the relevance of the community engagement framework's components in promoting community participation in

sustainability programmes. Psychological needs, physical facilities, personal motives, public perception, price systems, and policies all influence community engagement. University case study shows the framework's applicability to university communities.

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Accelerating the Paradigm Shifting Actions Towards Low Carbon Energy Transition in Indonesia

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ABSTRACT

According to Indonesia's National Energy Plan, the country intends to reach at least 23% and 31% of its renewable energy targets. Currently, Indonesia is still dependent on high-carbon energy sources. To meet this target, the country must accelerate the transition to low-carbon energy. This paper aims to identify: (1) government pathways to a low-carbon transition; (2) the barriers and risks to financing a low-carbon transition; and (3) international partnerships to support a sustainable low-carbon transition. We employed market surveys and meta-policy analysis as our methodology. The findings reveal that efforts to accelerate the low-carbon transition should focus on accelerating the transition from carbon-intensive fuels and enhancing international cooperation in supporting policy, institutional, and market development towards low-carbon energy. Establishing a low-carbon transition fund and government guarantee program, expanding risk reduction mechanisms, and programs to increase capacity are the solutions we propose to address barriers and risks in financing low-carbon transition efforts. The study also shows the importance of making a strategic plan for international cooperation that provides policy support during the transition process.

Keywords: Low carbon transition, Energy transition, National policy, Indonesia, International cooperation, Coal phase-out, Renewable energy

1. INTRODUCTION

By the years 2025 and 2050, Indonesia aims to achieve at least 23% and 31% of renewable targets, respectively according to the Indonesian National Energy Plan (2017) [1]. In the international fora, Indonesia has strengthened its climate pledges using an updated nationally determined contribution (NDC) that aims to reduce emissions by 29% through its own efforts and 41% with international cooperation to achieve the goals of the Paris Agreement. Along with this, the Long-Term Strategy on Low Carbon and Climate Resilience 2050 (LTS-LCCR 2050), submitted by the Ministry of Environment and Forestry, is designed to provide long-term national policy direction on climate change, emphasizing efforts to mitigate low carbon scenarios and a net-zero target to be in line with the Paris Agreement goals. Moreover, Indonesia's state electricity company, *Perusahaan Listrik Negara* (PLN), released the National Electricity Supply Business Plan (RUPTL) 2021–2030, which includes a low-carbon scenario where 51.6% of the planned 40.6 Gigawatts (GW) of additional generation capacity up to 2030 is to come from new and renewable energy (NRE), bringing the total share of NRE in the energy mix to 24.8% by 2030. However, there is also an additional 19.5 GW of fossil fuel-based power plants planned, of which 13.8 GW would come from coal. Heavy dependency on fossil fuels, particularly oil-based energy sources and coal-fired power plants, is still in place. Coal power plants have provided more than

60% of the total commercial electricity in Indonesia [2]. Even though the government has publicly stated its intention to utilize more sustainable energy sources for electricity generation, the RUPTL mentioned that 47% of Indonesia's electricity supply in 2038 would be still generated by coal. The government also plans to expand the coal production target for 2022 electricity generation [3]. The current country's climate commitments and actions are conflicting because the aim has not been reached. How can Indonesia speed up its transition to a low-carbon economy? And what are the barriers and risks to financing low-carbon transition efforts? It is believed strengthening the national policy strategies, enabling markets, and international collaboration would accelerate the transition efforts. Therefore, this paper addresses these questions. The objectives of this paper are to identify: (1) the government's pathways towards low carbon transition; (2) elements that stumble blocks and risks in financing low carbon transition efforts; and (3) international partnerships to support the sustainable transition towards low carbon transition. This study's methodology includes a market survey and meta-policy analysis. ERIA conducted a market survey in its previous study [4] to determine the demands, challenges and risks the private sector faced while funding low-carbon energy projects. Furthermore, as with the comparison method and part of a case study analysis, the meta-analysis method looks for the underlying principles behind a current phenomenon to determine what factors are responsible for it [5,6]. Meta-analysis has been proposed as a way of performing literature reviews that is more objective than alternative methods [7]. Triangulation, which uses more than one source of data to obtain a more complete picture of a research problem, was used to back up the results of the market survey and meta-policy analysis and come up with policy recommendations for Indonesia's low-carbon transition.

2. RESULT AND DISCUSSION (including conclusion)

Findings showed that to accelerate the low carbon transition efforts lie in speeding up the shifting from carbon-intensive fuels such as coal-fired power plants to more sustainable energy sources, as well as reaching up the international cooperation in supporting policy, institutional, and market development to low carbon energy.

Coal phase-out and renewables surge can boost energy security The Indonesian government's implementation of the phase-out of coal is a crucial step toward achieving the objectives of the low-carbon energy transition. The Minister of Energy and Mineral Resources has stated that the government is considering retiring coal-fired power plants with a total capacity of 9.3 GW before 2030. This plan needs around 426 trillion Rupiah according to Indonesia's Ministry of Finance (2021) [8]. The goal of a low carbon economy and net-zero emissions is intended to be achieved through the plan to terminate the coal-fired power plants, since Indonesia aims to achieve carbon neutrality by the year 2060 or sooner. In addition to that, it is important to add renewable energy capacity to the country. The low-carbon transition must be meticulously planned, with the development of renewable energy and energy efficiency as the top priorities. The role of private financing is imperative in this matter. The survey results indicate the key barriers faced by the private sector, namely public policy incoherence, lack of access to de-risking methods, and a lack of competence to communicate opportunities among financial institutions and project developers. This paper suggests four interconnected ways to deal with these risks and promote a low-carbon transition: creating a low-carbon transition fund and government warranty programs, expanding de-risking mechanisms, and boosting capacity through

programs. Therefore, removing coal from the energy mix while simultaneously expanding renewable financing is a critical step toward achieving net-zero emissions.

Expanding international cooperation can speed up the plan to switch to low-carbon energy The ASEAN Energy Cooperation has pledged to integrate 23% of renewable energy by 2025, and regional grid connectivity and cross-border power exchange are essential to reaching this goal. However, the scarcity of R&D capacity and skilled labour capable of implementing low-carbon innovations in emerging Asia highlights the necessity of regional collaboration in pooling human capital resources [9]. There is a wealth of technical experience in the four Asian countries of Japan, China, Korea, and India that may be shared with Indonesia to spread the low-carbon transition. For example, the latest cooperation between Indonesia and China occurred in supporting hydropower plant development and China's plan to export solar PV components [10]. Moreover, at the technical level, Japan and Indonesia conducted a joint study on the co-combustion of fuel ammonia in coal-fired power plants [11]. Additionally, multilateral development financing institutions also play an important role in promoting the development of a low-carbon economy [9]. Some financial institutions such as the Asian Development Bank (ADB), the Asian Infrastructure Investment Bank, and the World Bank, facilitate green infrastructure financing. Moreover, a strong commitment to supporting Indonesia's low carbon economy has been presented by Japan's Ministry of Finance grants of US $25 million to an Energy Transition Mechanism managed by ADB with Indonesia and the Philippines as the frontier countries. It is shown that international support is critical in creating the enabling conditions for a low-carbon economy. At the national level, Indonesia should build transparent instruments and procedures, such as public-private partnerships and blended finance, to allow possible grants and concessional loans to support green initiatives [12].

3. **Conclusion** Given the ambitious goal of reducing emissions, Indonesia must accelerate its transition to a low-carbon economy. To achieve the goal, various strategies and scenarios need to be developed to speed up the process. RUPTL 2021–2030 aims for the early retirement of coal-fired power plants to realize a low-carbon transition and reach a net-zero emission goal. However, to finance low-carbon initiatives, several challenges must be solved. International corporations have been put in place to overcome these barriers. Recommendations include the policy and strategy for weaning the region off coal. Its foundation must be strengthened by increasing the capacity of renewable energy sources in the region. Lastly, strategic plans for international collaboration that provide the necessary policy assistance during the transition to a low-carbon economy need to be encouraged.

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Disclosure statement

No, I don't have a conflict of interest

Potential Integration of Waste to Energy (WtE) and Carbon Mineralization Technology in Indonesia

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ABSTRACT

WtE development in Indonesia is being boosted as it is believed to accelerate the energy transition and solve waste problems at the same time. However, several issues arise such as environment, finance, and policies. This study offers a solution by integrating WtE - incineration with carbon mineralization as one of the CCUS technologies. Previous research stated that heavy metals contained in the combustion residue can be stabilized as they are trapped in carbonates and are safe for the environment. Moreover, with a combustion capacity of 1000 tons of waste/day scenario, it is equivalent to a carbon emissions reduction up to 25 tCO2/day due to this integrated technology. A feasibility study in Estonia revealed that if WtE is integrated with carbon mineralization, the resulting NPV is 9,209,662 EUR for waste-to-product or 387,931 EUR for waste-to-safe-landfill. This can be an opportunity for Indonesia as according to current calculations, the existing WtE generates 133,500 EUR of NPV. The existing policy states that the construction of a WtE plant must be accompanied by the construction of a residue treatment plant facility. Therefore, the integration of WtE with carbon mineralization can also help simplify the complexity of WtE development requirements because residue treatment becomes easier.

Keywords: Waste to Energy, CCUS, Carbon Mineralization, CO2 Reduction, Waste Management, Integration

1. INTRODUCTION

Indonesia is undergoing economic growth that will not only lead to increased energy demand but also a higher waste generation. According to the Ministry of Environment and Forestry, Indonesia generates 25.3 million tons of waste/year with the majority ending up in landfills [1]. Thus, Waste to Energy (WtE) seems to be the best option to overcome those problems. In addition, it plays a role in accelerating the energy transition in accordance with Ministry of Energy and Mineral Resources (MEMR) Regulation No. 12 of 2017 on the Utilization of Renewable Energy Resources for Electricity Procurement and supported by Presidential Regulation No. 35 of 2018 on the Acceleration of Municipal Waste to Energy

Power Plant Development. Among WtE thermal process technologies in Indonesia, incineration has the main advantage in reducing the volume and mass of waste by over 90% [2]. Several issues in WtE arise that result in the difficulty of Indonesia to develop into full acceleration. Such as many discontinued environmental regulations [3], expensive provision of WtE facilities [4], and on top of that, CO2emission and solid residue with high content of heavy metals are generated from the combustion process [5]. From those issues, integrating WtE with carbon mineralization as one of the Carbon Capture, Utilization, and Storage (CCUS) technologies can be a possible solution. The captured CO2 will be reacted with solid residue from combustion and produce more valuable, and environmentally friendly materials. Moreover, the analysis results of policy, socio-economic, and environmental aspects using secondary research methods in this study indicate that the potential of integrating WtE with carbon mineralization seems promising.

2. RESULT AND DISCUSSION

Incinerator (known as municipal solid waste incinerator or MSWI) is one of three WtE thermal process technologies in Indonesia, the other two are pyrolysis and gasification. According to the U.S. Energy Information Administration, MSWI starts with the preparation; putting waste into the furnace; combustion produces heat as well as bottom ash; heat converts water in the boiler into steam; steam drives turbines and generates electricity; reduction of acidity, NOX, and dioxin levels before the flue gas is discharged into the atmosphere; and collection of bottom ash and fly ash (from air pollution control). Figure 1 illustrates how WtE is integrated with CCUS. CO2 capture technology needs to be installed so that the exhaust gas released into the atmosphere becomes CO2-free. According to Wienchol et. al. (2020), a suitable CO2 capture technology for WtE is oxy-fuel combustion [6]. Captured CO2 will then be used for carbon mineralization, which is described as the reaction of CO2 with materials containing metal oxides (Ca, Mg, Fe) to form insoluble and valuable carbonates. Calcium in MSWI fly ash is the highest (36 - 60%) among other elements so that with carbon mineralization, up to 0.25 t-CO2will be permanently stored per t-MSWI fly ash [5].

Incineration produces two types of residues, bottom ash from combustion and fly ash from air pollution control (APC). Referring to Ministry of Environment and Forestry Regulation No. 26 of 2020, bottom ash can be directly used as a road base or cement material or returned to landfill facilities. Meanwhile, fly ash needs further processing until the heavy metals (12 in total) are below the limit as stated in this regulation. Previous studies [7, 8, 9] have shown

that heavy metals leaching is significantly reduced by carbon mineralization as they are trapped in insoluble carbonate, resulting in value-added and environmentally benign products. Moreover, about 3 - 10% of fly ash will be generated from the waste combustion [2], and by referring to the Benowo WtE plant in Surabaya with a combustion capacity of 1000 tons of waste/day, the 30 - 100 tons of fly ash/day produced is equivalent to a reduction of 7.5 - 25 tCO2/day. This is in line with Indonesia's Nationally Determined Contribution (NDC) where the energy transition is needed to fulfill the commitment of reducing its carbon emission by 29% below business-as-usual by 2030.

Different governmental bodies have their own roles for WtE operations where the central government acts as the regulator, whereas private sectors act as the operator. This is because WtE provision requires large costs which hardly be financed by the local governments [10]. However, they still have the obligation in financing which is then given to business entities as a tipping fee. This creates disagreement among local governments as many have difficulties or lack of funds to finance WtE projects. Presidential Regulation No. 35 of 2018 also requires the State Electricity Company (PLN) to purchase electricity from WtE where the price of electricity for the acceleration program is much more expensive than coal-fired power plants [11]. A techno-economic study shows that WtE with a scenario of 1000 tons of waste/day, tipping fee of IDR 600,000/tons, or an electricity price of IDR 1,750, Net Present Value (NPV) generated is IDR 209.7 billion or 133,500 EUR [12]. Another feasibility study shows that if WtE in Estonia applies carbon mineralization with a waste-to-product or waste-to-safe-landfill approach, the resulting NPV is 9,209,662 EUR or 387,931 EUR, respectively [13]. This additional profit could be an opportunity in overcoming the financial problems of WtE in Indonesia if integrated with CCUS - carbon mineralization technology.

From a policy perspective, the slow WtE development is caused by several issues, such as the discontinuation of certain regulations due to the unwillingness of certain governmental actors to boost their effort for WtE, policy clashes with existing local-level regulations, and complex requirements of WtE plant constructions where the combustion residue treatment plant must be included [11]. In Bali, for example, the government is promoting the 3R (Reduce, Reuse, Recycle) program which is seen as colliding with WtE development. However, it should be noted that the waste accumulated in a landfill also needs to be considered. With this integration, in addition to reducing the volume of waste, the complexity of requirements of WtE construction also can be overcome as the combustion residue treatment will be much easier.

3. CONCLUSION AND OUTLOOK

Integration of WtE with CCUS - carbon mineralization can be the best alternative since it captures CO2 which will then be reacted with fly ash and produce value-added and environmentally benign products. Besides being able to reduce carbon emissions and stabilize heavy metals in the residue, this integration also can increase profits to overcome the financial problems of WtE in Indonesia.

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Surface Modifications of Catalysts in Nanoscale for Improvement of Selectivity and Durability of Photoconversion of Environmental Pollutant and Biomass

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ABSTRACT

Photocatalytic processes for purifications of wastewater to environmentally friendly materials and conversion of sugars to energy and valuable chemicals are considered as new renewable energy technologies and innovations in terms of energy transitions. This work focused on the modification of photocatalysts for the purification of wastewater and conversion of sugars to high-value chemicals. The photocatalysts were designed by optimization of preparation conditions or surface modifications. In terms of purification of wastewater, the photocatalysts were modified using the molecular imprinting technique to create the specific binding cavity for dye molecules on the surface of TiO_2. This technique can increase the selectivity of the photocatalysts. While the application of conversion of sugars focused on the optimization of preparation TiO_2 coating on supporters (ceramic ball, glass ball, and alumina ball) to apply in a flow reactor. The developments of those photocatalytic systems provide strong platforms for photo-purification of environmental pollutants and photoconversions of sugars to value-added chemicals.

Keywords: wastewater purification, glucose conversion, photocatalyst, molecular imprinting, flow reactor

1. INTRODUCTION

Photocatalysis is considered as a favourable technology for the purification of wastewater and/or conversion of sugars to valuable chemicals due to its environmentally friendly method and low cost [1]. TiO_2 photocatalyst has received the most research attention because of its affordability, nontoxicity, high photoactivity, and high chemical stability [2].

The challenges for the photocatalytic reaction are the fabrication of photocatalysts, recycling of photocatalysts after use, and improving the selectivity of the photocatalysts. In this work, we described the fabrication and modifications of photocatalysts for purification of wastewater and conversion of sugars to high-value chemicals (e.g., functional sugar derivatives) through the improvement of catalyst specificity by optimization of preparation conditions or surface modifications and design and assembly of a prototype flow reactor. The modifications of photocatalyst and development of the photocatalytic system can enhance a strong efficiency in photo-purification of environmental pollutants and photoconversion of sugars to value-added chemicals [3-4].

2. RESULT AND DISCUSSION

Effective and selective photodegradation of an environmental pollutant (methyl red) was investigated by using molecular imprinted TiO_2 hollow nanofibers (MIHNF_-TiO_2)._ MIHNF_-TiO_2 was prepared from the mixture of methyl red, $Ti(OiPr)_3Cl$, acetylacetone, polyvinylpyrrolidone (PVP),_ and $Ti(OBu)_4$ in EtOH through electrospinning biased under 15 kV at the distance of 15 cm and a feeding rate of 3_.0 mL h^-1^._ After the dryness under the atmospheric conditions followed by dipping into 1_%_ NH_3 aq, the obtained fibers were calcined at 600 ˚C for 3 h_._ Photodegradation of methyl red_ (6.25, 12.5, 25, and 50 ppm) by MIHNF-TiO_2 in water (pH 7.0) under the irradiation of a 500 W Xe lamp at room temperature was performed and the decrease of the absorbance of methyl red was monitored._ The time_-course changes in the concentration of methyl red obeyed the pseudo-first-order kinetics with good linearity and the estimated rate constants were replotted as a Lineweaver Bulk plot._ Michaelis constant (K_m) and apparent maximal rate constant (Vmax/Km)_ after the formation of methyl red-TiO_2 complex were estimated. It was found that the affinity (viz. comparison of 1/K_m value)_ of the molecular imprinted TiO_2 for methyl red is 4 times higher than that of the non-imprinted one._ Larger Vmax/Km of molecular imprinted TiO_2 than that of non-imprinted one was reflected by the predominant formation of methyl red -TiO_2 complex through molecular imprinting, which might be able to create the specific binding cavity for methyl red on the surface of TiO_2. It can conclude that the improvement of selectivity of molecular imprinted TiO_2 photocatalysts for purification of wastewater could be increased. For photoconversion of sugar, we developed a flow reactor using Ag/N-TiO_2 as a photocatalyst coated on several supports (ceramic balls, glass beads, and alumina balls) to solve the problem of catalyst separation and recovery. After coating with Ag-N/TiO_2, the surface morphology of ceramic balls and glass beads were

covered with Ag-N/TiO_2 in the form of nanoparticles. It could be seen that the catalyst-coated ceramic balls achieved particles with very fine size and well dispersion compared with those in cases of glass beads and alumina balls. Among the several coating techniques tested, the impregnation process resulted in the highest efficiency for photocatalytic conversion of sugar. Moreover, we found that the rate of glucose conversion was increased with an increase in the flow rate because more glucose molecules can contact catalyst surfaces per unit of time. The flow rate of 100 mL min^{-1} showed the highest glucose conversion of 50% for 6 h with a high yield of gluconic acid, arabinose, xylitol, and formic acid as same as a previous report [5]. The durability of the catalysts was studied, and 99% catalyst recovery could be achieved.

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Predicting and Analyzing of Pressure Drop in Two-Phase Geothermal Fluids: Study Case Karaha Bodas Geothermal Power Plant

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ABSTRACT

The principle of Geothermal Power Plant (GPP) is to maintain the geothermal fluid pressure from the production well to the turbine. Meanwhile, in fact there is a pressure drop in the pipeline. The decrease in pressure affects the performance of GPP. The greater the pressure drop, the lower the GPP performance while the pressure drop that is too small causes damage to the GPP component. So, it is important to know the magnitude of the pressure drop for each pipe segment with the prediction method. Harrison & Freeston method and Bril & Mukherjee method are used. This research was conducted at the Karaha Bodas GPP in Tasikmalaya to determine the two-phase flow pattern, the most suitable method for each cluster, and the final pressure in GPP. Flow pattern in Cluster-4 is Stradified, Cluster-5 is Annular Mist and Wavy Flow, Talaga-3 is Stradified and Annular. The Bril & Mukherjee method is suitable for use in Cluster-4 and Talaga-3, the Harrison & Freeston method is suitable for use in Cluster-5. The final pressure on the GPP before entering the separator is 7.16 bar for Cluster-4, 7.443 bar for Cluster-5, and 7.35 bar for Talaga-3.

Keywords: Two Phase, Pressure Drop, Flow Pattern, Geothermal Power Plant, Pressure

1. INTRODUCTION

The principle of Geothermal Power Plant (GPP) is to maintain the pressure of geothermal fluid from the production well to the turbine to remain stable while in fact there is a pressure drop in the pipeline [1]. The decrease in pressure affects the performance of GPP. The greater the pressure drop, the lower the GPP performance while the pressure drop that is too small causes damage to the GPP component [1]. Factors that influence the value of pressure drop are friction, geometry and pipe dimensions, fittings, fluid flow velocity and flow patterns [2]. For this reason, it is important to know the magnitude of the pressure drop for each pipe segment with the prediction method. In this research, Harrison & Freeston method and Bril & Mukherjee method are used. This research was conducted at the Karaha Bodas GPP in Tasikmalaya, specifically at Cluster 4 (KRH 4) that has one geothermal well (K4-

1), Cluster 5 (KRH 5) that has 2 geothermal wells (K5-1 and K5-2) and Talaga 3 (TLG 3) that has 2 geothermal wells (T3-1 and T3-2) in Karaha Bodas GPP, the paths of which are shown in Figure 1below. Every geothermal fluid that come from two geothermal well will be merged in Header before flow to Separator. The aims in this research were to determine the two-phase flow pattern, determine the most suitable method for each cluster, and determine the final pressure resulting from the predicted pressure drop in GPP.

2. RESULT AND DISCUSSION

This research resulted in the flow pattern in Cluster 4 is Stradified, ie the liquid phase is at the bottom of the pipe and the vapor phase is at the top in the pipe, but no waves are formed. The determination of the flow pattern is based on the velocity coefficient, which for the vapor phase is the same as the superficial velocity of the steam but for the liquid phase, in addition to considering the superficial velocity of the liquid, it also considers the viscosity of the liquid and the surface tension of the liquid. Cluster 5 is Annular Mist Flow and Wavy Flow. The difference in flow pattern is not caused by the difference in diameter because the diameter in this line is the same, worth 0.6 m so that the difference in pattern is caused by the increase in mass flow rate and steam quality values. Talaga 3 is Stradified and Annular. This difference in flow pattern is caused by the superficial velocity formed in each cluster has a different value. In addition, the value of the pressure at the wellhead between the three clusters is also different so that the value of the fluid thermodynamic parameters between the three clusters is also different. This affects the value of the superficial velocity. In addition, the dimensions of the pipes in these three clusters are different so that the superficial velocity is also different. The Bril & Mukherjee method is suitable for use in Cluster 4 and Talaga 3. This is because the deviation or error value of this method to the actual pressure at the separator inlet is 13.63% for Cluster 4 and 2.61% for Talaga 3. The Harrison & Freeston method is suitable for use in Cluster 5 because the deviaton or error value is 9.454%. From the calculation of pressure drop, the final pressure on the GPP before entering the separator is 7.16 bar for Cluster 4, 7.443 bar for Cluster 5, and 7.35 bar for Talaga 3. *Flow pattern in Cluster 4 is Stradified, Cluster 5 is Annular Mist Flow and Wavy Flow, Talaga 3 is Stradified and Annular. The Bril & Mukherjee method is suitable for use in Cluster 4 and Talaga 3, the Harrison & Freeston method is suitable for use in Cluster 5. The final pressure on the GPP before entering the separator is 7.16 bar for Cluster 4, 7.443 bar for Cluster 5, and 7.35 bar for Talaga 3.*

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Reflection & Outcome Projection on the Impact of ASEAN Energy Transition to Regional Cohesivity

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ABSTRACT

Within the past decades, the world is combating climate change that leads to the need for clean energy. In consideration of the previous notion, ASEAN has become one of the important actors in supporting the process of achieving clean energy in Southeast Asia. On the other hand, each of the countries has different potential for every type of renewable energy. That being said, Southeast Asia's transition to clean energy has a consequential impact on the cohesivity of the region. We use neoliberal theses, specifically the green economy, to explain this. In this paper, we argue that optimistically, clean energy will bring positive impact towards regional cohesion in economics and policy terms. The cohesion itself is the result of the stepping up of ASEAN's clean energy cooperation and the growth of intra-regional trade in that respective area. Aside from that, institutionalists also argue that institutions—in this case ASEAN—may change the state's behaviour. Nevertheless, there are few things to note if ASEAN sought to accelerate their energy transition: national interest, the involvement of great powers, the inequality in technology distribution, and the overshadowment in global investment to China, India, and Brazil due to their potential.

Keywords: ASEAN, regional cohesivity, green economy, energy transition, clean energy

1. INTRODUCTION

Within the past decades, the world is combating climate change that leads to the need for clean energy. In consideration of the previous notion, ASEAN has become one of the important actors in supporting the process of achieving clean energy in Southeast Asia. On the other hand, each of the countries has different potential for every type of renewable energy. Southeast Asia's transition to clean energy has a consequential impact on the cohesivity of the region. We use neoliberal theses, specifically the green economy, to explain this. In this paper, we argue that optimistically, clean energy will bring positive impact towards regional cohesion in economics and policy terms.

2. RESULT AND DISCUSSION

In this paper, we argue that optimistically, clean energy will bring positive impact towards regional cohesion in economics and policy terms. The cohesion itself is the result of the stepping up of ASEAN's clean energy cooperation and the growth of intra-regional trade in that respective area. Aside from that, institutionalists also argue that institutions—in this case ASEAN—may change the state's behaviour. Nevertheless, there are few things to note if ASEAN sought to accelerate their energy transition: national interest, the involvement of great powers, the inequality in technology distribution, and the overshadowment in global investment to China, India, and Brazil due to their potential.

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Optimization and Simulation of Distributed Generation Systems using Load Forecasting Methods: A Case Study

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ABSTRACT

Distributed generation (DG) represents a paradigm shift from the traditional electric grid to localized generation of electric power along with the capability of incorporating renewable energy (RE) sources into the energy mix. Responding to the need for DG systems and addressing insufficient analysis of simulations and feasibility of implementing DGs, this study aims to design a DG system for a university building and analyse its economic benefits. The viability of existing load forecasting methodologies for energy systems is also presented in this paper. The ideal system design was determined through predictive modelling of the load profile of the building using historical data, optimization using machine learning methods, namely auto-regressive integrated moving average (ARIMA) and long short-term memory (LSTM), and DG system simulation using HOMER. Results show that a grid-connected solar photovoltaic (PV) system installed on the roof coupled with an energy storage system (ESS) will provide the most economic benefits because it yields a reduced cost of energy (COE) per kilowatt-hour for the building. This study shows that in line with efforts to transition towards clean energy, DGs using RE not only have economic benefits, but also ensure energy security and environmental sustainability.

Keywords: Distributed generation, Energy systems modelling, ARIMA, LSTM, Load forecasting, RE technologies, Cost of energy

1. INTRODUCTION

With affordable and clean energy being part of the United Nations' Sustainable Development Goals, the global energy economy seeks to increase renewable energy (RE) generation in the global energy mix by 2030 [1]. Distributed energy is a growing segment of the energy industry, representing a paradigm shift from remote central power plants toward more localized energy generation—especially in cities, communities, and campuses. Integrating renewable energy sources in the form of a solar PV system is seen as a possible

and economic solution to tackle the issue of climate change [2]. System sizing and modelling can be done using historical load profiles. In the event of the unavailability of real-time data or the incapability of measuring actual energy consumption, it is possible to simulate the desired load profile by using historical data through predictive modelling [3]. This paper aims to simulate a distributed energy system in a university building using HOMER, a software capable of performing techno-economic and sensitivity analyses to determine the most optimal distributed generation system and component sizing based on the historical power consumption and the predictive models resulting from the historical data of the building. In this paper, predictive modelling was developed using two load forecasting methods, auto-regressive integrated moving average (ARIMA) and long short-term memory (LSTM), using historical data to determine which results can be applied in the HOMER simulation. This study can provide insights that contribute towards the goal of clean and affordable energy, as institutions such as universities transition into greener energy systems.

2. RESULT AND DISCUSSION

Comparing the performance of the two predictive modeling algorithms that were used in the study, it was shown that the LSTM model achieved higher accuracy than the ARIMA model based on the forecasting metrics. The LSTM model had a root mean square error (RMSE) of 4,373.26, a mean absolute percentage error (MAPE) of 8.00%, and an R2 value of 0.87, meanwhile, the ARIMA model had an RMSE of 8,754.51, MAPE of 18.95%, and an R2 value of 0.49. Figure 1 shows the graph comparing the actual and predicted load values generated by the ARIMA and LSTM models. Results from the predictive load model and the HOMER simulation showed that a grid-connected solar photovoltaic (PV) system installed on the roof of the building with an energy storage system yielded the most economic benefits as the system can reduce the cost of energy by approximately 10.96 % based on the average monthly rate in 2017. When compared with the historical cost of energy from the utility grid [4], HOMER simulation results show that the installation of solar PVs would yield lower costs of energy, as seen in Figure 2. Figure 1. Actual load vs. predicted load using the ARIMA and LSTM models. Figure 2. Cost of energy from the HOMER simulation of the solar PV system and ESS.

Machine learning can be used to model the energy consumption of a building using historical monthly consumption data. Two predictive model algorithms: ARIMA and LSTM were used, and, in this study, the LSTM model achieved higher accuracy than the ARIMA

model. The combination of solar PV and energy storage system as a result from the HOMER simulation is the optimum DG system for the university building because the predicted cost of energy is reduced by 10.96 % based on the average monthly rate. The DG system utilizes renewable energy and storage therefore it is environmentally friendly and provides a certain level of autonomy from the utility grid.

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Application of Demand-Side Management (DSM) for Evaluation & Optimization of Electric Vehicle's Charging Cycles

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ABSTRACT

Electric vehicles (EVs) are potential transportation alternatives for internal combustion engines thanks to lower carbon emissions and high energy efficiency. The combination of EVs with other renewable energy sources (RES) is regarded as a viable solution for eliminating the emission on the road and during the electricity generation process, also reducing the reliance of EVs energy demand on the non-renewables. However, the higher penetration of EVs and unpredictable charging dynamics could place a tremendous burden on the power system. This study proposes a demand-side management (DSM) strategy for an EVs-integrated residential grid with the assistance of grid-tied rooftop photovoltaic (PV) systems. The main objectives are to minimize the load peaks and fluctuation while ensuring the EVs' effective charging and vehicle-to-grid (V2G) scheme based on time-of-use (TOU) tariff and real-time pricing (RTP). The EVs' travelling distances, driving periods, initial state-of-charge (SOCs), and plugging states are considered. One-day simulation in different scenarios is carried out to evaluate the strategies. The results indicate that the proposed model can reduce load demand, flatten the load curve, and reduce electricity cost, maintaining the system's stability. The approach can be an indicator for load aggregator and utility to manage PEVs as DSM tools in the system.

Keywords: electric vehicle, vehicle-to-grid, demand-side management, photovoltaic system, time-of-use tariff, real-time pricing

1. INTRODUCTION

Due to the depletion of finite natural resources and the disastrous impacts of the internal combustion engine vehicles on the environment, electric vehicle (EV) has acquired vast attention thanks to their high energy efficiency, lower carbon emissions, and independence from fossil fuels. Furthermore, the combination between EV and renewable energy sources (RES), or solar energy in particular, could play a significant role in constituting micro-grids

within urban areas and improving the emission factor of the road transportation sector. However, several obstacles are hindering further integration of such system, namely the lack of charging infrastructure dedicated for EVs, risk of transmission line overload due to the upsurge of energy demand for EV charging during high-peak hours, the intermittency of PV systems.

Acknowledging the dire consequences of EVs' uncontrolled charging scheme and the uncertainty of PV power generation, the study has proposed two optimization model for EV charging scheme in a testing 8-node PV-assisted residential network for 24 hours. Based on the given EV-related data, i.e., driving patterns, plugging states, initial and desired state-of-charge (SOC), maximum bidirectional charging/discharging rates, and PV generation, the models are developed to (1) minimize the load peaks and (2) minimize the variance of the load profile. Two dynamic pricing schemes, which are time-of-use (TOU) and real-time pricing (RTP) are considered in the optimization models to ensure that the suggested charging scheme will satisfy the consumers economically. The optimization technique used in this study is linear programming. The library used for deploying the model is CVX – a MATLAB-based modelling system. Four scenarios are analyzed by two optimization model to stategize the optimal charging schemes:

- Scenario #1: The EVs are charged with maximum charging rate until fully charged right after being plugged in, no vehicle-to-grid technology (V2G) is applied;
- Scenario #2: Model 1 is applied to minimize peak demand without considering the charging cost. V2G is applied;
- Scenario #3: Model 2 is applied to minimize the variance of the load profile and charging cost based on TOU tariffs. V2G is applied;
- Scenario #4: Model 2 is applied to minimize the variance of the load profile and charging cost based on RTP. V2G is applied.

2. RESULT AND DISCUSSION

Based on the information from the three EVs, testing grid, daily load profile of eight households, dynamic pricing schemes (TOU and RTP), and PV systems, four scenarios have been carried out. The constraints on the SOCs, maximum charging/discharging rate, and node voltages are applied in the objective functions. Regarding the results, Scenario #3 has the highest peak and variance of the load profile, while Scenario #2 shows the lowest, followed by Scenario #4 and #1, as shown in

Figure 1. However, in terms of the charging costs, Scenario #3 has the lowest charging costs based on both TOU and RTP pricing scheme. Scenario #2, meanwhile, has the highest TOU charging costs and second highest for the RTP, as shown in Figure 2. Fortunately, when considering the voltage profiles, all scenarios except the Baseline do not violate the voltage limit, which is between 0.9pu and 1.1pu.

It can be seen that, from the utility's perspective, Scenario #2 is more desirable as both the peak and variance is the lowest and load balancing is achieved; but Scenario #3 is more beneficial from the consumers' perspective, as it has the lowest charging cost. The tradeoff is, when lowering the charging costs, the balance of the load has to be compromised and vice versa. The participation of PV systems has reduced the energy demand from the grid during daytime, and theV2G activities has enabled energy from EVs to be injected back to the grid has significantly improved the load and voltage profiles in optimized scenarios.

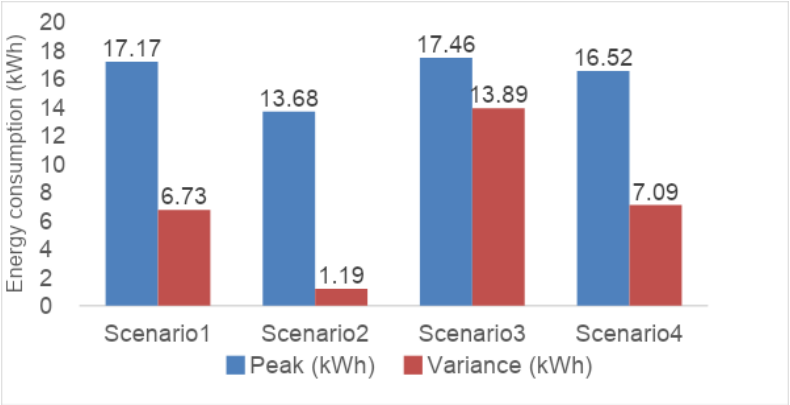

Figure 1. The peak value and variance of each evaluating scenario

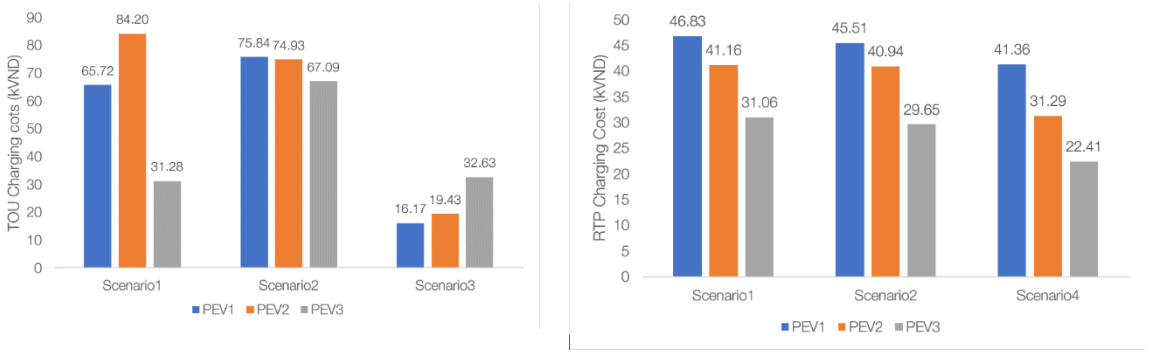

Figure 2. Charging costs of the EVs in TOU and RTP pricing scheme

In conclusion, the study has proposed different charging schemes based on different scenarios, with consideration of the benefit of the utility and the consumers to reduce load peaks and load variance, striving for a balance network. The PV systems and V2G activities

has provided voltage support to the grid, as well as serve the energy demand. Further development of the study should be the extension of simulation time, as well as the testing grid to accurately evaluate the influence of increasing EV fleets to the power grid and develop the corresponding optimization strategies.

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The Effects of Solar Home System on Rural Household Welfare in Cambodia: Evidence from Propensity Scores Matching

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ABSTRACT

There is a huge amount of solar home system has been deploying across Cambodia but there is no any study that intend to find the effect of solar home system on household welfare in Cambodia. This research aims to investigate the effect of using solar home system on household welfare in Cambodia. Propensity scores matching is used to estimate the effect of solar home system. The results show the significant effect of solar home system on non-food expenditure as well as health expenditure.

Keywords: Solar home system, causal inference, household welfare, conventional source of electricity, Propensity scores matching

1. INTRODUCTION

Solar home system is widely used in developing countries for providing electricity access to rural households [1]. For off-grid households, the solar home system has been used for replacing conventional sources of electricity [2]. From 2013 until 2020, around one hundred thousand solar home system has been distributed to rural households in Cambodia by the Cambodian government [3], [4], [5], [6], [7], [8], [9], [10]. There are several studies that have been conducted to find the effects of different treatments on household welfare and well-being as the outcomes. For example, Han P. and Fukunari K. (2019), studied the impact of energy poverty on households' well-being specifically on respiratory diseases and they found energy poverty has a negative correlation with respiratory diseases [11]. Alam H. M. and Dieter K. on another hand studied the impacts of the solar home system on the development of society and the results showed that the solar home system has a negative correlation with pollution while it has a positive correlation with household income [12]. However, that research have not elaborated on the effect of solar home systems on household welfare. This research aims to fill that gap by studying the effects of solar home systems compared to conventional source usage. This research uses cross-sectional data from the 2019 Cambodia Socio-Economic Survey (CSES) data. Among 10,074 observations in CSES data, there are 1,054 households that use the solar home system, and 502

households currently use the conventional source as their source of electricity. We use Propensity Scores Matching (PSM) to estimate the results. PSM is a two stages estimation method introduced by Rosenbaum and Rubin (1983) [13]. In the first stage, we use logit model to estimate the propensity score which is the probability of a household will use a solar home system given a set of observable covariates (such as an urban dummy, gender, age, education, housing condition, and floor area) that cannot be affected by the treatment. Then the treated group (households that use solar home systems) and the control group (households that use conventional electricity sources) are the same except for the treatment status, based on their propensity scores. The second step in PSM is estimating the average treatment effect on treated (ATET) of solar home system households by using nearest-neighbour matching, which was introduced by Becker and Ichino, (2002) [14].

3. RESULT AND DISCUSSION

We find that using a solar home system has some positive effects on household expenditure. It significantly increases non-food expenditure and health expenditure by USD 6.8 and USD 11.62, respectively. However, we do not have enough evidence to show the statistically significant effect of solar home systems on total expenditure, food expenditure, and education expenditure (see Table 2). Our findings provide evidence to highlight the positive effect of solar home systems on household welfare in Cambodia. Any unobservable confounder that we cannot control, or capture is the limitation of this research. An example of an unobservable confounder can be any different policy such as a soft loan that is currently implemented across Cambodia. And if this happens then this kind of confounder will affect both probability of getting treated as well as increasing household expenditure. The main objective of this research is to investigate the effects of the solar home system on household welfare in Cambodia. By using propensity scores matching, we found that the solar home system increased non-food expenditure and health expenditure. But the effects on total expenditure, food expenditure, and education expenditure were not statistically significant. Our finding provides empirical evidence for supporting the solar home system implementation in Cambodia.

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The Future of Nuclear Power: A Philippine Perspective

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ABSTRACT

A global transition toward sustainable energy systems is of capital importance to avert the adverse effects of climate change. However, at the forefront of this paradigm shift remains energy security as a key constituent. The Philippines, amid imposing high electricity rates because of the importation of coal and fossil fuels, continuously struggles with its energy consumption. As it commits to a 75% reduction and avoidance of greenhouse gas emissions by 2030, the Philippines endeavours steps toward meeting its concomitant energy demand while investing in more sustainable energy sources. Among the most viable options, national policy discussions on the introduction of nuclear power in the energy mix are of principal interest as its inclusion is projected to present huge potential and prospects for the government and its people in terms of employment, energy security, and a sustainable environment. In lieu, this paper pivots on the future of nuclear power in the Philippine context through a comprehensive review of the status of its energy sector, the historical context and status of its nuclear power, public acceptance, capacity building, and economic feasibility.

Keywords: CO2, Electricity, Nuclear Energy, Energy Security, Philippines, BNPP, Energy and SDGs

1. INTRODUCTION

A global transition toward sustainable energy systems is of capital importance to avert the adverse effects of climate change. However, at the forefront of this paradigm shift lies energy security as a key constituent [1]. Subsequently, the Philippines is a developing country in the Southeast Asian region that remains to be among the most vulnerable to climate change, signifying its high interest in a low-carbon transition and global carbon emissions mitigation. Among the commitments of the Philippines to the Paris Agreement on Climate Change included a 75% reduction and avoidance of greenhouse gas emissions by 2030. Thence, the

country itself endeavours steps toward meeting the concomitant energy demand increase of its population without compromising the quality, reliability, affordability, and sustainability of the energy mix to accommodate its needs [2]. The search for sustainable energy sources is heightened amid energy trade disruptions due to the Ukraine-Russia war which has exacerbated inflationary trends in oil prices. As a result, national policy discussions on the introduction of nuclear power in the energy mix are of principal interest. In lieu, this paper pivots on the future of nuclear power in the Philippine context through a comprehensive review of the status of its energy sector, the historical context and status of its nuclear power, public acceptance, capacity building, and economic feasibility.

2. RESULT AND DISCUSSION

As a coal-dependent country, PH CO2emission is projected to reach 136.02 million tons, as shown in Figure 1a. Principally, it peaked at approximately 146.61 million tons of gas emitted from population growth and production-based industries from the previous year [3] with electricity and heat as the major emitters. It is believed that the transition to clean energy is needed in the country as its population increase by 1.32% per annum by 2021 [4]. Although renewables are considered sustainable sources, nuclear energy remains to be a more viable option forCO2 reduction than renewables and carbon capture and sequestration (CCS). As evidenced in the extreme Clean Energy Era strategy (CEE) case, 8NPPs save two-thirds of the CO2 emissions from 1NPP. Furthermore, nuclear energy distributes 62% of total electricity while emitting less than 5.25 % of total CO2 in the 8NPPs nuclear energy series (NES) [5]. Figure 1b illustrates that the Philippines likely has the second-highest electricity prices among ASEAN nations, after Singapore. For households and businesses, the price per kilowatt-hour (kWh) is anticipated to be $0.17 and $0.119, respectively [6]. Given that the Philippines is a third-world nation, it should be accounted for that shifting to a more cost-effective alternative energy source that also benefits the environment should be adopted. To backtrack, PH became the first-ever ASEAN Member State (AMS) to have built its own nuclear power plant at the height of the 1973 global oil crisis. However, safety issues and unanticipated nuclear and political events impeded the construction and operation of the 621-MW Bataan NPP (BNPP) which harboured staunch domestic resistance, putting it in further dormancy. However, the clamour has yet again surged with prospects of addressing energy demands and decarbonization [7]. In fact, the 2019 Department of Energy (DOE) public survey revealed increased public acceptability with the rehabilitation of BNPP garnering a favourable 79% approval rating while 65% concurred with the construction of a

new NPP. Further, the government recently gave a green light on the pursuance of the civilian nuclear energy (CNE) development for power generation. According to the International Nuclear Information System (INIS) database, there are 4,260 papers under the study of Nuclear Science and Technology (NS&T) that could aid in broadening an individual's knowledge pertaining to nuclear and energy studies [8]. In line with the insufficient data about nuclear studies, this would be beneficial to the energy economy in the Philippines. Implementing the fundamentals of nuclear energy in educational systems explains the significance of shifting from conventional gases to nuclear energy as the primary power source. Moreover, there will be growing pressure for the pioneers in nuclear engineering as PH nears the pursuance of nuclear energy inclusion in the energy mix. However, as a democratic country, contrasting decisions will be made, such as a government responsible for formulating nuclear policy and a community that provides feedback regarding nuclear power [9]. Due to its efficiency, nuclear energy is regarded as the most efficient energy source. The majority of investment is moving toward nuclear technology as a result of the repercussions of global warming. It is predicted that by 2050, nuclear and CCS technologies would account for a significant proportion of the energy mix. The long-term viability and profitability of nuclear energy in terms of capital and return on investment will have a significant impact on the technology's future. In the meantime, it is noteworthy that nuclear energy produces low carbon emissions and requires a slight amount of land space compared to other renewables, despite the fact that many environmentalists oppose its use and claim it to be the Devil's excrement.

3. CONCLUSION AND OUTLOOK

The Philippines, amid imposing high electricity rates because of the importation of coal and fossil fuels, continuously struggles with its energy consumption. In this case, most industries are heavily reliant on fossil fuels as an energy source. Given that CO2 emissions are increasing and that the effect of global warming is no longer just a hypothesis, this projects a threat not only to the Philippines but to the rest of the world. Among the energy sources, nuclear energy is regarded for its low carbon emissions and least construction space requirement. The use of nuclear energy would thereby present prospects for the government and its people in terms of employment, energy security, and a sustainable environment. A nuclear energy training program is now being given at several universities including Philippine government organizations as the clamour for the restoration of the BNPP becomes in full swing. The potential reactivation of BNPP is still seen as a sensible

development by researchers, as heightening interests ensue amid the assumption of the newly elected president Marcos Jr. who is motivated to carry on the work of the late president Marcos Sr.

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The Stimulus-Organism-Response (SOR) Model-Based Analysis on Appliances Acquisition in the Philippines: An Empirical Study on Consumers' Behavior towards Purchasing Refrigerators

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ABSTRACT

Through the Stimulus-Organism-Response (SOR) Model, the paper was designed to answer five (5) questions: (a) What are the factors affecting the decision of the Filipinos in buying refrigerators?; (b) What are the reasons that encourage Filipinos to purchase refrigerators?; (c) What is the relationship between energy labels and the purchasing behaviour of the Filipinos?; (d) What are the internal and external referents associated in purchasing behaviour?; and (e) How do socio-demographics affect the purchasing behaviour? SOR explains that several external aspects can act as a stimulus which influences a person's internal state, referring to the organism, which will result to certain behavioural response. The prevailing motivation of consumers rely on their hedonic behaviour which attributes with the experiences of sensory appeals including emotion and gratification The study suggests that the consumers lack ample knowledge and capacity to use their familiarity and awareness on the existence of energy labels on making sound decisions when purchasing refrigerators. The importance of energy labels was being set aside by the consumers when being conflicted with the product's brand, features, and aesthetics. Subsequent interventions of government may be necessary in order to address the gap between the consumers purchasing motivation and purchasing behaviour.

Keywords: Energy Efficiency, Refrigerators, Energy Labels, Technology Management, Appliances, Energy Management

1. INTRODUCTION

In 2019, the Philippines total power peak demand reached 15,581 MW which is 5.40% higher than the 2018 peak demand of 14,782 MW (Philippine Department of Energy, 2020). To address the increasing carbon footprints and achieve sustainability, the shift to energy-efficient appliances is vital for the Residential Sector (Ullah, 2019). Technological change serves as a key driver of productivity progress and developed living standards in a

community (Comin and Mestieri, 2018). It can also establish and carry fundamental revolutions to economies and lead social and human advances while reaching those in need (Kordunsky, 2017). Through the enactment of Republic Act 11285 or also known as the Energy Efficiency and Conservation (EE&C) Act, a more concrete and specific framework for leading and institutionalizing essential policies on EE&C that include the promotion of technologies that are energy efficient (Department of Energy, 2019). The initiative of the Philippine Government mainly focuses on making EE&C as the nation's way of life and to increase awareness on the importance of attaining energy savings through various programs and projects of the Department of Energy. The present strategies being executed includes the aggressive campaign on energy efficient technologies in the country which expects to provide greater energy savings both for the end-user and manufacturer through the conduct of information, education, and communication activities. (IEA, 2019) Through the Stimulus-Organism-Response (SOR) Model-Based Analysis, this paper will analyse the purchasing behaviour of Filipinos specifically on the acquisition of refrigerators among households. The study will analyse the effect of stimulants, such as awareness and informativeness of energy labels and subjective norms, to the organisms' purchasing behaviour. Moreover, the following problem statement shall be drawn:

1. What are the factors affecting the decision of the Filipinos in buying refrigerators?
2. What are the reasons that encourage Filipinos to purchase refrigerators?
3. What is the relationship between energy labels and the purchasing behaviour of the Filipinos?
4. What are the internal and external referents associated in purchasing behaviour?
5. How do socio-demographics affect the purchasing behaviour?

3. RESULT AND DISCUSSION

In line with the purpose of the study to determine the factors and variables affecting the consumer behaviour of Filipinos towards purchasing refrigerators, the study applies the theory of S-O-R to analyse the acquisition behaviour of the respondents. Most of the respondents are Female aged 26 to 35 years old living with four household members and have bachelor's degree. They are single holding a regular/permanent position with an average individual monthly income of Php 20,0001.00 to Php 30,000.00 and average household monthly income of Php 19,001.00 to Php 38,000.00. Based on the classification of Philippine Institute of Development Studies (PIDS), family income for a family of 5 ranging between Php 19,040.00 to Php 38,080.00 are considered as lower middle-income class.

Moreover, a family composed of five (5) members would only be considered as middle income if its monthly income is between Php 20,000.00 and Php 115,000.00. Given this range, the study was able to gather 252 responses from the middle-income class which is 63.80% of the total number of respondents. Brand, Energy Efficiency, Budget, Country of Origin, Type, Capacity, Warranty, Space, and Design affects the decision of Filipinos when buying refrigerators. According to Kokemuller (2019), choosing certain brands and origin tend to be related to the desire of people to fit in, whether at school, work, or in social circles. With this, consumer sometimes choose brands which will contribute to greater social acceptability. This can be supported by Handlin (2016) where good branding strategy allows simplified shopping which enables consumers to decide quickly and efficiently what they want. Familiarity with brands reduces the likelihood of getting disappointments when purchasing appliances. The result on the inclusion of Energy Efficiency and Budget in the can be associated with the fact that when the price range of the product in the low, consumers will tend to choose high energy consuming appliances but when the price range is in mid-to-high range, the decision of the consumer will vary (Wang, 2021). The study also agreed that inverter technology is the most efficient refrigeration technology available on the market today, it saves up to 30-50% of the electricity consumed as compared to conventional refrigerators (Jain, 2020). Budget, Capacity, Brand, Energy Efficiency, and Design greatly affects consumers' decision when acquiring refrigerators (Belman-Flores et al, 2019). The same time, the presence of energy labels plays a vital role on the intent of consumers to purchase refrigerators, given that there are also precedent recommendations of their families, friends, or knowledge based on newspaper, television, and social media. Since energy labels provide reliability and eliminates uncertainty (Huse, 2019), they should be understood, trusted, and valued as a tool for consumer's decision making (Zainudin, 2014). Respondents are encouraged to purchase refrigerators is presented with an energy label. The perception of the respondents that energy labels are reliable and aids in the reduction of electricity consumption plays a vital role on buying refrigerators. Respondents were also encouraged based on the recommendation of their family, friends' approval as well as influences from newspapers, television, and social media especially if the refrigerator is deemed as energy-efficient and beneficial to environment. One of the purposes of the study is to determine the purchasing motivation of the Filipinos on acquiring refrigerators. Based on the results, Respondents will choose a refrigerator based on their preferred features, the products affordability, functionality, and aesthetics over its energy efficiency. Since utilitarian behaviour refers to the effectiveness, functionality, and practicality of the product, sacrificing energy efficiency for features and aesthetics means the motivation of the

consumer doesn't rely on its utilitarian behaviour. The prevailing motivation of consumers rely on their hedonic behaviour which attributes with the experiences of sensory appeals including emotion and gratification (Moon et al, 2017). Based on the results, the internalities focused on the information awareness on energy label which include the provision of details on energy efficiency rating, electricity consumption, and possible savings when the refrigerator is purchased. On the other hand, externalities focused on the marketing aspect of the refrigerator. Consumers will gravitate more on products that are well marketed, advertised, and promoted. This result proved that marketing is critical in getting the product to the consumers. It is more crucial to deliver the product according to the consumer's preferences. Providing a unique marketing plan aids in acquiring a diverse range of customers. (Pandian, 2020). Marketing is also a vital strategy on increasing product reach and possibly brand patronage among consumers (Ugona, 2017). All variables identified in the socio-demographic of the respondents have significant relationship among the Energy Labels, Consumer's Behaviour and Subjective Norms. Based on the Likert scale, the consumers' behaviour is Neutral. Their socio-demographic profile has their own preference in purchasing refrigerators. The study suggests that the consumers lack ample knowledge and capacity to use their familiarity and awareness on the existence of energy labels on making sound decisions when purchasing refrigerators. The importance of energy labels was being set aside by the consumers when being conflicted with the product's brand, features, and aesthetics. Subsequent interventions of government may be necessary to address the gap between the consumers purchasing motivation and purchasing behaviour. The intensification of information campaign and supporting policies may provide avenue to ensure that consumers are empowered on choosing energy efficient appliances. Furthermore, the development of a comprehensive communication plan that will cut across sectors may address the concerns on the appliances acquisition of the Filipinos. Furthermore, future studies may focus on the impact of the government policies to the middle-income class towards their consuming behaviour and other factors affecting their decision towards energy efficiency and conservation.

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Prospect and Challenge the Implementation of Green Hydrogen as the New Industrial Strategy for Decarbonisation in Indonesia

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ABSTRACT

Green hydrogen is hydrogen that is produced from renewable energy sources. This can certainly be a new industrial strategy to achieve the decarbonization target of 29% by 2030 considering that renewable energy empowerment is the most effective way to achieve an energy transition. However, apart from that, of course there are opportunities and challenges when green hydrogen is implemented in Indonesia when looking at the existing laws and regulations. This study uses a normative juridical method to explain theoretically about green hydrogen as the new industrial strategy for decarbonisation in Indonesia in the literature and review its implementation in other countries. Then, this paper examines the opportunities and challenges of implementing green hydrogen as part of Indonesia's efforts to reduce carbon emissions. This study aims to see whether green hydrogen plays an important role in efforts to reduce carbon emissions when viewed from several considerations of other aspects that affect the effectiveness of its implementation, such as economic, regulatory, and other aspects.

Keywords: Green Hydrogen, Decarbonisation, Industrial Strategy, Indonesia, Energy Resilience

1. INTRODUCTION

The Indonesian government estimates that Indonesia and several countries in the ASEAN region need to invest up to $25.2 billion to develop green hydrogen by 2060 [1]. Green hydrogen produced from electrolysis (a high energy process) and renewable energy sources are high-cost options, accounting for only about 5% of total H2 production. Currently, most global hydrogen production comes from fossil fuel sources (methane gas reform) and will continue for decades. However, as production capacity increases for more efficient and cost-effective electrolyzers, it is expected that production costs will drop drastically as technology rollouts and renewable power generation capacities mature. In order to produce a safe, resilient and decarbonized energy system, the mass production and

storage of hydrogen will play a critical role in balancing the discontinuous supply of energy from renewable energy sources with the demands of end users (e.g., for power grids, household and industrial heating and fuel for transportation).

2. RESULT AND DISCUSSION

In the outlook, Hydrogen is the most abundant element in the Universe and despite the challenges associated with its extraction from water, is a unique and abundant source of renewable energy, perfect for our future zero carbon needs for combined heat and electricity supply. In addition, Hydrogen fuel cells provide a clean source of energy, without any adverse environmental impacts during operation as the only by-products are heat and water. Unlike biofuels or hydropower, hydrogen does not require a large area to produce. Furthermore, hydrogen fuel cells are more efficient than many other energy sources, including many green energy solutions. This fuel efficiency allows the production of more energy per pound of fuel. For example, conventional combustion-based power plants generate electricity at 33-35% efficiency compared to up to 65% for hydrogen fuel cells. The same is true for vehicles, where hydrogen fuel cells use 40-60% of fuel energy while also offering a 50% reduction in fuel consumption [2]. Furthermore, there are other opportunities as Indonesia seeks to implement green hydrogen as a decarbonization effort, such as hydrogen fuel cells that do not produce greenhouse gas emissions like fossil fuel sources, reducing pollution and improving air quality as a result. Thus, hydrogen fuel cells do not release greenhouse gases, which means they have no carbon footprint when used. As technology advances, hydrogen fuel cells will be able to provide energy for a variety of stationary and mobile applications. Hydrogen powered vehicles are just one example but can also be used in smaller applications such as domestic products as well as large-scale heating systems. Similar to ICE power plants, the functions of energy storage capacity (i.e., fuel tank) and engine size are separated, in contrast to battery-based power (i.e., where power scales linearly with mass), providing great flexibility in design [3]. In addition to the opportunities above, the application of green hydrogen in Indonesia also has several challenges, such as hydrogen extraction. Although it is the most abundant element in the universe, hydrogen does not exist by itself and so needs to be extracted from water by electrolysis or separated from the fossil fuel carbon. Both processes require a large amount of energy to achieve. This energy can be more than that obtained from hydrogen itself and is also expensive. In addition, this extraction usually requires the use of fossil fuels, which in the absence of CCS undermines hydrogen's green credentials. In addition, from a cost

perspective, the cost of a single unit of power from a hydrogen fuel cell is currently greater than that of any other energy source, including solar panels. This may change as technology advances, but nowadays this cost is prohibitive for the widespread use of hydrogen even though it is more efficient once it is produced. In summary, the advantages of hydrogen fuel cells as one of the best renewable energy sources have been proven, but there are still several challenges that must be overcome to realize the full potential of hydrogen as a key enabler of future decarbonized energy systems.

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Optimization of a Hybrid Renewable Energy System for a Rural Community using PSO

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ABSTRACT

The strive for a more energy secure future in the Philippines is greater than ever due to the availability of new technologies brought about by rapid technological advancement and globalization. Despite this, much of the country is still unable to reap the benefits of new technologies due to the lack of basic infrastructures most evidently in rural areas of the country wherein the national grid is inaccessible and there is high-cost expansion. The installation of microgrids in these areas have the potential to improve energy access by utilizing renewable sources of energy, namely solar, wind, and hydro power. This paper presents an energy management system using particle swarm optimization (PSO) designed to direct and allocate the energy generated by a hybrid renewable energy system (HRES) and minimize the operational cost of the microgrid. The current and future load scenarios of the community were considered in the proposed HRES, and the operational cost and levelized costs comparison are presented in the paper.

Keywords: Energy accessibility, Energy and SDGs, Hybrid Renewable Energy Systems, Particle Swarm Optimization, Levelized Cost of Energy, Energy management

1. INTRODUCTION

The intermittency of renewable energy (RE) resources remains to be a challenge in electrifying rural communities even with different renewable energy resources. For an optimal hybrid renewable energy system (HRES), there is a need for an energy management system that would allow for a resilient and stable microgrid, as well as to reduce electricity costs for the community due to the stochastic nature of RE systems. The unpredictable weather conditions result in variable power generation, which depend on numerous factors, for these RE resources. This affects the overall energy that the HRES can potentially generate. Nebey proposed an efficient resource management system for a rural community in Ethiopia using MATLAB and HOMER to solve the aforementioned problem, and conditionally

manage the system's power demand and supply [1]. Ignat et al. examined the use of particle swarm optimization (PSO) as the means for effective energy management for an island microgrid that utilized various renewable energy sources [2]. The purpose of a proper energy management system is to minimize the operational cost of the microgrid while meeting the electricity demand of the consumers. The ideal way to achieve this is with the use of optimization algorithms. This study proposes an HRES that can provide 24-hour electrification in a rural community by integrating the existing 10 kW micro-hydro microgrid system of the community with solar photovoltaic and energy storage system, and using PSO intelligent control systems for energy management, which can form into a smart microgrid network for the community to meet its current and future load profile. PSO is a type of optimization algorithm that is inspired by the natural behaviour of birds or fish (the particles) as they search for food or when it ideally converges toward the global optimum solution of the problem, that is in this case, energy management. PSO may be utilized in managing the energy flows so that the operational cost of the microgrid will be minimized while the operational and security constraints are fully satisfied.

2. RESULT AND DISCUSSION

(External link to the Tables) Table 1. Optimal operation cost with different Load Scaled Average Table 2. Comparison of LCOE calculated using HOMER Simulation and PSO.

Table 1 shows the operational cost per day for the HRES. The load scaled average refers to the energy consumption of the community and corresponds to an HRES design determined using HOMER. The values in Table 1 includes the current and projected increase in energy demand when electricity is made available 24/7. The HRES designed with a load scaled average of 154 kWh/day has the lowest operation cost among the four system designs since the existing micro-hydro system provides sufficient energy for this energy demand. Thus, the additional system cost is very minimal, and the operational cost remains low. The operational cost is observed to have minimal increase as the load scaled average increases from the 219 kWh/day to the 308 kWh/day. Table 2 shows the comparison of the levelized cost of energy (LCOE) as determined by the simulation using HOMER and the levelized cost from utilizing PSO for energy management. The PSO levelized cost was determined by calculating the average of the daily cost for each hour. Results in Table 2 show lower LCOE with the implementation of the PSO-based energy management system.

The proposed energy management system using PSO was able to optimize the use of energy and reduced the levelized cost of energy of the HRES. This is evident in the comparison made with results from the HOMER simulation. Moreover, the PSO algorithm used in this study utilized cost per hour data, thus providing detailed calculations of the LCOE for accurate analysis.

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Financing Green Buildings: Barriers, Policies, Solutions

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1. INTRODUCTION

Building and construction sectors contribute to about 29% of the Green House Gas (GHG) emission and consume 30% (22% from residential and 8% from the non-residential building) of the total energy. With the growing population and increasing income, the demand for construction and building will continue to rise, which means that GHG emissions from the building and construction sector will continue to rise. Green buildings have been recognized as an important pathway to mitigate GHG emissions from the construction and building sectors. Green building encompasses the use of materials and processes which are environmentally friendly and minimizes the use of resources from design, construction, maintenance, and demolition stages. This paper makes a systematic review of the literature, standards, and policies and provides a pathway for the implementation of green buildings, particularly in developing countries. We find that the major challenges for the implementation are access to construction materials and skilled labourers for green buildings, followed by the high cost of construction, lack of standards, policies, and support from the government. To reach net-zero carbon emission and other nationally determined contributions, construction, and building sectors have a tremendous role, thereby providing opportunities for investment in construction, buildings, and allied sectors.

2. RESULT AND DISCUSSION

Rapid changes in the climate the climatic condition with the increase in the frequency of extreme weather events such as prolonged heat and drought, flooding, glacial lake outburst flooding (GLOF), erratic rainfall, salination, sea inundation has been the cause of concern for the future of the humanity. Therefore, global efforts encompassing all sectors are needed to check climate change through reduction in GHG emissions. As the building and construction sectors consume one-third of the energy and contribute to one-third of Green House Gas (GHG) emission it has the potential to contribute significantly to the reduction of the GHG emission and reversing the trend of climate change. Furthermore, rapidly growing population, which is expected to reach 9.7 billion by 2050, and increasing income, the

demand for housing will rise, hence it is critical to bring about significant innovation in the sector to reduce GHG emission. Therefore, green buildings could play a crucial role in reducing GHG emissions from the construction and building sectors. Green building involves greening entire processes from manufacturing of the construction materials, design, construction, maintenance, and demolition. Green buildings are environmentally friendly involve the use of process and material which causes minimal damage to the environment and are energy and resource efficient, besides providing attractive amenities such as better indoor air.

However, there are several challenges for implementing green buildings, and particularly in developing countries [1]. For instance, in developing countries, the construction materials and skilled labourers for green buildings are not easily available, which acts as a major barrier to implement green buildings. Further, the cost of constructing green buildings is high which makes it challenging for the low-income families to construct the green building [2]. Lack of standards, policies, and support from the government also acts as a barrier to implement green buildings in developing countries [3]. Therefore, policy should develop skilled labour through training and promote policy to increase access to green building material together with better financing options and tax exemptions.

Attractive financing methods for mobilizing private finance in green buildings include green bonds, green sukuk, PPP and ESCO. However, companies with lower ratings, smaller size and located in countries with volatile currency exchange rates require more support for issuing green bonds, such as green bond grants and tax incentives.

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Development of ASEAN Energy Resilience Assessment Guideline for Energy Infrastructure Climate Adaptability Enhancement

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ABSTRACT

The world agreed to strive for carbon neutrality at COP26. Resilience has recently gained attention as a key concept to ensure that the transformation towards carbon neutrality happens sustainably. Energy resilience enhances climate adaptability of energy infrastructure, especially renewable systems that can contribute to the carbon neutral goal. ENTEC has been promoting energy resilience in ASEAN and made it one of the ASEAN COSTI's 2021 priorities. Based on the experience in conducting energy resilience assessment in Thailand, the ASEAN Energy Resilience Assessment Guideline was developed. The guideline includes the standard operating procedure (SOP) and the detailed steps for energy resilience assessment. Though it looks similar to risk assessment, it includes evaluation of the changes of risks over time which is the necessary information to enable rapid recovery and adaptation to future threats, and it is designed to appropriately involve stakeholders at all possible steps. The guideline will help the ASEAN community create the common ground for energy resilience assessment, which will facilitate the actual implementation of the assessment in ASEAN Member States and enable comparison of the results to further enhance the understanding and the application of the concept.

Keywords: energy resilience, climate change, adaptation, guideline, COSTI

1. INTRODUCTION

Sustainable Development Goal (SDG) adopted by United Nations and the 26th Climate Change Conference (COP26) held in Glasgow have highlighted resilience as one of crucial concepts to adapt to climate change, especially in energy sector. The term is included in at least four desirable targets including Goal 1: No Poverty, Goal 11: Sustainable Cities, Goal 13: Climate Action and Goal 14: Life below Water [1] and indicated as an action on adaptation to protect and restore habitats in COP26 [2]. Thailand, as one of the members which contributes to both SDG progress and shared actions on adaptation on COP26, has

furthered the concept of energy resilience through conducting a series of research in Thailand and international workshops to disseminate the understanding to ASEAN Member States (AMSs). National Energy Technology Centre (ENTEC) made efforts on driving energy resilience to be adopted as one of the ASEAN Committee on Science, Technology and Innovation (COSTI) 2021 Priorities. Three workshops under the theme of "Enhancing Climate Adaptation Capacity of ASEAN Energy Systems through the Concept of Energy Resilience" were conducted with 142 active participants from 11 member states to raise awareness and promote actual implementation of the concept. Essentially, many AMSs were interested in pursuing the concept and expressed willingness to perform energy resilience assessment. Therefore, a common guideline for the assessment would facilitate understanding and accurate procedure for maximum benefits and enable comparison and discussion for the assessment outcomes. To our best knowledge, there are various methodologies developed and used to facilitate the assessment of resilience of energy systems. A Self-Guided Reference for Practitioners [3] of National Renewable Energy Laboratory (NREL) are among well-known methodologies in existence. This ASEAN energy resilience assessment guideline was built upon this self-guided reference with slight modifications to match ASEAN local context. The assessment was exercised with four different types of power plants in Thailand and then developed into a standard operating procedure (SOP). This piece of work demonstrates ENTEC's effort in developing the ASEAN guideline for energy resilience assessment based on its experience and exercises to further promote the concept and encourage actual implementation in ASEAN region.

2. RESULT AND DISCUSSION

According to ENTEC experience in conducting energy resilience research and assessments, the steps that the assessors can follow from preparation of the assessment until monitoring of the outcomes from applied resilience countermeasures, and detailed steps of the assessment to be conducted with stakeholders, in the forms of focus group meeting or interview, are essentially needed. Therefore, this reference guideline includes the SOP and the detailed procedures for energy resilience assessment, along with samples of worksheets to guide focus group meeting(s) and interview(s) of stakeholders. The SOP shows systematic procedure for the assessment, comprising of determination of assessment direction and scope, data collection and preparation for discussion with stakeholders, assessment exercise with secondary data, energy resilience assessment, summary of risks and countermeasures to be further considered, assessment of change overtime of the risks, countermeasure

selection, analysis of cost and benefit, countermeasure selection for sustainable application, public hearing with stakeholders, implementation of the selected countermeasures, and assessment of actual changes of risks. This energy resilience assessment share similarities with energy risk assessment where threats, impacts, vulnerabilities, and risks are assessed. However, changes of risks over time are taken into account. The additional information of risk changes is necessary since it helps select suitable measures for rapid recovery and adaptation to future threats. This elements of the recovery and adaptation are considered important because a resilient system should not only be able to avoid climate-induced disruptions and absorb consequent impacts, but also to rapidly recover after the disruption and adapt to future threats. Besides, the assessment considers social inclusive aspect since it was designed to appropriately involve all-level stakeholders at all possible steps. The significant difference from traditional risk assessment is that it relies more on the experience of the stakeholders rather than the knowledge of the assessor(s). Once the developed guideline is endorsed by ASEAN COSTI, it will ease the scientific community in creating common ground for energy resilience assessment, facilitate actual implementation of the assessment in AMSs, and enable comparison of the results to further enhance the understanding and application of the concept.

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Recovery of Silicon Wafers from End-of-Life Silicon-Based Solar Cells for Alternative Photovoltaic Applications

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ABSTRACT

As the world is switching toward renewable energy, solar energy always appears to be the first topic for discussion. Solar power plant installation grows extremely fast globally, almost exponentially each year, resulting in massive amounts of waste from the end-of-life modules. There is currently no ideal technology to recycle such a complete module back into use, however, researchers have proposed many methods to recycle usable materials. Silicon is one of the valuable materials in solar cells which is worth recovering. The silicon wafers from the end-of-life cells were recovered using an etching method. The properties of the obtained wafers were investigated whether they are matching enough for the perovskite solar cell applications.

Keywords: Solar energy, Solar cell, Silicon, Waste recovery, Etching process

1. INTRODUCTION

As the global temperature keeps rising, the use of energies from fossil fuel resources is encouraged to avoid. In such issues, solar energy is considered one of the most suitable alternative energies, therefore, the installation of photovoltaic (PV) power plants is growing extremely fast [1]. In 2020, a total PV capacity of 760.4 GW was installed worldwide [2], while at the end of 2021, despite the covid-19 pandemic, the global PV installed capacity reached at least 942 GW [3]. Cambodia also stated the energy from solar power plants has increased to 15% of the total energy consumption [4]. These strongly show that the solar industries are growing in every corner of the world. This continuous growth results in huge amounts of disposal solar panels after they reached their lifetime limit. International Energy Agency Photovoltaic Power Systems Programme (IEA PPSP) has estimated in its annual report that the global cumulative waste from end-of-life solar panels (EoL) will reach 1.7-8.0 million tons by the end of 2030 and this figure will be increased up to 60-78 million tons cumulatively by 2050 [5]. For silicon wafer-based cells, the silicon wafer is the main material used in a light

absorption layer of the cell and it carries 60% of the cell cost. In addition, the energy consumption of silicon wafers manufacturing is extremely high [6]. As a result of the EoL cell waste, we can imagine the huge amount of recoverable silicon which increases together with the growth of PV installation. In terms of properties, several researchers claim that the recovered silicon wafers have identical properties (both physical and chemical) to those virgin-commercial wafers and can also be reused in new cell production or even other applications [6, 7]. One significant benefit of silicon recovery is sustainable waste management which provides a good impact on the environment. For these reasons, the silicon recovering process is required. Moreover, it is interesting to apply the recovered silicon-based materials for alternative energy applications, like perovskite photovoltaic cells.

2. RESULT AND DISCUSSION

The silicon wafers from the end-of-life cells were extracted using an etching method. The silicon cells were etched by dropping 10 M NaOH onto the back surface for 5 min at a temperature of 63°C to remove the back electrode (aluminium). The front electrode (silver) was removed sequentially by applying 6 M HNO_3 onto the silver surface for 5 min at a temperature of 70°C. The anti-reflection coating and emitter were removed using 90% phosphoric acid (H_3PO_4) for 45 min at a temperature of 70°C [8]. The layers inside the cells used in this work were a bit different from the reference works, so the concentration of the substances and timing were adjusted till the desired wafers could be obtained. The properties of the obtained wafers were investigated to see whether they are matching enough for the perovskite solar cell applications.

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The Challenges of Nuclear Power Plant Development in Indonesia: A Case of Thorium Power Plant in Bangka Island, Indonesia

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ABSTRACT

This research maps out the challenges of nuclear power plant development in Indonesia. This is based on the idea that nuclear power could play a vital role not only for energy transition but also to move away from fossil energy. Nuclear power generation is aligned with Program Area No. 7: Civilian Nuclear Energy of the APAEC signed by ASEAN member states and monitored by the ASEAN Centre for Energy. With the rising energy consumption in Indonesia, the nuclear power plant is a promising alternative for a country with 240 million population spread across archipelagic geography. Drawing on the case of the development of Thorium Molten Salt Reactor (TMSR) in Bangka Island, we aim to understand the social, political, and ecological challenges of the nuclear power plant development. We specifically map the public acceptance of nuclear power plants; the ecological impact, especially land use and nuclear waste management; and the politics of energy in Indonesia. We explore the political dynamics between local and national actors in the development of TMSR in Bangka Island and how it could provide an alternative for energy development. This research is based on a qualitative method that utilizes secondary data from online media and documents.

Keywords: Nuclear power plant, Socio-politics, Development, Challenges, Indonesia

1. INTRODUCTION

Indonesia becomes one the prominent countries in developing nuclear technology both in ASEAN and Global. Indonesia has been committed to developing its nuclear power plant technology since 2014 which resulted in the National Energy Policy and included the nuclear on it [1]. The country has greater experiences and infrastructure compared to other ASEAN member states. However, the long plan on nuclear development faces challenges which can determine the dynamic and the process of it. The research has identified three challenges related to development of TMSR and nuclear power in general Indonesia.

Public acceptance as vital legitimation in nuclear power plant development

One of the dominant issues against nuclear power plant development is its risk. People and media have not differentiated between the risk and the danger of nuclear power plants so that there is misinformation which leads to paranoia and a movement "Not in My Backyard". However, the scientists prove that the nuclear power plant would not be dangerous if we can operate and manage it properly [2]. A survey from Surakarta State University shows that over half of the community in Bangak Belitung province (73%) agree with the TMSR development project [3]. It implies that a more comprehensive and educative discourse is important in achieving the social acceptance in nuclear power plants development. Ensuring public acceptance is part of political negotiation in sustainable development, including for the nuclear power plants.

Political dynamic both from national and local actors

The high development comes with high political risk at the same time. Nuclear power plants development needs a significant investment. It is estimated that the TMSR development in Bangka Island needs around 17 billion [4]. Moreover, the nature of the investment can bring a dilemma internally and externally. Internally, the national development vision needs to adjust and coordinate with local governments. It aims to harmonize the national plan on energy transition. A little misunderstanding with the other government institution could lead to a big problem, especially if the nuclear issue is accommodated in the election process. Externally, the challenges may come from the society which sees the investors as the representation of global capitalism. That discourse is not something new for the Indonesian government. However, the government needs to mitigate the people's reactions regarding financial issues.

Ecological challenges on nuclear catastrophe and waste management

The TMSR development brings a technological breakthrough in nuclear power generation. Based on a molten salt fission reactor, the liquid fuel is more 'mobile'. The power plant is built on a floating hull. It gives the reactor multiple advantages compared to generic nuclear reactors. In terms of energy distribution, the floating reactor can be towed directly to the end-user. But the biggest advantage lies in its safety. Because it can be fully operational on water body at the sea, it can operate far from the proximity of inhabited areas. It can also withstand 1.0 g of earthquake and 200 m/s aircraft impact [5]. However, the fatal cases of Chernobyl and Fukushima are still highlighting the narrative of nuclear danger. In terms of

ecological impact, nuclear power plants have much less emissions compared to fossil-based power plants. Nevertheless, radioactive waste produced by nuclear power plants is inevitable, including TMSR. Instead of released to the nature or processed into less damaging substance, nuclear waste is stored. Therefore, there are extra expenses needed to develop a large-scale, long-lasting nuclear waste storage to make sure that the radioactive nature is isolated safely. Compared to uranium-based nuclear power plant, however, the challenge has the potential to be an opportunity. Thorium is generally much safer and easy to manage. Thorium has much less destructive capability due to its fissile nature. Also, radioactivity of thorium waste only lasts for 500 years compared to 10.000 years of radioactivity from uranium waste [6].

2. RESULT AND DISCUSSION

The development of nuclear power plants is not only urgent for national security but also for its society as well. The various discourse which out of the context leads to a wrong misperception on the nuclear power plant. To greener its energy, the government needs to keep up the social, political, and ecological harmonies at the same time. It is because the development of nuclear power plants is highly political which involves actors from various backgrounds and interests. In the end, the development of TMSR is not merely the government's achievement, but also as a political symbol in public acceptance that nuclear energy is safe and can solve the uneven power source in the Indonesian archipelago.

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Cost Saving Potential in Biomass Powerplant Operation by Fuel Switching in Northern Thailand

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ABSTRACT

In this work, a cost optimization model considering biomass and transportation as main parts of total cost was applied to a case study of a 9.4 MWe Phrae power plant in northern Thailand. Objective of this work was to evaluate if fuel switching would result in cost reduction. Originally, the biopower plant uses rice straws and husks solely as fuel. Several potential agricultural residues in northern Thailand within 70 km radius of the plant were considered for full or partial substitution of the current biomass fuel used. Linear programming was applied to several supplies in calculating the cost to the demand point, with transportation by 10 wheel-trucks. From the simulation, it was revealed that more than 50% of the power generated could come from corn residues while the rest was from rice straws. Total cost saving of almost 44% or about 1.11 million USD a year was potentially possible.

Keywords: Green investment, Energy economic recovery, Cost optimization, Power generation, Biomass & bioenergy

1. INTRODUCTION

In many countries, agricultural residues or wastes are usually generated in large amount. They can be harnessed for energy via various techniques such as densification, torrefaction, carbonization, fast pyrolysis, gasification, direct combustion. But, ultimately, power generation from residual biomass is probably the most desirable in striving towards climate change mitigation and sustainable development goals.

There are plenty of agricultural residues available in northern Thailand. Most biomass power plants usually use only a single source of biomass type. Utilizing other available agricultural biomass materials in place or addition to the main biomass fuel will help abate this problem. The objective of this work was to evaluate and demonstrate if fuel switching would enable cost reduction in operation of a biomass power plant.

2. METHODOLOGY

Biomass supply data in Thailand was from the most abundant agro residues consisting of sugarcane bagasse and leaves, rice straws and husks, maize leaves and stalks, oil palm fronds and empty fruit bunches, cassava peels and rhizomes, and rubber woodchips. Data in terms of amounts available and location is available. This information is from the Ministry of Energy. Calculation of biomass supply-to-electricity cost was based on biomass material and transportation costs from sources to the powerplant.

A case study of Phrae biomass power plant situated in northern Thailand was considered. At present, the power plant generates 9.4 MWe from using rice residues solely as fuel. The power plant was assumed to run 24 h a day, 330 days a year. A total annual generation of 74,450 MWh is expected. Potential biomass sources which were locally available in northern Thailand were considered. Limitation of maximum 20% supply from each source was set. In this work, derating in efficiency and maintenance cost were not taken into consideration.

3. RESULT AND DISCUSSION (including conclusion)

The Phrae biomass power plant is located at latitude 17.838524 and longitude 99.876165. Apart from rice residues, there was other potential agricultural residues (corn, sugarcane, and oil palm residues) available. Within 70 km radius of the power plant, there are 15, and 6 supply sources of rice residues (straws and husks), and corn residues, respectively, that can supply the power plant. Biomass to electricity potential and price for relevant agricultural residues were considered. Total biomass-to-electricity cost from the biomass cost and the transportation cost was considered and optimized using a linear programming technique. The amount of biomass required and the transportation cost from nearby biomass supplies to the power plant were examined based on the number of sources and energy requirement. The minimum total cost that was dependent on available biomass types, biomass cost, distance, and loading. It was apparent that the most valuable options for the biomass cost were rice straws, and corn residues, that are available around the power plant and gave the lowest cost per MWh. Our case study showed that a significant saving in the plant operating cost of almost 44% could be obtained.

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Revival of Nuclear Power in Philippines: Its Safety Design Feasibility using IVR-ERVC SAM Strategy

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ABSTRACT

This work included the safety feasibility of APR1400 for the revival of Bataan Nuclear Power Plant. Historical nuclear power context and motivation to pursue nuclear program in Philippines was briefly discussed. Most importantly, the passive cooling safety system feature of APR1400 was highlighted through Computational Fluid Dynamics (CFD) simulation of its natural convection. The severe accident progression upon uncontrollable molten corium relocation would be visualized by water cooling system in the annular boundary that would at least mitigate the increasing pressure imposed in the vessel; consequently, it'd prevent the rupture of structural integrity of pressurized vessel and its containment. Results show that, through Reynolds Averaged Navier Stokes turbulent convection, thermal hydraulic phenomena in the curved side wall of the reactor's lower plenum is in agreement with the experimental data. Less than 10% of error was yielded in all the simulation cases, thereby, paved way to integrate these CFD codes into the actual safety design code to be implemented in advanced power reactors.

Keywords: Nuclear Accident Management, Corium Retention, Passive Cooling Safety System, Numerical Simulation, APR1400

1. INTRODUCTION

As of 2022, Philippine government established a nuclear energy program to expand the country's power source. Two feasibilities are of given a great importance: (1) Revival of BNPP using South Korea's APR1400 design and (2) ROK's design of SMR, called SMART, in the site of Cagayan. Both of these designs adopt an IVR-ERVC, called In-Vessel Corium Retention through External Reactor Vessel Cooling, as a severe accident management (SAM) strategy to prevent vessel failure during the progression of corium in the lower plenum of reactor. The main objective of this paper is to estimate the heat flux distribution from the corium to

the external reactor vessel using the numerical analysis, that highly integrates the turbulent natural convection of oxide pool.

2. RESULT AND DISCUSSION

Despite several Reynolds-Averaged Navier Stokes (RANS) turbulence studies conducted in the past, the latest codes and appropriate models, which seem to have the potential to simulate turbulent natural convection phenomena, are rarely validated for high Ra' oxide pool scenarios. In this paper, both the flow and thermal behaviour under highly turbulent natural convection with internal heat source are numerically investigated, which also aimed to outline comparisons among the standard RANS models and the modified one that incorporated Algebraic Flux Model (AFM) [3] that are implemented in the chosen CFD solver. In relation to the experimental validation, the BALI test was a quarter-circular slice with radius of 2.0 m [4]. This internal heating study utilized a high Ra' of ~1016 in accordance of the volumetric decay heat input, with centre wall as adiabatic and top/side surface maintained at 273 K. Upon validating the experimental results, performance of RANS models used were compared, using the absolute temperature and heat flux profile.

The v2f model provided the most satisfactory agreement with the measured experimental data regarding the homogenous thermal region. Such model also slightly gave higher heat flux values in the stratified region, which are quite near to the measured data. Based on the report from BALI test case of top cooling, the heat flux was quite uniform over the top height (i.e., 60% of the depth) [3], which indicates that the transitioned boundary layer flow would appear at the depth of 1.2 m. Such finding is more likely suited with the heat flux profile of v2f RANS model. More so, the temperature profile of its modified version, v2f-AFM, has its steep temperature difference that separates the unstable and the stable stratified layer. However, the thermal thickness of unstable layer is overpredicted and yielded higher values as compared to other models due to solid ice formed in the bottom part of pool. On the other hand, the modified model gave further low prediction in its heat flux profile, but the flow separation of the downward flow along the curved flow is mostly distinguishable among the other models. While v2f-AFM is uniquely able to improve the flow separation phenomena existing in BALI test case, the dissipated heat flux to the top surface is still overwhelming with these coefficients, which makes the current RANS model impractical to use for this buoyant turbulent convection scenario under IVR-ERVC assessment.

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How much should Provinces Reduce Greenhouse Gas Emissions for the National Target Achievement? Lessons from Scientific Approach using GCAM-Korea

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ABSTRACT

Devolution is one of the key elements in response to climate change. As a role of local government has been emphasized in response to climate change, emissions reduction plans are established at provincial level. The provincial strategies are primarily for the achievement of the national target achievement. Then, how much should provinces reduce emissions? As an Integrated Assessment Model, GCAM-Korea, a version of GCAM with provincial level resolution of Korea, is selected in this study. NDC scenario is investigated. Based on the simulation results, this study points out potential problems that arise from the limitation of local government, and the unsettled calculation method for greenhouse gas emissions.

Keywords: Provincial analysis, Integrated Assessment Model, Greenhouse gas emissions, South Korea, NDC

1. INTRODUCTION

Devolution is one of the key points in response to climate change. As a role of local government has been emphasized in response to climate change, emission reduction plans are established at local level. In South Korea, metropolitan cities and provinces must submit the basic plan for carbon-neutral green growth to the Ministry of Environment (MoE) and the Carbon-Neutral Green Growth Committee under the framework act on carbon neutrality, green growth for response to climate crisis (hereinafter 'Carbon Neutrality Framework Act). For each province to set their emissions reduction target is two sides of the same coin. On one hand, as citizens' participation in building emission reduction strategies (e.g. emissions reduction target, energy and climate policies.) increases, a province is likely to set higher emissions reduction target [3]. Also, provincial competition for emissions reduction goals is a strong motivation for setting higher emissions reduction goals [4]. On the other hand,

considering economic loss possibly caused by efforts on emissions reduction, provinces have a disincentive to set higher emissions reduction target. Considering the two opposite motivations, it would be the best for provinces to be able to declare higher emissions reduction rate with expectation of the least efforts (i.e., least expenses) on the emissions reduction.

2. RESULT AND DISCUSSION (including conclusion)

Not surprisingly simulation results shows that electrification is essential for the achievement of the NDC. As shown in Fig. 1 (a), the share of electricity consumption increases from 22.9% to 28.0% during the period of 2018-2030. Despite of the increase in electricity consumption, the total energy consumption in 2030 is kept at the same level as the one in 2018, owing to the drastic decrease in coal consumption.

Replacement of fossil fuel with electricity is necessarily required to reduce emissions. It is necessary, nonetheless, to search which province has enough potentials for the substitution. Provinces, in which large-scale facilities for steelworks are placed, show the considerable electrification. For example, in JN and GB provinces the share of fossil fuel consumption decrease by 16 and 26 percentage points respectively during the period of 2018-2030 while the share of electricity consumption increase by 7.8 and 18.1 percentage points respectively during the same period as shown in Fig. 1 (b) and (c). On the contrary, populous provinces are likely to have relatively high electrification already. Those provinces show the slight energy transition. For example, in SU and GG provinces where 44.7% of the total population resides, the share of fossil fuel consumption decreases by 3.1 and 6.5 percentage points respectively during the period of 2018-2030 while the share of electricity consumption increase by 1.8 and 2.6 percentage points respectively during the same period.

Without the sizeable reduction of energy consumption, emissions could be reduced enough to achieve NDC target owing to electrification and cleaner power mix. Getting rid of the carbon-intensive energy sources in the energy system, simulation results show that industry and electricity sectors account for 91.3% of the total reduction in NDC scenario.

The reduction pattern could be directly represented in provincial views. Considering that coal-fired plants or iron and steel industries are clustered in the specific provinces, six provinces accounted for 89.0% of the total reduction. The top six contributing provinces to

the national emissions reduction, as shown in Fig. 4(a), are CN, JN, GN, GB, IC and GW provinces in descending order (w/o LULUCF sector). For example, in the CN province electricity and industry sectors account for 98% of its emissions reduction. On the other hand, in GG province those two sectors account for 50% of its emissions reduction.

It must be noted that a province is limited to make efforts on emissions reduction by electricity and industry sectors. For example, in electricity market KEPCO (Korea Electric Power Corporation), the public enterprise affiliated with MOTIE (Ministry of Trade, Industry, and Energy), and its six subsidiaries dominated generation, transmission, distribution and retail. And it is difficult for provinces to have decisive impacts on emissions reduction in industry sector.

Given that i) the industry and electricity sectors have a lot of emissions reduction potential and ii) provinces have the limitation to those two sectors for the emissions reduction, it is necessary to re-evaluate provinces' emissions reduction potential excluding industry and electricity sectors. Fig. 4. (b) shows provincial emissions reduction potential excluding electricity and industry sectors, which shows a sharp contrast with the emissions reduction pattern in Fig. 4 (a) (i.e. emissions reduction including all sectors). For example, the top three contributing provinces to the national emissions reduction would account for 61.1% of the national total emissions reduction in Fig. 4 (a), and 33.5% in Fig. 4 (b).

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Green Bonds in the Context of Cambodia

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ABSTRACT

This paper discusses, analyses, and focuses on Green Bonds in Cambodia. To prepare the long-term net zero engagement with the Government Ministries, Regulators, Private Sector, Institutional Investors and Stakeholders, Cambodia needs to promote and facilitate green financing development and solutions. The objective of the research is to analyse the gap between the Policy of Frameworks on Development of Government Securities objectives and the existing infrastructure and capacity in place. After several face-to-face interviews made in in Phnom Penh and some desk research, we have found that there are still some major challenges to be addressed to promote the Green Bond in Cambodia and to make it a success. These issues were mostly the same experienced at the earlier stage in Green Bond issuance, particularly in emerging markets, as referred to the research papers cited in our literature references from 2013-2022. The challenges in Cambodia are typical as those in developing country, however theses may be overcome by an enhanced policy framework, with consistent taxonomy and procedures aligned with international best practices and guidelines, an active and smooth collaboration among market participants, beneficial for the green bond issuance ecosystem, and the needed capacity building on technical features and implementation, to build trust and recognition of the Green Bond market.

Keywords: Green Bonds, ESG, SDG, ICMA, CBI, Bonds Issuance, Green Finance, Climate Finance

1. INTRODUCTION

The Royal Government of Cambodia (RGC) is committed to addressing the risks of climate change, meeting the Paris Agreement commitments, and achieving the Sustainable Development Goals (SDG). To achieve these goals significant financing must be directed to climate adaptation, mitigation, and SDG priorities. However, the government cannot do this alone; a range of traditional and innovative financing instruments must be leveraged, allowing for the mobilization of both public and private finance. The Government of Cambodia sees the issuance of Green Bonds as one financing mechanisms which can

support the achievement of these goals. The issuance of green bonds by both government and the private sector could play a crucial role in directing much-needed funding to activities to achieve the SDGs and reach the investment levels required to create low-carbon and climate-resilient communities. As to date, only 9 bonds have been issued in Cambodia since 2019, and mostly corporate bonds (banks, MFI, consumer, telecom) and none of them can be qualified as Green Bond.

The stakeholders are multiple in this nascent capital market: Policy makers, Issuers, Market facilitators, Financial Institutions, Public. And the challenges are well known by the participants: we still have excessive issuance costs, the length of the process to get bond listed is still behind international best practices, and we have a nascent regulatory framework which is getting gradually more consistent and soon be well-aligned with regional and international standards (ICMA, CBI). The other key challenge is the current pipelines of the Green Bonds in Cambodia which remain limited and not yet scalable, and some pipeline relies on private opportunities and demand or appetite of investors, rather than a pipeline driven by the government or a public-private partnership. Least but not last, the capacity building is a top-priority for the success of Green Bonds in Cambodia. Training, certification and public awareness are essential and will give more confidence for the market participants, especially issuers and investors, and will have likely a positive impact on the fixed-income appetite of domestic and foreign institutional investors.

2. LITHERATURE REVIEW

The Paris agreement adopted on 12 December 2015 in Paris by 195 countries (plus the European Union) also called the "Paris Agreement", aims to limit the adverse effects of climate change. The event opens debate on how to drive the planet towards a low-carbon future. The costs of climate change have been estimated by the Economist Intelligence Unit at the net present value costs of climate change at USD 4.2tn (Orsagh, 2020). Among several climate proposals, the Green Finance and Climate Finance have emerged since one of the most followed topics since. Nowadays, the "Green bond" issuance is growing fast, part of the overall trend of "do-good investments" becoming more popular ii. And according to CBI (Climate Bonds Initiative), the Green Bonds issuance is set to reach globally more than USD 1tn in 2022 (cumulative since 2007). The Green Bonds are also a part of the "Thematic Bonds" family. Thematic Bonds are fixed-income securities that highlight the issuer's environmental and social objectives, and commit funds to relevant activities, and are labelled as such

(Hussain, 2022). There are several different types of bonds available under the banner of "Thematic Bonds". And these bonds include, but are not limited to, green, social, sustainable, and SDG bonds (Martin, 2021).

For example, Green Bonds include Climate Bonds linked to climate mitigation, such as projects in solar and wind technologies that reduce GHG emissions, and climate adaptation, such as infrastructure projects to protect against flooding. At the same time, other types of Thematic Bonds have emerged in response to new challenges. The main difference is that Thematic Bonds are primarily for funding projects that generate environmental and social benefits (Martin, 2021).

The Green Bonds as well as Thematic Bonds, are common to fixed-income bonds. The section 2, will elaborate on difference between Green Bonds and Vanilla Bonds, offering predictable returns/yields for investors in the form of a fixed coupon in exchange for medium to long-term funding.

In 2022, the global issuance of all types of Thematic Bonds including Green, Social, Sustainability, and Sustainability-Linked Bonds is expected to reach a new cumulative record amount of USD 1.5tn (CBI, 2022). And the Green bonds will take the lion's share. The Green Bonds are increasingly a prominent instrument in sustainable finance. The Green Bonds initially emerged in 2007 (Fatica et al., 2021) and the market has expanded since (Tang et al., 2018), rapidly, and recently reached the milestone of USD 1tn of Green Bonds issued globally (more than 66% of the total of thematic bonds).

The Green Bonds are also expected to see new record issuance volumes in 2022 (CBI, 2022), maintaining their position as the dominant Thematic Bond Category [iv]. In the past decade, Sustainable Finance Initiatives in the ASEAN region have become quite dynamic market with the growing launch Thematic Bonds to finance numerous projects across the region. Mobilizing private finance for renewable energy and energy efficiency is critical for Association of South-East Asian Nations (ASEAN), and it is not only for the reduction of global temperature, but also for meeting fast-growing energy demand (Azhgaliyeva et al., 2019).

When we talked about Thematic and Green Bonds, we also have to refer to two international certification mechanisms, which are currently available to any issuers who wish to issue Thematic Bonds:

- The Climate Bonds Initiative ("CBI") and
- the ICMA (International Capital Market Association)'s Green Bond Principles ("GBP")

Both serve as gatekeepers to assess the eligibility and credentials of Green Bonds (Clifford Chance et al., 2022). For instance, the CBI and ICMA have developed their own taxonomies for setting out a Green Bond, beside ADB, World Bank-IFC and the United Nations.

The CBI was launched in 2009 by the Network for Sustainable Financial Markets and is supported by the Carbon Disclosure Project. It is an international not-for-profit organization focusing on mobilizing the bond market for climate change solutions. In 2010, to drive down the cost of capital for climate change projects and grow aggregation mechanisms for fragmented sectors, CBI launched the Climate Bond Standard and Certification Scheme ("CBSC Scheme"), which serve as a fair trade-like labelling scheme for bonds. The CBSC Scheme is used globally by bond issuers, governments, investors and the financial markets to prioritize investments which genuinely contribute to addressing climate change.

GBP – The GBP were produced in 2014 collaboratively by capital market intermediaries, issuers, investors and environmental organizations under the ICMA leadership. The GBP were set to encourage more transparency and uniformed disclosure from the issuers and promote integrity in the Green Bonds market by laying out recommended rules for each step of a Green Bond issuance. The GBP, which are annually updated by ICMA, are divided into the following four components: (1) Use of Proceeds; (2) Process for Project Evaluation and Selection (3) Management of Proceeds; and (4) Reporting (Martin, 2021).

Beside the Green Bonds Principles (GBP) which outline the best practice when issuing bonds serving social and/or environmental purpose, however beside (GBP)vi, ICMA also oversees and helps to develop:

- Social Bonds Principles (SBP)vii
- Sustainability Bonds Guidelines (SBG)viii
- Sustainability-linked bonds Principles (SLBP)ix

Social Bonds fund projects that address or mitigate a specific social issue and/or seek to achieve positive social outcomes, such as improving food security and access to education, health care, and financing, especially but not exclusively for target populations.

Sustainability Bonds fund projects with both environmental and social benefits. They usually finance a mix of green and social projects. And the Sustainability Bonds are any type of bond instrument where the proceeds or an equivalent amount will be exclusively applied to finance or re-finance a combination of both Green and Social Projects.

Sustainability Linked-Bonds refers to the Sustainability-Linked Bond Principles, this refers to "any type of bond instrument for which the financial and/or structural characteristics can vary depending on whether the issuer achieves predefined sustainability or (environmental, social, or governance) objectives. Sustainability-linked bonds are a forward-looking, performance-based instrument and are aligned with the Sustainability-Linked Bond Principles." (With linkages to Sustainability Performance Targets or SPT and associated Key Performance Indicators or KPI)

In this report, we focus mainly on Green Bonds and look at some industry case studies of several broad categories of Green Projects. The Green bonds are a nascent but fast-growing fixed income asset class that are issued by governments, corporations and other institutions used to finance environmental and climate-friendly projects, such as renewable energy, recycling and green infrastructure (Gilchrist et al., 2021). And in global practices, the ICMA Green Bond Principles, are currently adopted by 95% of issuers (IFC, 2022).

The green bonds still need to face some challenges and will drive new opportunities:

- Research has discovered that environmentally responsible practices not only enhance shareholder value but also the value accrued to nonfinancial stakeholders (Gilchrist & Zhong., 2021).
- Furthermore, green bonds allow investors to fulfill their environment, social and governance concerns and mandates by allowing for climate-aligned investments. This "bonus" moral or green factor is what currently sets the market apart from its traditional counterparts (Weber & Saravad, 2019)
- However, a major concern among practitioners and investors relates to the so-called 'Greenwashing,' (Blecker-Olsen & Potucek, 2013), whereby companies purport to engage in green investment in order to attract impact-oriented investors while in practice engaging in investment that has little environmental value (Grene, 2015; Fatica & Panzica 2021)
- Taxonomies can play an important role in scaling up sustainable finance (Ehler et al., 2021). A solid and consistent Cambodian Green Taxonomy aligned with EU, BIS, ASEAN, UN and

international organizations could facilitate the bonds issuance process and reduce risk of Greenwashing,

• While widely recognized by financial professionals; however, little is known about the convenience of green bonds for corporate and non-corporate issuers, and most important driver in investment decisions is the funding cost (Gianfrate & Peri, 2019) and the "Greenium" Effect (Loffler at al., 2021). The Greenium is basically the premium over green bond prices, i.e., the spread between green and non-green bonds of the same issuer. (Larcher & Watts, 2020)

In order to boost the green bonds industry, some significant recommendations have been proposed (but not limited) in terms of certification, disclosures, governance and capacity building:

• A proper certification by independent third parties (SPO), is an important governance mechanism in the green bond market (Flammer, 2022) and has a potential impact on public policy framework.

• All corporates and financiers must also use a standardized reporting format on climate risks (as set out in the TCFD or SSAB-ISSB recommendations (Burgess & Walker, 2017)

• (Bhattacharyya, 2021) also emphasizes on the importance of financial disclosures and the role of regulators and investors in strengthening the green finance schemes

• The governance will also be a key issue. And a solid governance framework on green bonds can contribute to long term sustainable development to ensure that the green bonds market matures with integrity, weaknesses in governance structures must be addressed (Berensmann et al., 2018).

• Education is also a must. Investors need to continue to educate themselves about climate change in order to provide clients with the climate-related analysis they deserve. (Orsagh, 2020). Financial markets will play a major role in those disruptive changes and practitioners, policymakers, and scholars are converging in stressing how crucial the support of finance is in delivering an actual and timely transition to a low carbon economy (Gianfrate & Peri, 2019)

Also, last but not least, the inclusion of ESG and SDG Goals criteria will be critical as: issuing size, maturity and currency do not have a significant influence on differences in pricing, but industry and ESG rating (Hachenberg & Schiereck., 2018).

3. HYPOTHESES

In this qualitative report (no statistical samples and hypotheses), we focus mainly on Green Bonds principles and best practices in Cambodia, and their stakeholders and we also look at some industry case studies of several broad categories related to past Green Projects in ASEAN (Thailand, Vietnam).

4. METHODOLOGY

The research framework and methodology include initial data collection tools and instruments (corporate bonds feature analysis, regulatory framework) and also interviews of key players in Cambodia from academics, investment advisers (underwriters), issuers (corporates), auditors, technical experts, media, green project owners, non-governmental organizations and also regulators (NBC, SERC, MEF). Secondary data sources will also use the literature review from international organization (IFC, World Bank, UN and ADB), and the practical case studies from real life situation, based on experience and interviews with Cambodian professionals (such as underwriters: Yuanta Securities, SBI Royal Securities and RHB Securities).

Th interviews have been done in Cambodia though different format: online or/and physical or conference/workshop. We also paid some courtesy visit with Regulators, some International Organizations and met several private sectors for Q&A sessions with high-level specialists. Here below, the list of our interviews (the questionnaire template could be found in the appendix C):

- The MEF or Ministry of Economy and Finance (ACR, Public Management Debt)
- The NBFSA (Non-Bank Financial Services Authorities) in charge of SERC (Securities Exchange Regulation of Cambodia) and CSX (Cambodian Securities Exchange)
- Several SPO (Second Party Opinions) Experts/Assurance approved by SERC/CSX such as Audit companies (KPMG, EY, Deloitte)
- And the top-tier Underwriters in Cambodia, we met CEO of respectively Yuanta Securities, SBI Royal Securities and RHB Securities, the three main underwriters in Cambodia
- The Rating agency: (ex Standard & Poor, Fitch) and specifically the new domestic rating agency: RAC (Rating Agency of Cambodia) recently approved by SERC.
- And also, some Tax and legal advisory such as VDB Loi and experts on Bond Tax Incentives

- However, in terms of ESG compliance services providers, we don't have any relevant local ESG and the international ESG-SPO (EY, Deloitte, Sustainalytics-Morningstar, Bureau Veritas, others…) are more active in Vietnam, Thailand, Malaysia and Singapore.
- The Cambodian media provides also some resources with Bond/Securities articles form the Cambodian Investment Review, The Phnom Penh Post, and Khmer Times.

The paper is divided into two parts:

(1) The first section examines policy and regulatory issues to be addressed for the effective operation of a green bond market in Cambodia including market standards (ICMA, CBI Principles) for all issuers (government and corporate). This section will describe different international and regional standards and key elements within these standards, and how Cambodia should be aligned with.

(2) The second section analyses the process and best practices for a green bond issuance (pre-issuance & post-issuance) in Cambodia, based on the current context in the capital market including key barriers and challenges to existing corporate bonds. This section also looks at benefits /costs of issuance in the current context (Underwriting, Legal, Audit, SPOs). It lastly compares the processes and procedures and recommend best practices for green bonds issue.

In final, the research is not able to analyse all the current pipelines of the Green Bonds in Cambodia, because some are mostly relying on private opportunities and demand of investors, rather than a pipeline driven by the government. Therefore, some information of ongoing corporate green bonds will or must remain limited or confidential.

Also, the ongoing process of issuing the first government bond in Cambodia, may add further updated information and may have implication the revised framework and appetite of investors and as well on the Green Bonds issuers side and Investors as well. Additionally, ESG and SDG Goals criteria will be explored but not elaborated in a section, some references will be in the appendices.

We will examine the current context in the bond market in Cambodia including key barriers and challenges to bond issuance as well as possible benefits of issuance. The research will try also to identify all institutional actors/investors and key stakeholders' landscape in Green Finance, searching who/what are the specific actors in Cambodia promoting Green Bonds and Green Finance Initiatives? What is the policy-making landscape and what implications for policies to the domestic and international actors (issuers, underwriters, investors)? What

could be the limits and challenges of Green Financing Regulatory Framework? What are the current taxonomies for Green Bonds currently used or implemented in/by the government? What is the pipeline and plan in targeting Green Industries? What is the current situation for reporting and/or disclosure requirements, related to social and environmental performance (voluntary based on guidelines of TCFD, ISSB)? What would be the barriers and opportunities for the securities industry and the private sector? And what would be the need in capacity building, in order to have a stronger and attractive Green Finance in Cambodia?

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Just' Access to Electricity: Energy Justice in Indonesia's Rural Electrification (LISDES) Program

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ABSTRACT

The monolithic system in Indonesia's electricity framework has raised questions about whether such a system has sufficiently achieved "just outcomes" in one of the dominant national policies and programs in the country's electricity sector: the rural electrification (LISDES) program. Using the three core tenets, three categories of energy injustice were identified: distributive injustice, procedural injustice, and recognition injustice. In terms of distributive injustice, unequal income to pay electricity bills, uneven geographical conditions, and unequal distribution of the population were identified as the key elements that hinder the equal distribution of the costs and benefits of the LISDES program. Regarding the procedural injustice, inadequate access to information regarding the problems and solutions for the program; lack of meaningful participation of subnational actors; and lack of a comprehensive law and regulatory framework in place to protect private sectors in the program were detected as the key elements that handicap a representative and impartial decision-making process in the program. Lastly, a lack of understanding of the various meanings of electricity as the key to the public welfare and non-recognition of distinctive socioeconomic characteristics in various locations in Indonesia are the key elements of the rural communities that have been overlooked by the program.

Keywords: Rural electrification, Indonesia, energy justice, electricity poverty, Energy policy and planning, social intervention and community development in energy and environment

1. INTRODUCTION

Problem definition

Despite a growth rate of electricity access in Indonesia of approximately 8% per year, increasing demand for electricity remains challenging to meet (Malik, 2021). This situation presents numerous challenges. For example, eight out of thirteen electricity systems in Indonesia have negative reserve margins, forcing many regions, including Kalimantan and most areas in Eastern Indonesia, to tolerate daily rolling blackouts (Maulidia et al., 2019).

This example of poor electricity access in Indonesia has indicated an unequal distribution of costs and benefits in electricity services. Furthermore, the government gives a mandate to the state electricity company (PLN) to control the national electricity from power generation to electricity distribution (van Bommel & Höffken, 2021). This arrangement raises the question of whether the decision-making process in Indonesia's electricity sector is representative and impartial. As one of the country's dominant national policies and programs in the electricity sector, it is unclear in what way and to what extent the LISDES program has achieved "just outcomes." (Winrock International, 2007; Vannucchi, 2020). It has been argued that this situation is exacerbated by the fact that the concept of "justice" has received little attention when it comes to the electricity system, particularly in a developing country such as Indonesia (Milchram et al., 2020).

Objective

This study is to help examine energy injustices that emerge from the LISDES program by assessing the extent to which core tenets of energy justice are observable in the program.

Research questions

(i) Which narratives of energy justice have been prevalently in the LISDES program?
(ii) What are the perspectives of the key actors on the energy injustices that emerge from the LISDES program?
(iii) In what way and to what extent the LISDES program has improved the access to electricity in the rural communities in Indonesia?

2. METHODOLOGY

Qualitative research was applied in this study to focus on understanding the situation of Indonesia's rural electrification program through textual descriptions and key actors' perspectives, without making strong claims about generalizability to other cases (Setyowati, 2021; Emonds & Tamas, 2021). In this thesis, document analysis and semi-structured interviews were conducted to collect facts and perspectives related to the LISDES program. In total, there were six documents analysed and seventeen interviews conducted in this study. The collected data were then analysed using the core tenets of energy justice to examine 'energy injustices' that emerge from the LISDES program.

3. RESULT AND DISCUSSION (including conclusion)

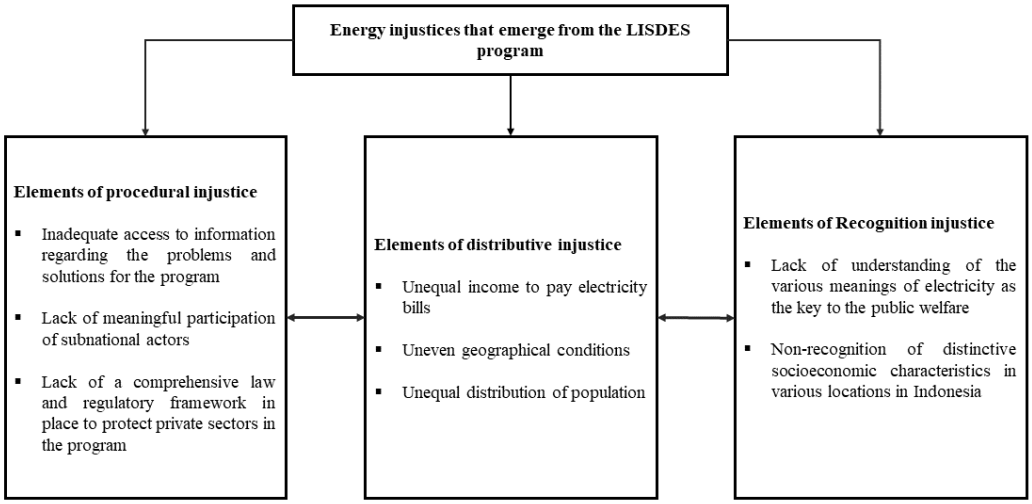

Figure 1. The elements of energy injustice that were identified in the LISDES program (Author, 2022).

Providing electricity access at an affordable price throughout Indonesia becomes the narrative that the LISDES program frequently employs in its implementation. Powered by such a narrative, electricity accessibility and price affordability become two major aspects of the program. Unfortunately, these factors have led the program to prioritize the expansion of PLN electricity rather than small-scale off-grid solutions, which may not be feasible in most remote and isolated areas of Indonesia. Furthermore, such a narrative has also incentivized the program to tend to choose "cut corners" in the program's construction of the physical infrastructure. Choosing quantitative targets over quality electricity, the program is frequently built by inexperienced contractors using low-cost infrastructure. Therefore, components' damage and stalled projects are frequently observable from the program. As for the repercussions of such a narrative, a lot of issues emerge from the LISDES program. These issues are not new discoveries, but rather long-standing issues that impede "just outcomes" in the program. In Figure 1, the issues in question were reframed as energy injustices to make them more visible. These issues are divided into three categories: distributive, procedural, and recognition injustice. The elements of distributive injustice delineate why electricity poverty remains evident in the program. It is because the elements of distributive injustice are highly correlated with the five aspects of electricity poverty:

electricity costs; income; electricity efficiency; individual electricity needs; and climatic conditions (Bagnoli & Bertoméu-Sánchez, 2022). When it comes to procedural injustice, the three elements identified in Figure 1 represent the collective issues that lead the program to focus on maximizing short-term quantitative outputs rather than on the long-term outcomes and the developmental impacts (Derks & Romijn, 2019). Lastly, recognition injustice. The failure of the program to incorporate the distinctive socioeconomic characteristics of rural communities shows that the program has devalued the needs and aspirations of the communities in favour of focusing on the program's accomplishments: the electrification ratio and the ratio of electrified villages. Lastly, multiple interpretations of electricity as the key to public welfare, ranging from mere options to survival determinants, are commonly disregarded in the program, resulting in the LISDES program becoming underutilized. Drawing from the elements of energy injustice as described in Figure 1, the LISDES program has not achieved "100% electrification" as described by the program's indicators: the electrification ratio and the ratio of electrified villages.

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Environmental, Social and Governance Policy & Sustainable Forest Management

Flow Simulation in Stung Sen River Using SWAT Model Forced by the Large-Ensemble Climate Simulation

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ABSTRACT

The historical hydrology flow is a significant data that is required for watershed model simulation including water quantities and water quality assessment. The purpose of this study is to apply a watershed model, SWAT model to assess the hydrology flow in the Stung Sen River under the force of the large ensemble climate simulation, d4PDF database. The calibration and validation of SWAT model in daily time step received a good statistics indicator (0.8 of NSE, 0.82 of R2, -0.90 of Pbias for model calibration from 2000-2010 and 0.8 of NSE, 0.81 of R2, -7.39 of Pbias for model validation from 2011-2016). The calibrated model was then applied to perform with the d4PDF data, 100 simulations (m001-m100) historical climate data from 1951-2010. The result shows that among 100 simulations, only 7 simulations received a statistic performance indicator value. The climate model forced simulation m037 received the best performance indicator among others, with the statistic indicator value 0.56 of NSE, 0.73 of R2, and -34.48 of Pbias. The result also found out that the climate model forced simulation flow is overflow the observed flow data, however the graphic line chart of both observed and simulation flow have a good pattern and timing.

Keywords: Historical flow, Historical hydrology, SWAT, Watershed model, d4PdF

1. INTRODUCTION

Cambodia is a developing country and had passed through several wars, especially the Khmer Rouge Regime which resulted in most rivers missing and losing several necessary baseline data from the past such as hydrologic and climate data for conducting watershed management or flood risk assessments [3]. Whereas flow is essential hydrologic data that use to practice in watershed model simulation, natural disaster event forecasting, and prediction such as flood and drought [1]. This study aims to examine the hydrological flow simulation forced by the large-ensemble climate simulations of Stung Sen River, one of the largest tributaries of the Tonle Sap Great Lake in Cambodia. The objective of the study is

divided into two parts; first is to set up a Soil and Water Assessment Tool (SWAT), SWAT model simulation (1995-2016), and then process a manual calibration and validation. The second is to apply the Database for Policy Decision-Making for Future Climate Change (d4PDF), a large-ensemble climate simulation that assigns to assess the risk of climate change [2], to the force SWAT model in the historical run period (100 simulations from 1951-210). The output of this study is a simulation of historical flow data in Stung Sen River that can be beneficial for different studies related to sediment, nutrient load, drought, or flood analysis in the river basin. Furthermore, the historical hydrologic data is significant for further study related to the watershed management, hydrologic process, water quality, and quantities within the catchment.

2. RESULT AND DISCUSSION (including conclusion)

SWAT is a watershed model that is designed to predict the influence of land management on watersheds including water quantity and water quality, and hydrologic processes within a catchment [4]. Calibration and validation are the required processes to evaluate the accuracy of the model before applying it to simulate the actual hydrological phenomena [5]. The statistical performance between simulation and observed flows from the daily calibration (2000-2010) and validation (2011-2016) received a good range of statistical indicators, such as 0.8 of NSE, 0.82 of R2, -0.90 of Pbias, and 0.8 of NSE, 0.81 of R2, -7.39 of Pbias, respectively. Figure 1 demonstrates the calibration hydrographs of the observed and simulated stream flow with daily rainfall time series from 2000 to 2010, and those of the validation period from 2011 to 2016. It is evident that simulation-based overestimates the observed flow in both calibration and validation period, however, it shows a good pattern and good timing between the two curves. After obtained a well-calibrated SWAT model setup, the 100-ensemble simulations of d4PDF historical climate data are applied and the result showed that among 100 simulations, only 7 simulations are considered a good performance. Among these 100 simulations, the climate model forced simulation (CMFSim) m038 has the best performance simulation with the values of statistic indicators of 0.56 NSE, 0.73 of R2, and -34.48 of Pbias, respectively. From Figure 1, the CMFSim-m038 has a good pattern with the simulation-based and observed flow, even though the discharge from the simulation m038 obviously overestimates the simulation-based and observed flow. In contrast, CMFSim-m017 has the most unsatisfied performance among the 100 simulations with -1.04 of NSE, 0.48 of R2, and -113.46 of Pbias, respectively. The hydrograph also verifies that the CMFSim-m017 strongly overestimates the other simulated flow and observed flow,

while the rainfall-m017 also obviously has the most peak rainfall among others. Especially in the middle of 2006, its rainfall and flow are about six times higher than the others. Besides, the ensemble means of the 100 CMFSim received a satisfied value of NSE (0.5) and a good R2 of 0.78, but an unsatisfied Pbias value, -48.83. Moreover, the ensemble means of the 100 CMFSim graph in Figure 1 clearly shows that it has a good pattern and timing with the simulated-based flow, but undoubtedly overestimates the simulated-based flow. Considering the lack of data and error from the baseline data such as precipitation, temperature, and observed flow, the result of this study is acceptable and can be applied for further analysis.

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Impact of Electric Vehicles toward Energy Reliability of the Jawa-Madura-Bali Electrical Power System

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ABSTRACT

There is an observed limitation in the number of electric vehicles using battery as power source (e.g., plug-in electric vehicle) in Indonesia. However, the number of said electric vehicles is increasing in response to the government commitment to shift the transportation energy source towards electric energy for a more sustainable environment.

Keywords: Reliability, Electric vehicle, Power integration, Energy systems modelling, Jawa Madura Bali

1. INTRODUCTION

With the increased number of electric vehicles that requires high energy capacity, an inevitable impact on the current electric network and infrastructure will surface. These impacts include the increase in electricity needs and dynamism.

Lessons learned from other countries have shown that the adaptation of electric vehicle and rooftop PV that happens in a short span of time creates an imbalance in the supply-demand energy, such as the deficit/surplus of energy or the duck curve phenomena. Not only there is an urgency to prevent the negative effect of said phenomena, but there is also a need to prevent financial loss that will influence many sectors, such as power generator and electric energy distributors.

2. RESULT AND DISCUSSION (including conclusion)

The Jawa-Madura-Bali system is an independent system that should become the focus to develop an adaptive infrastructure in Indonesia. Analysis of the readiness of this system can be a learning lesson for other independent electric power systems.

Therefore, this paper aims to prepare the Jawa-Bali energy power in anticipating the increased need of power for electric vehicle. The study will begin with data collection, followed by a dynamic simulation of electricity need from the 'demand' perspective. Then, the data will be compared to the change in the amount of electricity supply (e.g., renewable

energy sources such as rooftop PV). Finally, a conceptualization of management plan for the energy system to mitigate the imbalance of supply and demand of electric energy supply will be developed.

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Decarbonization Program through an Implementation of 411 kWp OFFGRID PV Rooftop in Reducing GHG Impact in Muara Karang Combined Cycle Power Plant

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ABSTRACT

The Indonesian government commits to reducing greenhouse gas emissions in accordance with the Paris Agreement to the Nations Framework Convention on Climate Change. Indonesia targets to reduce GHG emissions by 29% by 2030 with business as usual and 40% with international assistance. Through PT PJB Muara Karang in Jakarta, we have operated PV Rooftop with total capacity of 411 kWp which is one of the renewable energy sources. The solar plants have been installed on the roof of an office building aimed at own-used. Calculation of the reduction of greenhouse gas emissions uses the reference CDM AMS I.D Version 18.0. By using this method, the reduction in greenhouse gases is 154,634.51 kg of CO2 from 2021 until 2022. Based on a life cycle assessment (LCA) study of PJB Muara Karang, global warming is one of the hotspot impacts that significantly occurs in power plants. Thus, PV constructing is one of the programs to tackle GHG impact. This program can generate 411,839.7 kWh of electricity by doing so it can decrease the global warming impacts from 201,389.63 kg of CO2to 46,755.12 kg of CO2. With all that benefits, therefore, PV Rooftop in the future can be a solution for Decarbonization Program.

Keywords: Life cycle assessment, Just energy transition, Social intervention and community development in energy and environment, COP26 implications, Climate and energy policies nexus

1. INTRODUCTION

The Indonesian government shows its commitment and participates in reducing home gas emissions where this has been stated in the Republic of Indonesia Law no. 16 of 2016 concerning the ratification of the Paris Agreement to The Nations Framework Convention on Climate Change with international assistance. On the other hand, Indonesia is committed in the RUEN to increase the national energy mix with a target of 23 % from New and Renewable Energy by 2025. The Ministry of Energy and Mineral Resources launched a de-

dieselization program in 2020 to contribute to reducing fuel imports and help control the target national energy mix.

Solar Power Plant (Solar PV) is a power plant that uses renewable energy sources. The application of the PLTS system can be off-grid which is not connected to the transmission network or on-grid which is connected to the transmission network. The application of PV Rooftop off grid systems is used to use energy from the PLN network and reduce carbon emissions in generating activities. Currently, there have been many off-grid PLTS implementations on the roofs of office buildings aimed at using their own energy, reducing carbon emissions, and utilizing the open space on the roof of the building. To achieve the 2 °C target set in the 2016 Paris Climate Accord; feasible, clean, and renewable needs to be carried out in stages to efficiently eradicate global GHG emission sources, for this reason PT PJB UP Muara Karang in its commitment has built a PV Rooftop which will be installed in power plants with a capacity of 411 kWp in 2021.

2. RESULT AND DISCUSSION

This program can achieve a reduction in greenhouse gases is 154,634.51 kg of CO2 from 2021 until 2022. Based on a life cycle assessment (LCA) study of PJB Muara Karang, global warming is one of the hotspot impacts that significantly occurs in power plants. Thus, PV constructing is one of the programs to tackle GHG impact. This program can generate 411,839.7 kWh of electricity by doing so it can decrease the global warming impacts from 201,389.63 kg of CO2to 46,755.12 kg of CO2. With all that benefits, therefore, PV Rooftop in the future can be a solution for Decarbonization Program.

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Achieving COP26 Energy Transition Goal: The Status Quo and the Future of Renewable Energy Investment Incentive in Indonesia

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ABSTRACT

The noble action of mitigating climate change effect has been manifested through the ways of energy transition. Conference of Parties 26 (COP26) has aimed to support energy transitions by pushing for doubling the investment in renewable energy sector and adopting policies to ease renewable energy investment. Indonesia as one of the members for COP26 have also committed for reaching that goal. Indonesia currently has adopted policies to increase investment in renewable energy such as mandatory policies and fiscal policies. However, as renewable energy target role is aimed to increase by 23% in 2025, Indonesia needs to push harder to innovate incentive policies in renewable energy. The plan of enacting New and Renewable Energy Bill, establishment of Energy Transition Mechanism and Renewable Energy Fund are the future of renewable energy incentive in Indonesia which could help to reduce investment risk in renewable energy sector. This paper will establish the policy review of current renewable energy mechanism in Indonesia, as well as to provide the analysis over the future of renewable energy incentive in Indonesia to reach the energy transition goal of COP26.

Keywords: COP26, Renewable Energy, Investment, Incentive Policy, Indonesia

1. INTRODUCTION

Energy transition has been recognized as one of the most important steps to mitigate climate. Stipulated under Paragraph 20 of Glasgow Climate Pact, nations of the world are encouraged to adopt domestic policies which fasten the development and deployment of clean power generation [1]]. Conference of the Parties (COP26) has also allocated special attention towards energy transition through the establishment of Energy Transition Council (ETC). ETC acts as a special forum between governments, industry, investors, workers, and civil society to accelerate the transition to clean power [[2]]. One of the ambitions that ETC aims are doubling investment rate in clean power by 2030 and developing of policy and regulatory frameworks to attract the private sector finance renewable energy investment

needs [[3]]. These commitments are signed by 21 countries, including the Republic of Indonesia promise to increase new and renewable energy role in national energy mix by 23% in 2025 [4]]. To achieve such target, Indonesia requires a total of US$72.5 billion of investment in renewable energy sector [5]]. Investment plays an important part to finance assets for renewable energy project [[6]]. Tyson argues that while the funding for renewable energy project exists, lenders tend to hold their investment due to the lack of project`s bankability [[7]]. According to Zhu and Chua, bankability is the ability for a project to yield optimal returns which involves fair risk allocation [[8]]. Egli notes that most of risk in renewable energy investment are associated with lower revenue caused by volatility in energy policy, power pricing and inaccurate resource prediction [[7]]. Moreover, Hanan maps out that in the context of Indonesia, geographic barriers, complex technological applications, and huge up-front costs could also add more risk of renewable energy investment [[9]]. To address such problems, Van de Putte explains that Governments have a variety of policy tools available to de-risk renewable energy projects [[10]]. There are at least two policies to de-risk and to incentivize renewable energy investment, which are the mandatory policies and fiscal or financial policies [[11]]. This research employs a policy review methodology which is conducted through an analysis of Indonesian energy policy that could contribute towards de-risking renewable energy investment. The study of policy will assess the adequacy of current energy, market and fiscal policy that could incentivize renewable energy investment in Indonesia as a commitment to COP26. The result of this paper is aimed to analyse laws and regulations that could be invoked by the investor to ease renewable energy investment and for future policy improvement by the Indonesian government.

2. RESULT AND DISCUSSION

Energy sector in Indonesia is categorized as a highly regulated market. Thus, laws and regulations play an important role to design energy policy in Indonesia. According to IEA, there are two important incentive policy to attract renewable energy investment, mandatory policy and fiscal policy.[11]

Mandatory policy for renewable energy in Indonesia has been designed to increase renewable energy role in the national energy mix from the year 2020-2050 through National Energy Policy (NEP). Indonesia has also implemented mandatory PPA for State Electricity Company (PLN) to buy electricity from renewable energy IPP [12]. This policy has reduced

market-access risk, as they provide integration of power generation and national grid [13]. However, these regulations are regulated under the instrument of Ministerial Regulation, a lower legal instrument which is not the product of national legislation and exposed to political risk as they are prone to be amended through a minister political decision. To reduce such risk, New and Renewable Energy Bill (NRE Bill), is currently proposed by the House of Representative (DPR) and the Government of Indonesia to provide strong legal basis from business conduct of renewable energy in Indonesia. The NRE Bill also contains newer mechanism to increase IPP role in providing power generation through assignment mechanism, which would grant them with government compensation [14].

Fiscal incentive is a policy that aimed to reduce power generation costs [15]. Current fiscal incentive on renewable energy in Indonesia provides tax facilities such as 30% corporate income tax reduction for six years, accelerated amortization and reduction of dividend income tax for foreign investors [6]. Financial service institutions are also obliged to make sustainable investment portfolio in eco-friendly sector which includes low-emission energy generation [17]. However, this obligation heavily relies on self-assessment mechanism which provides financial service institution freedom to invest or not invest in renewable energy sector. Another form fiscal incentive such as subsidized loan is currently limited for the geothermal sector through geothermal resource risk mitigation facility. Although Indonesia has provided fiscal incentive, ADB notes further fiscal incentive for renewable energy is difficult to scale up [7]. To solve this problem, Indonesia has implemented Energy Transition Mechanism (ETM) and proposed the establishment of the Renewable Energy Fund (REF) through NRE Bill.

ETM is an agreement made by the Republic of Indonesia, Philippine and ADB. ETM will explore the financing possibility for the coal power plant and clean energy transition [18]. Indonesia has selected PT Sarana Multi Infrastructure (PT SMI), a project financing state-owned enterprise, to become the legal platform of the ETM [19]. The funds directed to PT SMI from ETM could be used to reduce loan interest rate, considering that PT SMI has high interest of 6.9%-9% interest rates p.a. and there is no loan subsidy mechanism provided by the government. REF on the other hand is a specific fund that would be cultivated by the Ministry of Finance (MOF) and projected to fund renewable energy infrastructure, incentives, compensation, research and development, human resources development and subsidy [8]. REF will be sourced from the national budget, regional budget and other sources such as carbon trade and grants [9]. REF is also projected to incentivize the energy transition of fossil-

energy company that has diversified their renewable energy portfolio [10]. The sectoral funds in Indonesia have been widely implemented to boost the performance of specific sectors such as palm oil fund, education endowment fund and environment fund. REF mechanism has also been implemented to grant and/or co-finance renewable projects and reduce budget risks such as in Malaysia, Scotland, and Vanuatu.

3. CONCLUSION

Indonesia commitment to provide better climate for renewable energy investment is currently provided through mandatory and fiscal policies such as mandatory energy mix, renewable energy PPA, tax facilities and subsidized loans. However, innovation need to be made to de-risk and provide better bankability for renewable energy investment. Future policies such as enactment of NRE Bill, assignment for IPP, ETM and REF to address difficulty in scaling up fiscal incentive that could incentivize investor to direct their investment towards renewable energy sector to fulfil COP26 ETC goal in renewable energy sector.

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Maximum Demand Reduction (MDRed) Modelling using MATLAB Stateflow®

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ABSTRACT

Based on several energy-based case studies, the MDRed (Maximum Demand Reduction) Model is created as an optimization apparatus for the solar PV-battery system. In this paper, MATLAB modelling toolbox is used for simulation of the solar PV-BESS design and verification of the MDRed modelling via variations in MD limit and solar PV load. Based on MDRed model, the maximum demand supervisory control algorithm is developed via MATLAB Stateflow® for the battery management system (BMS) to monitor and regulate the load to maintain the net load consumption below MD limit with the solar PV system. In summary, the simulation with the master MD controller shows the effectiveness of the proposed controller on the BMS to cater for MD reductions during solar irradiance and load pattern variations.

Keywords: Maximum Demand, Solar PV, Battery energy storage system, Battery management system, MATLAB Stateflow

1. INTRODUCTION

Currently, commercial and industrial operations face increasingly high costs for electric power, besides increasingly frequent and costly disruptions in the grid. These costs affect their business and for some businesses, it can severely affect their ability to operate profitably. Moreover, most commercial, and industrial customers' utility prices are split into two major classifications such as net consumption (in kWh) and peak demand or maximum demand (MD) (in kW) [1][2].

Currently, energy storage has developed into a technology with the potential to reduce peak demand to support the fluctuation. Solar PV and battery technologies are options to decrease the energy consumption, lower peak demand, enhance the consistency of electricity supply, and provide businesses with an advantage in local and global markets [4] [5]. Since it is not feasible to consistently reduce the MD charges because of the fluctuating solar irradiance pattern during bad weather, the integration of the solar PV-battery system

desires to be correctly in place for MD shaving, as per the design. Hence, overall integration of solar PV-battery with BMS control algorithm is required to integrate the battery system to perform the battery charging and discharging operation throughout the MD charges period based on the commercial and industrial sectors' electricity tariff.

2. RESULT AND DISCUSSION (including conclusion)

As part of system development, substantial use of MDRed modeling and simulation is performed to help understand system performance. Simulation of MDRed model is performed based on three (3) modes to help support arguments presented in the analysis to justify with system development in future. MATLAB Stateflow® is used for simulation of the solar PV-battery design. Stateflow enables to design and develop MD shaving supervisory control and MATLAB Simulink® models react to input signals such as load profile and solar irradiance. The concept of MDRed modelling were proven using MATLAB Simulink and Stateflow chart with the integration of MD shaving supervisory control algorithm which mainly emphasizes on battery operation for MD reduction.

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Assessment of Bioenergy in ASEAN Energy System for Energy Security and Sustainability

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ABSTRACT

As part of regional effort towards energy security and sustainability, ASEAN has set aspirational target of achieving 23% renewable energy share in primary energy supply in 2025. Additionally, countries have put national targets and policies toward energy transition, including in accelerating the renewable energy deployment. Among other sources, biomass has been largely underutilised in the region. This includes agricultural and municipal waste, biogas, biofuel-purpose crops, and others. This study aims to assess and model the role of bioenergy in the ASEAN energy system, especially within the framework of energy transition. Among others, the current target of biofuel blending and the needs of land to grow the crops, i.e., sugar cane and oil palm, would be analysed.

Keywords: Energy security, Biomass, Biofuel, Modelling energy system, Energy transition

1. INTRODUCTION

The study used the Low Emission Analysis Platform (LEAP), a powerful, versatile software system for integrated energy planning and climate change mitigation assessment tool. The energy system of all 10 ASEAN member states (AMS) has been modelled, based on the latest energy balance table, socioeconomics data, and various detailed modelling parameters and variables. The energy system is driven by a full set of demand sectors, from residential and commercial to transport and industry. Such demands would then be translated to transformation system, which generate secondary fuels, such as oil products, electricity, processed biomass, and gases. Bioenergy is demanded in various parts of the energy system. For example, biofuel has been largely promoted as blending to gasoline and diesel--important strategy to both reducing emission and dependence on import. Various type of bioenergy has been used to generate electricity, including biogas, biomass co-firing, and waste-to-energy. Even so, the utilisation is yet to be optimised.

2. RESULT AND DISCUSSION

In 2020, 3.1 billion GJ of energy in the region came from biomass and others. This is roughly translated into 11% of total primary energy supply. Most of these, though, are in form of traditional use of biomass, such as cooking with wood. The numbers are estimated to be reduced in the future along with the clean cooking policies projected by the model. The use of biomass (bioenergy) is then expected to increase in the power and transport sector.
Even so, the utilisation of biofuel will still be modest. An accelerated scenario is required to further elevate the utilisation of bioenergy, both biofuel and for electricity generation and industry use. Crucial in this analysis is the sustainability practice of bioenergy feedstock production. Specific for the biofuel, almost 3 million hectares of land is estimated as requirement to produce the biodiesel and bioethanol. The number might go to 9 million hectares in the future. Therefore, it is crucial to properly assess the potential of bioenergy, including its optimum and sustainable utilisation, especially noting the importance of energy-land-water nexus.

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Spatio-temporal Mapping and Monitoring of Mangrove Forests Changes from 1991 to 2021 in Panay Island, Philippines using Machine Learning

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ABSTRACT

Mangrove forests hold a crucial role in our social, economic, and ecological activities. Despite this immense importance, they are constantly threatened by reclamation, deforestation, and climate change. To forward conservation and restoration efforts, accurate and cost-effective mangrove mapping and monitoring must be done. This paper explores the use of a supervised learning algorithm called Random Forest (RF) in mapping mangrove extent in Panay Island, Philippines from 1991-to 2021. Using land cover data from Landsat, maps of the mangrove extent from 1991to 2021 were developed. Results revealed that there has been an 8% decline from 1991 to 1996; 24% decrease in 1996 to 2001; 6% increase in 2001 to 2006; 21% decline from 2006 to 2011; 17% increase in 2011-2016; and 16% increase in 2016 to 2021. Over the past three (3) decades, the Philippines has lost 20% of its mangrove forests. From 31713 ha in 1991 to only 25313 ha in 2021. Through a confusion matrix, the model was evaluated, and it showed a specificity, sensitivity, and AUC (Area Under the ROC Curve) above 70%. This suggests that machine learning, when integrated with remote sensing, can provide an effective yet low-cost approach to mapping mangrove extent at a large-scale.

Keywords: coastal management, geospatial, mangrove management, remote sensing, mangroves, forest changes, artificial intelligence, mangrove mapping, data science, machine learning, Soil and water conservation, Forest management

1. INTRODUCTION

Mangroves are salt-tolerant trees found in the intertidal zones of tropical and subtropical coastlines (Spalding et al., 1997). These forests hold a crucial role for many coastal communities, serving as breeding grounds for fishes, reducing wave action during typhoons, and ultimately combating climate change by storing blue carbon (Jennerjahn & Ittekkot, 2002). Dubbed as the "blue forests," mangroves can store up to four times more carbon than

upland terrestrial trees (Murray et al., 2011). Although mangroves are massively beneficial, these ecosystems are vulnerable to many threats, such as land conversion, urbanization, and pollution (Duke et al., 2014).

In the Philippines, the aquaculture industry is the biggest contributor to the decline of mangrove forests. Not until 1981, when the conversion of mangrove areas was prohibited by law (Ron & Padilla, 1999). Despite the existence of laws, there's generally a lack of awareness and implementation of these policies which is a massive snag to the overall mangrove protection and rehabilitation programs conducted by government and non-government organizations (Garcia et al., 2014). From half a million ha of mangrove cover in 1918 to only about 120, 000 ha in 1994, mangrove conservation in the country faces many institutional issues such as the promotion of development through aquaculture, low economic valuation of mangroves, bureaucracy, corruption, and lack of political will (Brown and Fischer, 1918; Primavera, 2000).

Being part of the typhoon belt – an area in the western Pacific Ocean where nearly one-third of the world's typhoons form – the country is hit by about 20 typhoons annually, some catastrophic (Santos, 2021). Mangroves, which serve as natural buffer zones against storm surges and floods, can protect hundreds of thousands of communities from climate change-induced weather disasters (Dieta & Arboleda, 2004). For a country where 60% of the population lives in coastal areas, it is evident that mangrove conservation must be placed in the spotlight (Taguiam & Quiambao, n.d.).

In 2013, Panay Island in the Philippines was struck by one of the most powerful typhoons ever recorded – Typhoon Haiyan. The typhoon destroyed almost 90,000 homes and hundreds of boats for fishery-dependent coastal communities (Moss, 2014). Disasters like these are a testament that there is an urgent need for us to increase the resilience of coastal communities.

To aid in coastal resiliency, mangrove planting has been a popular measure for many coastal resource management projects in the Philippines. However, there have been multiple reports where mangroves are planted at locations that are not natural mangrove habitats, affecting mudflats, sandflats, and seagrass beds (Samson & Rollon, 2008). With that, this paper argued that mangrove extent must be analyzed spatiotemporally to better assist

conservation and restoration efforts, providing data about areas where mangroves have originally existed.

Despite data on mangrove extent in some areas of Panay Island, there's a critical deficiency in updated and accurate information on large-scale mangrove cover change over time (Long & Chandra, 2011). To address this urgent need to understand the status of mangroves and the drivers of their forest loss and gain, rapid and accurate extent mapping must be done (Baloloy et al., 2021). By harnessing the power of satellite technology as well as artificial intelligence, these ecosystems can be managed more effectively. With that, remote sensing and GIS provide a way to quantify the historical distribution of mangroves, helping researchers and policymakers identify key areas for rehabilitation (Giri & Muhlhausen, 2008).

1.1. Objectives of the Study

This paper generally aims to map and monitor the status of mangrove forests in Panay Island by calculating their extent from 1991 to 2021.

Specifically,

i. to create a time-series analysis of mangrove extent from 1991 to 2021 using machine learning.

ii. to determine the colonization rate of mangroves; and

iii. to identify hotspots of mangrove loss and gain.

1.2. Significance of the Study

The purpose of this study is to advance the knowledge of policymakers, allowing them to make data-driven decisions for mangrove conservation and restoration. The developed model in this study can provide a cost-effective way to map mangrove extent at a large-scale.

1.3. Scope and Limitations of the Study

This research focused mainly on the application of machine learning to map mangrove extent in Panay Island. Due to time and monetary constraints, this study did not incorporate ground-truth data in the training model. Instead, the band indices of Landsat images were utilized to train the ML model. Additionally, the study only used one (1) machine learning model which is the Random Forest(RF) Classification and the authors, therefore, encourage future studies to use other modelling techniques such as Gradient Tree Boost(GTB) and Support Vector Machines(SVM).

2. RESULT AND DISCUSSION (including conclusion)

2.1 Temporal Changes of Mangroves in Panay Island

In a span of three decades (1991-2021), the overall change of mangrove extent in Panay Island dramatically decreased by 20%. From 31713 ha in 1991, mangrove extent in 2021 was reduced to only 25313 ha.

According to Primavera (1997), the mangrove deforestation in the Philippines is mainly caused by their conversion to fish and shrimp aquaculture farms. Shrimp production in the Philippines peaked in 1992 where it has recorded almost US$300 million in revenue (FAO, n.d.). By 1994, the Philippines was recorded to be the third-largest shrimp exporter in the world. This increase in demand has enticed many capitalists to invest in shrimp aquaculture. Primavera emphasized that Panay, along with Negros Island, were the country's top shrimp producers. This suggests that the rise in aquaculture farming are the top reasons why there has been a decrease in the mangrove extent in Panay Island from 1991 to 2001. The slight increase in mangroves in 2001-2006 can be attributed to the decline in shrimp export in the 1990s due to the rise of pathogenic shrimp diseases in the country which led to the abandonment of many aquaculture ponds, allowing mangroves to grow back (Ikejima et al., 2007). Dubbed as an "Aquaculture Laboratory", Panay island has remained as the hotspot for fish farming in the country. SEAFDEC (1989), emphasized the role of semi-feudal relations in the region where it has linked prawn farmers with national food conglomerates which further strengthened the exploitation of resources in the island.

In 2011 to 2021, there has been a constant increase in the extent of mangrove forests in Panay. As early as 2011, the Philippine government has been participating in blue carbon programs abroad such as International Blue Carbon Group of Experts which has evolved policy discourse in mangrove conservation in the country (Pangilinan, 2017). During the year 2011, the Philippine government – under the administration of Benigno Aquino Jr. – implemented the National Greening Program. It was one of the most ambitious reforestation programs which sought to plant 1.5 billion trees during his entire term as president, from 2011 to 2016. The program was intended to restore both terrestrial and mangrove forests in the country. By 2018, the project has reforested 1.91 million hectares of land, exceeding the project target of 1.7 million hectares (von Kleist et al., 2021). Along with this program, DENR and GIZ (Society for International Cooperation) also signed an agreement in 2016 to boost forest protection in Panay Island. The accord has been done to implement the Forest

and Climate (FORCLIM) Protection Panay Phase II which had a fund of P200 million (DENR, 2016).

Long & Giri (2011) reported 6,089.94 ha of mangrove extent in Panay Island during the year 2000. However, in this paper, the researchers recorded around 20,000 ha of mangrove extent – that's almost a 16% difference. As mentioned by Long & Giri, they were not able to clear the clouds in Landsat images, whereas in this study, clouds were masked in order to have a clearer mangrove imagery.

2.2 Mangrove Hotspots per Province

2.2.1 Aklan

The province of Aklan is one of the hotspots for mangrove gain. They're considered as one of the "success stories" in mangrove planting in the Philippines. With ~90% survival rates, New Buswang in Kalibo, Aklan was able to gain 50 ha and 13 ha of mangroves in 1989 and 1993, respectively (Primavera et al., 2008). In 2013, the province was struck by typhoon Haiyan, destroying thousands of mangrove trees. However, in 2014, the local government of Aklan planted 8,000 new propagules on a 2-hectare area of the Bakhawan Eco- Park, replacing the mangrove trees destroyed by the typhoon (Garcia, 2014).

2.2.2 Antique

Through the years, the province of Antique has lost a lot of its mangrove forests. The province also has no mangrove Eco parks unlike its nearby provinces where mangrove ecotourism is thriving. This deficiency in mangrove forests, makes Antique vulnerable to many typhoons. With that, local policymakers are pushing for the establishment of mangrove "greenbelts" in the province in order to prevent future damages from tropical cyclones, especially in coastal areas (Inquirer, 2022).

2.2.3 Capiz

Roxas City, Capiz is home to the Culajao Mangrove Eco Park. In a study conducted by Baticados (2014), found out that residents of Capiz are more likely to participate in mangrove conservation and rehabilitation activities if such action would increase their fish catch. They also emphasized that the younger generation are more willing to participate in conservation activities as compared to the older generation.

2.2.4 Iloilo

Iloilo River is one of the hotspots of mangrove loss and gain in Iloilo City. The development and expansion of the famous Esplanade Park led to the destruction pre-existing mangroves. However, after the construction of the park, these mangrove ecosystems were restored and are now part of a thriving ecotourism project in the city which has garnered multiple awards (USAID et al., 2017).

5.3 Model Performance

The random forest model has proven to be effective in mapping mangroves in Panay Island. As compared to other machine learning models, RF does not require hyperparameter tuning or feature scaling. This model is also easy to develop and implement. However, some problems in mapping mangroves using RF are still prevalent such as object misclassification. Jhonnerie et al., (2015) found that object misclassification is common in water bodies, bare land, and transition areas between water and land. These problems are common in remote sensing projects and can be resolved by gathering and comparing multiple images from different satellites.

3. CONCLUSION AND RECOMMENDATIONS

This study has generated the first mangrove extent map in Panay Island, Philippines. It has also proven that remote sensing, combined with machine learning algorithms, can effectively assist in the creation of mangrove ecosystem maps. Considering that this study was done by utilizing open-source data (Landsat) and software(QGIS and GEE), this can be easily replicated to be used for mangrove mapping in other areas in the Philippines. Hotspots of mangrove loss are recommended to be areas suitable for mangrove restoration. With that, we can ensure that mangroves are planted at their natural habitat.

Results from this study are recommended to be shared with different stakeholders involved in mangrove conservation and restoration, advancing decision-making by utilizing data. The researcher suggests future studies to utilize ground-truth data to make the machine learning model more robust. Mapping the drivers of mangrove cover change can also be considered in future research. Finally, utilizing other ML models would also be beneficial to determine the most appropriate algorithm for the area.

This study encourages future mangrove conservation programs to take into consideration the following recommendations:

a. Push forth information, education, and communication programs for the protection and conservation of mangroves. Increasing awareness on the importance of mangroves is highly beneficial in crafting a successful mangrove conservation program.

b. Utilize local data on mangrove distribution history to better identify areas suitable for mangrove restoration. This paper argued that abandoned aquaculture farms in the coastline are perfect areas for mangrove planting since these areas are originally mangrove habitats.

c. Collaborate with grassroots communities to better understand the drivers of mangrove loss and gain.

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The Relative Strength of Water Tenure Security for Oil Palm and Hydropower: A Preliminary Study

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ABSTRACT

Both Palm Oil Plantation and Hydropower depends on water to sustain its operations. This paper will analyse two factors affecting its water tenure security: how water is allocated in the legal framework and the relative strength of a particular tenure against other tenures. The case study area is the Kahayan Catchment (Central Kalimantan) and the Jatiluhur dam (West Java). This paper applies FAO's analytical framework: elaborate tenure typology, map water uses and weigh the security of the tenure. We find that the water tenure security for palm oil is weak, since it sits in the bottom rung of the allocation framework. We posited that environmental water use, especially for the prevention of forest fires, would be prioritized over commercial water use for smallholder palm oil farmers or corporate palm oil. Furthermore, community-based water tenure, although weak in the legal sense (de jure), can be strong in terms of practice (de facto); this could diminish palm oil water tenure security should there be an overlap or intersections among them. On the other hand, water tenure security for hydropower is considerably strong, but they are vulnerable to legal and political challenges from agricultural water use and "nuisance" from fisheries.

Keywords: water, energy, nexus, tenure, security, allocation, hydropower, palm oil

Monitoring Particulate Matters and Total Suspended Particles Along the Roadside and Public Area

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ABSTRACT

2-stroke engines, poor fuel quality, heavy traffic, bad road conditions, and old vehicles are some sources of vehicular pollution in urban settings. This study focuses on vehicle emissions and public park air quality, meanwhile, the air pollution determination is mostly held within 24 hours, yet the study of 8 hours (rush hours) pollution should be accomplished. Particulate Matter (PM) and Total Suspended Particles (TSP) are the main pollutants that were targeted to determine for two months long, two weeks per month, and one day per week. The sampling is conducted using High volume sampler (HV, Shibata 500V) for TSP and Nano-sampler (NS) to define PM (6 stages: TSP/PM10/PM2.5/PM1/PM0.5/<65 nm). The obtained results illustrate that the peak number of TSP on Russian Federation Boulevard (RFB) was 234 µg/m³ which is below the standard sets by the Royal Government of Cambodia. However, PM2.5-10 (47 µg/m³), and PM<0.1 (38 µg/m³) were the most found particle sizes in RFB compared to Wat Phnom (WP). Therefore, ministries responsible for human health should standardize the emission of smaller size particles namely fine and ultrafine particles because it was found in high concentration and should spread awareness about citizens' self-protection and avoid direct exposure to vehicle combustions.

Keywords: Particulate Matters, Total Suspended Particles, Air Pollution, Vehicular Pollution, Air quality

1. INTRODUCTION

In recent years, almost the entire world's population (99%) breathes air that exceeds WHO air quality standards, providing a health risk [1]. In the previous year, air pollution was responsible for 11.65% of deaths worldwide [2]. According to The Ministry of Public Works and Transport, there were 640,183 new registered vehicles in 2020, consisting of heavy

trucks, cars, and motorcycles. Since 1998, the number of vehicles in Cambodia has increased dramatically, from only 65,000 cars to 200,000 motorcycles [3]. One noticeable factor that has a really bad impact on air pollution is Motor vehicles [4]. Factors that have made motor vehicle becomes part of air pollution are fuel combustion, brake and tire wear, and lubricant oil combustion [5,6]. The exhaust emissions from these automobiles are normally categorized as; Particulate Matter (PMs), Total Suspended Particles (TSPs), and else [7,8].

The current study seeks to define the pollutants in a crowded area and public place where people are directly exposed to the ambient air pollution so this study could spread awareness for self-protection and prevention from pollution onwards. The existed works were done to frame the sampling for 24 hours or otherwise, while this study aims to reduce sampling time to only 8 hours which is the working hours and rush hours. Therefore, the main objective of this study is to 1) monitor and characterize PMs and TSPs in 2 different study areas: Russian Federation Blvd (RFB) and Wat Phnom Historical Park (WP). 2) The results obtained from this study will be taken to identify the air quality and characterize the air pollutants between a heavy traffic area and a public park. Furthermore, 3) the study also investigates the concentration of pollutants between March and April.

2. METHODOLOGY

The sampling of this study was conducted for 2 months long in the dry season (March and April), 2 weeks per month (2nd week and 4th week), and 1 day per week for 8 hours starting from 7 am until 3 pm. A high-volume sampler (Shibata HV 500-F) was operated to obtain the TSP concentration with specifications as 500 L/min flowrates, AC100V, 50/60Hz, 10A, and 16 kPa suction pressure [9]. Furthermore, the Nano sampler is chosen to suck in PM concentration (6 stages: TSP/PM10/PM2.5/PM1/PM0.5/<65 nm) by using PUMP that possibly varies the flowrate until 40 L/min maximum [10].

3. RESULT AND DISCUSSION

The concentration of TSP in Figure 1 that has taken to compare RFB and WP has shown that the most TSP polluted area is RFB which is a site that has a vast number of vehicles passing by during the whole 8 hours of the day, while WP is covered in trees and calmness. Following the same figure, the TSP that has been seen standing at around 234 $\mu g/m^3$ is the week 2 of March from RFB compared to others. It was polluted by surrounding emissions from motor vehicles and other factors including high humidity that was measured by a low-cost sensor

and strong wind blowing straight to the samplers' filter. In contrast week 4 of April in WP's site indicates the best compared to RFB's site air quality which is only about half the pollution. If we compare March and April, the data stated that March has higher TSP pollution, and April which has more rainy days conducted less pollution [11,12]. Surprisingly, all of the obtained data during 8 hours of sampling does not exceed the standard (330 µg/ m^3) set by the Royal Government of Cambodia for outdoor air pollution [13].

The distribution of PM in Figure 2 has shown that week 2 of March on RFB, PM2.5-10, and PM<0.1 are the most found particle size during sampling which is considered a hazard to public health's respiratory system. Moreover, the coarse particles (diameter 2.5-10 µm) during the sampling decreased from about 47 to 12 µg/ m^3 over time. Fine (0-2.5 µm) and ultrafine (<0.1 µm) particles also were found more polluted in the RFB site that was because of vehicles passing through the site. One more important trend is that in week 2 of April in WP sites, the ultrafine particles stated about 21 µg/ m^3 and it shows concerns as well to the surrounding people.

In conclusion, TSPs concentration results are lower than standards. However, the results of fine and ultrafine existed in the very high concentrations found in PMs which have no standard yet. Therefore, Ministries responsible for human health should standardize the emission of smaller size particles and as well as spread awareness for citizens' self-protection such as covering the nose with a clinical mask and avoiding direct exposure to vehicle combustions.

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Total Suspended Particulate Matter (TSP) Bound Carbonaceous Component in Makassar City, Indonesia

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ABSTRACT

As the initial study related to carbonaceous components in eastern parts of Indonesia, total suspended particulate matters (TSP) were collected in the roadside environments in Makassar city, Indonesia. The mean TSP level in this study was higher than NAAQS of Indonesia and much higher than WHO standards. It ranged from 21.6 to 838.6 mg/m3 which the lowest concentration was found during the rainy days in A site. The highest TSP level in all sites was found in the rush morning and late noon hour. It is related to the movement of the citizens during those periods of times. Regardless the sites and times of sampling, organic carbon (OC) is the main fraction of total carbon (TC) for around 62.2 – 84.0%. OC and EC had well correlation indicated both carbonaceous components were emitted from the common sources. It might be emitted from the traffic emission as seen from the greater correlation between TSP and soot-EC than between TSP vs. char-EC. Hence, exhaust emission from traffic and non-exhaust emission during the movement of vehicles should be two main sources of TSP and its carbon components in roadside environment of Makassar city.

Keywords: Total suspended particulate matters, organic carbon, elemental carbon, vehicle exhaust, Indonesia

1. INTRODUCTION

Recently many studies have been reported regarding the carbonaceous component of ambient particulate matters (PMs) and their harmful effects on human health and environments such as climate and visibility. It is commonly classified into two main fractions, i.e., organic carbon (OC) and elemental carbon (EC). Both of them can modify the lifetime of cloud, precipitation patterns and reflectivity of the atmosphere. In Southeast Asia (SEA),

Indonesia is the main source of carbonaceous components emitted into the atmosphere, especially from the forest fire in the peatland area which most of the studies focused on Sumatra and Kalimantan Island [1-3]. However, in the eastern part of Indonesia Sulawesi Island, there are no studies yet related to the carbon component of PMs. Thus, this study aims to evaluate the carbonaceous component of TSP in Makassar city, Sulawesi Island. The sampling sites were located at Sultan Alauddin Street. 4-different characteristic roadsides were selected or paved, gravels, paved with a pedestrian walk, and unpaved and further notes as A, B, C, and D sites.

2. RESULT AND DISCUSSION

The concentration of TSP in the 4-different characteristic roadside in Makassar city was higher during the rush-hour morning and late afternoon due to its citizens' movement from/to home and school or office. It can be seen from the highest number of vehicles during those two periods. In the afternoon, the TSP level was lesser due to it is the working and studying hours. Regardless of the site, the concentration of TSP during this period still meets the NAAQS of Indonesia (230 mg/m3 for 24-h average). The carbon component of TSP was mainly composed of OC accounting for around 63.2 – 84.0% of TC. The OC and EC were well correlated in all time periods suggesting both components emitted from common sources. Since OC vs. soot-EC and EC vs. soot-EC (see Fig.1) also has a good correlation, the main sources of carbon components in all sites and time periods should be vehicle exhaust emission. However, non-exhaust emission on the roadside might be influenced on the TSP and its carbonaceous component as well, especially in B-site where the characteristics roadside was covered only by gravel. Road-dust resuspension and tire wear abrasion from vehicles affected the carbonaceous component, particularly during the morning and late-noon rush hours. It is confirmed as displayed in Fig.2. that the carbon component or OC, EC, TC, and soot-EC correlation with TSP in B-site in the morning and late noon was not located at the same line with other data, indicating non-vehicle exhaust emission was affected during those periods.

3. CONCLUSION

The higher level of TSP was founded during rush-hour morning and late afternoon. Carbon components were predominantly composed of OC. OC and EC were emitted from the common sources in whole periods of time and sites as seen from the well-correlated between those carbon components. It is also confirmed by the good correlation between

OC vs. soot-EC and EC vs. soot-EC. Thus, the main sources of carbon components were vehicle exhaust. However, non-exhaust vehicles' influence on the carbon profiles could not be negligible particularly in B-site during morning and late afternoon.

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Size Fractionated Ambient Particles Down to Nanoparticles (PM0.1) during a Haze Episode in Myanmar

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ABSTRACT

This is the first report on the situation of airborne particles small to nanoparticles ($PM_{0.1}$) in Myanmar. The ambient air monitoring using a cascade air sampler of $PM_{10/2.5/1.0/0.5/0.1}$ stages was done in Tachileik, Myanmar, during the dry season period in 2022, Concentrations of $PM_{2.5}$ and PM_{10} seriously exceeded air quality standards, e.g., those by WHO in both periods. The $PM_{0.1}$ concentration ranged from 5.4 to 20.8 µg/m³, with an average of 13.1 ± 4.3 µg/m³, similar to other large cities in this area as Bangkok in Thailand. This result will provide air quality information in Myanmar, which is prone to the clean air act, and transition to sustainable air quality management in Myanmar and other developing countries.

Keywords: Geothermal, Land Use, Geographic Information System

1. INTRODUCTION

Most atmospheric PM in Southeast Asian countries is based on course and fine particle measurement levels via satellite remote sensing and ground-based monitoring [1,2]. However, data on sources and distribution of the size distribution of ambient particles down to the nanoparticle range ($PM_{0.1}$; with Dp < 0.1 µm) are still lacking in Asian developing countries. No standards for ambient $PM_{0.1}$ have been adopted in Asian countries.

Myanmar is recognized to arise from open biomass fires in the dry season [3]. However, the mass concentration of physical characteristics of size-fractionated particles down to nanoparticles ($PM_{0.1}$) has not been studied so far in Myanmar. Accordingly, this study's motivation was to investigate atmospheric particles' characteristics down to $PM_{0.1}$ conducted in Tachileik, Myanmar. The haze episode was monitored in Tachileik, Myanmar, during the dry season (March-April) in 2022. Nanosampler ($PM_{0.1}$ cascade sampler) with 4 impactor

stages ($PM_{10/2.5/1.0/0.5}$), an inertial filter (IF) stage ($PM_{0.1-0.5}$), and a backup filter ($PM_{0.1}$) located downstream of IF were used to collect each size distribution.

2. RESULT AND DISCUSSION

Figure 1. displays the daily mass concentration of size distribution of PM in Tachileik, Myanmar, during the dry season in March and April 2022. The level of Figure 1. displays the daily mass concentration of size distribution of PM in Tachileik, Myanmar, during the dry season in March and April 2022. The level of Figure 1. displays the daily mass concentration of size distribution of PM in Tachileik, Myanmar, during the dry season in March and April 2022. The level of Figure 1. displays the daily mass concentration of size distribution of PM in Tachileik, Myanmar, during the dry season in March and April 2022. The level of Figure 1. displays the daily mass concentration of size distribution of PM in Tachileik, Myanmar, during the dry season in March and April 2022. The level of Figure 1. displays the daily mass concentration of size distribution of PM in Tachileik, Myanmar, during the dry season in March and April 2022. The level of Figure 1. displays the daily mass concentration of size distribution of PM in Tachileik, Myanmar, during the dry season in March and April 2022. The level of $PM_{0.1}$ ranged from 5.4 to 20.8 μg/m^3 with an average 13.1 ± 4.3 μg/m^3, similar to other large cities in this area, such as Bangkok (14.8 μg/m^3) but lower than Chiang Mai (25.2 μg/m^3) in Thailand, during a haze episode in the dry season [1]. The highest mass fraction in size-segregated PMs in Tachileik, Myanmar, is the $PM_{2.5-10}$ fraction. The daily $PM_{2.5}$ and PM_{10} exceed the 24-hr values suggested by the World Health Organization (WHO) (15 and 45 μg/m^3, respectively). Interestingly, $PM_{0.1}$ mass concentration is in height during the dry season, and the PM mass concentration is high in the same situation in southeast Asian cities. Influences of local emission sources, including biomass fires, traffic, and industries, were discussed, along with transboundary results from satellite image data. The estimated air mass trajectories through the hot spot distribution [4]. Levels of particulate matter as PM_{25} and PM_{10} seriously exceeded air quality standards in Myanmar, e.g., those by WHO in both periods. These results highlight the status of focusing emission control strategies on different particle sizes in Myanmar. Transboundary migration over countries in this area could also be a critical issue that will merit future study in a more detailed investigation.

3. CONCLUSION

This is the first report on the situation of airborne particles small to nanoparticles ($PM_{0.1}$) in Myanmar. The ambient air monitoring using a cascade air sampler of $PM_{10/2.5/1.0/0.5/0.1}$ stages

has been done in Tachileik, Myanmar, during dry season periods in 2022. Concentrations of $PM_{2.5}$ and PM_{10} seriously exceeded air quality standards, e.g., those by WHO. The $PM_{0.1}$ concentration ranged from 5.4 to 20.8 μg/m^3, with an average of 13.1 ± 4.3 μg/m^3. This result will provide air quality information in Myanmar, which is prone to the clean air act, and transition to sustainable air quality management in Myanmar and other developing countries.

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A Descriptive Results on Environment Affecting Pupils in Cambodia – Case Study Primary Schools in Phnom Penh

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ABSTRACT

Due to the global climate change causing many negative impacts in many countries, one of the impacts focusing in this study is the heat stress on the grade 6 pupils in Cambodia. This paper has adopted the quantitative study by conducting a questionnaire survey with a total number of 507 questionnaires in two primary schools in Phnom Penh. The survey was conducted in face-to-face interviews using the Khmer language in 2022 by a team from the Department of Curriculum Development (DCD) from the Ministry of Education, Youth, and Sport (MOEYS) and a team from the Institute of Technology of Cambodia (ITC). The results showed that the participants consisted of 51.08% of girls, ranging in ages from 11-14 years old. The participants (60.9%) mentioned acceptable with the indoor air condition; however, they still required cooler air because the participants (92.7%) expected to receive more fresh air/wind by sitting nearby a window which meant the air ventilation inside the classroom is not sufficient. More importantly, we found that the symptom of heat stress occurring 46.7% of the participants experienced during the hot season; about half of the participants (51.4%) felt lost concentration when the classroom is hot.

Keywords: Heat stress, Heat stress symptoms, Heat impact in school, Heat stress coping mechanisms, Pupils

1. INTRODUCTION

Global warming is one of the most issues for uncountable reasons in all life. The climate model predicts that global temperature will rise in the future [1]. One of the impacts of climate change is heat stress. Heat stress has well-known physiological consequences [2] as the effect of a hydrated body, dizziness, muscle cramps and fever from temperature changes in the body and also leading to serious blood flow, breathing and cerebrovascular reactions. Even in developed countries, the environmental conditions in the classroom are typically

poor [3] while Cambodia is a developing country, public schools are often located on the available land and equipped with low ventilation systems. Most government schools depend on natural ventilation cooling. When the ambient temperature is high, they may open the door or window, some schools may have ceiling fans, but it is still low for cooling ventilation [4]. The number of students per classroom is also higher than the recommended number and body heat could increase the indoor temperature in a classroom [4]. Research has shown that increased classroom temperature and low ventilation rates can harm schoolwork performance and the health of students [5]. While students spend a significant amount of time in the classroom compared to any place, it is crucial to understand the impact of heat in school from high temperatures in the classroom that affect the health, well-being, and academic performance of learners [1]. Evidence from New York City high school exit test reveals that heat stress can have a major influence on student performance, resulting in lower exam scores in the short term and lower educational achievement (academic performance) in the long term [2]. This study aimed to provide evidence on the heat stress that occurred in Cambodian primary schools; thus, the objectives of this paper was to describe obtained the questionnaire results, including the heat stress and heat strain symptoms and coping mechanisms, conducted from two primary schools in Phnom Penh, Cambodia.

2. RESULT AND DISCUSSION (including conclusion)

Demographics: Of the total number of participants in this study, 51.08% of girl participants participated in the survey. The ages of the participants were in the range of 11-14 years old but all of them were from grade 6. The per cent share of 46.9% was from the morning class. Most of them study in their schools for more than 4 years. Their average of Body-Mass Index was 18.4 kg/m2; they like doing exercise thus they are in healthy condition. The selected schools have a fan as the facility for accelerating the air ventilation.

Heat stress and heat strain: The questionnaire results described the feeling of the participants regarding the indoor air condition of the classroom, they mentioned that feeling normal (57.08%), slightly warm (17.71%), warm (7.67%), hot (4%), slightly cool (14.56%), and cool (1.16%). The participants felt a little cold air flowing through the classroom (57.7%), the feeling of the air inside the classroom is cold just like when the weather is cold (23.71%), gentle stream of pleasing air in their classroom (9.09%), sense of stability in the gentle flow of warm air (7.7%), moderate of warm air (1.6%), and extremely hot (0.2%). However, 45.43% of the participants sat near the window because they give a similar reason (92.67%) targeting

to receive fresh air/wind. According to the heat stress, phenomenal happening in the classroom causes the heat strain occurring to participants during the study in their classrooms by including the participants feeling sleepy, thirsty, sweating, headache, weak, etc. The participants feeling sleepy sometimes, every noontime, every morning time, and both morning and afternoon time were described as 55%, 25%, 17.5%, and 1.66%, respectively. Besides that, 73.1% of them also got sweating during study time; corresponding to the answers of participants on feeling thirsty because 43.7% and 35.1% of participants felt thirsty and a little thirsty, respectively. However, most of them (67.6%) did not feel tired at all while some of them (8.6%) felt exhausted and wanted to take a break. The questionnaire results depicted the feeling to heat strain symptoms occurring in 46.7% of the participants experienced during the hot season; the symptoms were including mild headache 21.53%, dizziness 5.43%, weakness 3.18%, muscle pain 0.37%, and lower concentration 2.62%.

The impacts of clothing on heat stress: The participants felt very comfortable, moderately comfortable, and uncomfortable with their daily uniforms were 90.15%, 9.05% and 0.78%, respectively. The long sleeves shirt was preferred by about 70.1%; the girl participants preferred long skirts by about 92.4% and the boy preferred long pants by about 95.3%. They did not feel hot at all with the outfit/uniform (88.64%).

Student coping mechanisms: The participants adopted some strategies to manage heat stress at school; hand-fan (38.69%), drinking normal water (20.74%), drinking cool water (13.55%), increase water intake/hydration (12.42%). The participants took drinking water an average of 1.84 litres per day. Other methods of coping mechanisms at home were taking a bath/shower (32.43%), taking a rest in front of a fan (30,29%), and increasing water intake (10.81%).

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Precipitation Trend Analysis of Coastal Catchment of Cambodia

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ABSTRACT

Climate variability induces changes in temporal and spatial precipitation pattern. The pattern dictated the water resources availability in the region and the risk to local potential threat. In this analysis, the trend of the precipitation of three observation stations namely Kampot, Koh Kong, and Sihanouk were analysed. The annual precipitation at Sihanouk station showed negative trend with significance level greater than 10% while data at Kampot depicted positive trend. Annual precipitation at Koh Kong station depicted strong positive trend with significance level 0.001. The rainfall in all three stations showed strong seasonal pattern where over 80% of the rainfall falls in wet season. Koh Kong station illustrated remarkable positive trend in both seasonal and monthly rainfall analysis. Kampot station showed positive trend in dry season and negative trend in wet season. Sihanouk station experienced no obvious trend in all the analysis.

Keywords: climate variability, Mann-Kendall's test, Sen's slope estimator, trend analysis, water resources

1. INTRODUCTION

The coastal zone of Cambodia is facing various problems since there is increasing natural resource degradation due to forest, water, and land have been overused for economic development and pro-poor development activities country-wide up to date. These problems are major for the environment which appeared such as higher temperature, precipitation, and sea-level rise. High rainfall and uneven distribution throughout the province lead to floods in recent years in the city. The flood occurred in 2000 & 2002, which killed people and caused millions in damage to crops and infrastructure (NCDM, 2002). Meanwhile, the impact of drought in some regions in Cambodia has been observed frequently which is affected people and destroyed rice paddy. Hydrological pattern changes cause underground water salinization and seawater intrusion in coastal lowland areas which is used for agriculture, particularly during the dry season.

One of the triggering factors is the climate variability and climate change which leads to shifting the rainfall trend in the region where it plays a crucial role in the process of stream flow and demands spatial and temporal distribution of runoff, soil moisture, and groundwater reserves (Islam et al., 2012a; Srivastava et al., 2014, Gupta et al., 2014) because its variations in seasonal and monthly values, coupled with changes in extreme events, can impact on water resources, on natural environments and human activities, as well as on human health and safety.

Rainfall is one of the most important climate physical parameters (Singh et al., 2013) as it affects the environmental responsibility in the region affecting agricultural productivity (Modarres and da Silva, 2007; Kumar and Gautam, 2014). The water availability to supply demands in agriculture, industry, domestic use, and hydropower projects is defined by the amount of rainfall received in the local catchment (Gajbhiye et al., 2016). The fluctuation of groundwater level is sensitive, particularly in the coastal region where seawater intrusion is a major threat to the groundwater quality. Temporal change in precipitation trends would provide information about hazardous events like floods and drought (Srivastava et al. 2015). Scientific-based future climate scenario is derived and obtained from the understanding of spatial scales different in trend analysis of rainfall (Partal and Kahya, 2006; Singh and Srivastava, 2016; Yue and Hashino, 2003; Islam et al., 2014). Changes in precipitation showed a significant impact on society the information which is used to estimate the spatial distribution and variability of the catchment of interest (Ben-Gai et al., 1998; Yaduvanshi et al., 2015).

The purpose of this study is to investigate the variability of the rainfall of three rain gauge stations in the coastal region of Cambodia, one of the areas with potential economic development in the country. Monthly trends and seasonal trends will be investigated to understand the pattern and provide a scientific base for the management and development of water resources in the coastal area.

2. RESULT AND DISCUSSION

2.1. Statistical analysis of Annual rainfall

The annual rainfall time series data in each province was analysed by determining the statistical parameters such as mean, standard deviation, and coefficient of the variance respectively by 1888.41 mm, 333.17 mm, 17.64 % at Kampot, 4180.39 mm, 936.99 mm,

22.41% at Koh Kong and 3019.56 mm, 591.47 mm, and 19.59% at Preah Sihanoukville. The annual rainfall of the three stations depicts significant variation where Kampot station received the lowest annual rainfall with an average of 1888.41 mm, while Koh Kong recorded the highest precipitation of 4180 mm. Sihanouk station obtained an average annual rainfall of 3019.56 mm. The standard deviation varies in the range of 936.99mm to 333.17mm. It is observed that the station with relatively higher annual rainfall contains higher variability than the station with relatively lower annual rainfall.

2.2. Statistical analysis of seasonal rainfall

The study area possesses distinctive two seasons, the dry and the wet season. The dry season takes place from November to April, while the wet season is from May to October. All three stations presented strong seasonal rainfall patterns. Over 80% of the precipitation falls within the wet season. The analysis shows consistent characteristics of the variability of the data in the dry and wet seasons. It depicted larger variability for the dry season.

The results of trending the rainfall in the dry season showed that both Kampot and Koh Kong station signifies a positive trend at a 0.05 level of significance. The region has experienced the wetter condition. However, the dry season rainfall at Sihanouk station recorded decreasing trend with a level of significance greater than 0.1. The wet season rainfall at Kampot and Sihanouk stations showed a decreasing trend. It is noted that Kampot station depicted different trends between dry and wet seasons. The dry season has become relatively wet while the wet season rainfall contains a negative trend which became relatively drier. Koh Kong station, otherwise, presented a significant positive trend throughout the period.

2.3. Statistical analysis of monthly rainfall

Monthly rainfall time series data of the three stations were analysed to investigate the characteristic of rainfall. The results showed that February is the driest month in Kampot station with an average monthly rainfall of 18mm, and January is the driest month in Koh Kong and Sihanouk stations with an average rainfall of 51mm and 30mm, respectively. The wettest month is August for Kampot (344mm) and Sihanouk (551mm) and peak rainfall reaches early July (872mm) in Koh Kong station. The result of the statistical analysis showed a consistent variability pattern that the coefficient of variance is larger in the dry season months compared to wet season months. It signified the months in the dry season very much from year to year. The trend of the analysis showed the temporal characteristic of the rainfall

data. The results are summarized in Figure 8. For Kampot station, it is clearly seen that the dry season month, November, December, and January showed a significant positive trend. More rainfall is expected in the dry period. The early wet season month of May; however, presented a significant negative trend. It received less rainfall compared to the past. Koh Kong station depicted a generally positive trend for most of the month. The region is experiencing more rainfall which might generate floods in the local catchment. Rainfall in Sihanouk shows no remarkable trend throughout the year. The trend analysis on a monthly scale enables the investigation of the temporal variation of rainfall. It is crucial for water availability and water resource planning. In addition, it provides the potential flash flood hazard, particularly in the month when a significant positive trend is observed.

3. CONCLUSION

The analysis was conducted to investigate the rainfall trend using the MK test and Sen's slope estimator for the Kampot, Koh Kong, and Sihanouk stations. The annual precipitation of Kampot and Koh Kong is increasing in trend while Sihanouk station experienced decreasing trend. It is remarkable that the dry seasonal rainfall at Kampot station showed a positive trend while wet seasonal rainfall experienced decreasing trend. The trend of rainfall at Koh Kong depicted an obvious positive trend in both seasonal rainfall and months. Sihanouk station illustrated no imminent trend in all the analyses. The analysis of rainfall trends is beneficial to irrigation and water resources management in the basin.

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Preliminary Discussion about the Atmospheric Aerosols and Meteorological Conditions using Satellite Data in Afghanistan

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ABSTRACT

Kabul city, the capital of Afghanistan, is suffering from poor air quality for the last two decades. This study focuses on spatiotemporal characteristics of aerosol optical depth (AOD) and meteorological conditions in Kabul. The annual and long-term 20 years of AOD data is obtained from Moderate Resolution Imaging Spectroradiometer (MODIS) a combination of Terra and Aqua satellites using Google Earth Engine geospatial analysis platform to determine seasonal variation and long-term trend of the aerosols. Meteorological data including humidity, precipitation, temperature, wind speed, and direction were obtained from NASA. The air mass backward trajectories were calculated using the three-dimensional Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model. Furthermore, ArcGIS is used to visualize the AOD over the city. The results show high AOD in summer. However, autumn is recorded as the lowest AOD season. In addition, the 20 years data from 2001 to 2021 shows a slight increase. We suggest that the increase in AOD in the city is due to the rapid growth of the population. In addition, June, July, August, and September were examined with high temperatures and humidity. The cross-boundry atmospheric aerosols affect the balance of ambient air in the city.

Keywords: Afghanistan, atmospheric aerosols, MODIS, AOD, Meteorological conditions

1. INTRODUCTION

Air pollution is the biggest problem in the recent century. The air pollutants in Kabul are emitted from anthropogenic sources such as power plants, smelters, wood-burning stoves, gas-powered generators, and motor vehicles. Moreover, residents sometimes burn plastic tires and coal to stay warm. The air pollution phenomenon has not yet been studied so far [1-3] covering the city. To date, the Government has not compiled a comprehensive inventory of air pollutant emissions or not even an inventory of greenhouse gas emissions. Likewise, no source apportionment has ever been conducted to evaluate how much of the various sources contribute to atmospheric aerosols. This is due to the lack of a monitoring

station to record the air quality status and meteorological data. Most of the study AOD of a specific site has been performed by comparing the spatial data with the ground data and estimating PM2.5 from AOD [4-6].

2. RESULT AND DISCUSSION

The result shows that the summer and autumn seasons with 0.21 and 0.17 has the highest and lowest AOD level, respectively. In addition, Figure 1. Shows the variation of the AOD over 2021. The maximum and minimum value is recorded as 0.25 and 0.13, respectively. Figure 2. displays the long-term trend of AOD from 2001-2021. The figure shows a slight increase with 0.0007 slope rate gradually and a minor decrease in 2020 due to the COVID-19 lockdown. The city of Kabul is surrounded by mountains. We found that most of the atmospheric aerosol comes from northwest countries considering the wind direction.

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Size Segregated Carbonaceous Aerosol Down to Ultrafine Particle in Medan City, Indonesia

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ABSTRACT

In this study, we measured the distribution of PMs and its carbonaceous components including organic (OC) and elemental carbon (EC) to determine the extent to which carbon profiles within ambient aerosol differ among four different sites (roadside (RS), school environment (SE), industrial area (IA) and volcano area (VA)) in Medan city. Samples were taken by using ambient nano sampler (ANS) from February 19th to March 12th, 2019. Carbon analyser followed by IMPROVE_TOR methods was used to evaluate the carbonous component in all sites. Overall, OC is the primary carbon component, comprising more than 60% of all sites. Regarding particle size, the largest OC content was recorded in PM0.5-1 across all locations, suggesting that this particle size should be the primary focus of future evaluations of the consequences of biomass burning. The concentration of soot-EC dropped with the increase in particle size, since it was often influenced by vehicle emissions, which typically generated ultrafine and fine particles. PM0.1 has the greatest concentration of soot-EC. Due to their proximity to the city's busiest thoroughfare, RS and SE sites had a larger soot-EC proportion than the two remaining sites (IA and VA) (Sisingamangaraja Street).

Keywords: Nanoparticle, Carbonaceous Components, Mass Concentration, Sumatera Utara, Indonesia

1. INTRODUCTION

In recent years, particulate matter (PMs) in the ambient air receives the most attention in the Southeast Asia due to its affect not only to human health but also to the environment. One of the components of PMs that linked to those issues is carbonaceous components. It is commonly divided into two components i.e., Organic Carbon (OC) and Elemental Carbon (EC). OC generally emitted both from primary and secondary emission while EC is

generated only by primary incomplete combustion. Both of them play a significant role in global climate change and human health.

Recently, Indonesia especially in Sumatera Utara Province is facing a serious air problem due to its citizens and industries activities. However, there is still limited information related to air pollution considering the components of PMs including its carbonous component especially in size-segregated of PMs in this region. Hence, this study aims to characterize the distribution of PMs and its carbonaceous components in Sumatra Utara Province, Indonesia.

PM sampling was done at four different areas of different characteristics sites. Three of them were located in Medan City; roadside area (RS), School Environment (SE), an industrial area (IA) as an urban area while the Volcano Area (VA) was selected as Sub Urban area at Karo Regency. Samples were collected from February 19th to March 12th2019 by using ambient nano sampler (ANS) [1] which is a device that can classifies PMs down to ultrafine size (>10, 10-2.5, 2.5-1, 1-0.5, 0.5-0.1, <0.1 mm).

2. RESULT AND DISCUSSION

Fig.1. below depict the average concentration of OC, EC and TC in various sampling location for 24-h including Roadside (RSave), School Environment (SEave), Volcano Area (VAave), and Industrial Area (IAave). Overall, it can be seen , OC is the major component of carbonous component accounted more than 60% in all sites. Regarding the particle's sizes, the highest OC concentration was founded in PM0.5-1 in all sites suggested this particles size could be considered as the main focus for further evaluation of biomass burning effects. It is in line with the highest OC/EC ratio which was founded also at PM0.5-1. As previously reported by Amin et al [2-3] , the high OC and OC/EC ratio could be an indicator of the effect of biomass burning. Furthermore, the highest EC concentration were recorded in the finer particles' sizes i.e. particles smaller than 1 mm suggested major emission from vehicles combustion.

Soot-EC concentration was decreased along with the increasing of particles sizes since it was commonly affected by vehicles emission which generally emitted particles in ultrafine and fine particles size. The highest concentration of soot-EC was found in PM0.1. RS and SE sites were higher taking into account soot-EC fraction compared to two remaining sites (IA and VA) due to its location nearby the busiest street in Medan city (Sisingamangaraja Street).

Soot-EC/TC ratio varied from 0.06 to 0.19 where the highest was found in PM0.1among the particle sizes except in IA sites, indicated vehicles emission was more affected to the smaller particle sizes.

3. CONCLUSION

In this study, the size-segregated particles bound carbonous component in four different characteristic sites of PMs in North Sumatera Provinces were evaluated. OC is the dominant fraction of TC, accounted more than 60% and peaked at PM0.5-1. Then, the highest EC concentration was founded in PM0.1 in all sites except in IA. Regardless the site, soot-EC levels were decreased along with the increasing of particles sizes. Among four different sites, the highest soot-EC concentration was recorded in RS followed by SE, IA, and VA due to its location ±1.5 from Sisingamangaraja street. Then, soot-EC/TC ratio also was highest in PM0.1 among the other sizes except in IA site that might be correlated with the sampling sites.

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The Relationship between Sustainability Performance and Company Financial Performance with External Assurance as the Moderating Variable in Indonesian Listed Companies

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ABSTRACT

This research studied the relationship between sustainability performance and company financial performance, with external assurance as the moderating variable. Because previous research had primarily focused only on the sustainability performance and company financial performance relationship, this study attempted to investigate whether external assurance has a moderating effect on the relationship. Using regression analysis on a sample of 63 non-financial Indonesian listed companies that published a sustainability report in 2020, the results showed that unless the sustainability report was externally assured, there was no significant relationship between sustainability performance and company financial performance. Thus, it showed that external assurance has a moderating effect on the relationship. Therefore, external assurance is a strong and credible signal that could influence investors and position the company as superior. However, because the market has proven to be reactive to assured sustainability reports, this study also provides implications for regulators to take active approaches to formalize the regulatory basis for mandatory external assurance, resulting in a more consistent and comparable sustainability report that is in line with the development of sustainability disclosure standards.

Keywords: Sustainability report, Sustainability performance, financial performance, External assurance, Sustainability reporting regulation

1. INTRODUCTION

Sustainability reporting has been mandated in several ASEAN countries, such as Indonesia, Malaysia, and Singapore. The trend toward more significant reporting is expected to be continued due to the regulatory and market pressures [1]. On the other hand, companies also expect non-financial benefits, such as building a solid reputation [2] and attracting like-minded workers and customers who are aware of corporate responsibility [3]. A literature review conducted by Prado et al. [4] found no conclusive finding in the relationship between sustainability performance (SP) and financial performance (FP). Moreover, an uncommon

practice of assuring the credibility of disclosures within the sustainability report (SR) is considered a challenge for inexperienced stakeholders to verify the information [5]. Therefore, the current development of globally accepted IFRS sustainability disclosure standards will focus on the investor's need for decision-making. This condition is expected to bring lighter to SR as a medium for providing relevant information. As consistent applicability across the market is also expected, sustainability information eventually needs to be the subject of external assurance (EA) [6] to bring competitive advantage through verifiable quality of SP [7]. Therefore, it is crucial to study the relationship between SP and FP and how EA moderates the relationship, and contribute to the literature by highlighting the importance of EA as an enhancement mechanism for SP.

Signaling theory is used as the underlying theory because SR is one of the signals companies give to the market to boost investment decisions. Companies with good social performance tend to give voluntary EA to separate themselves from the equilibrium [8]. This study is quantitative research with an empirical cross-section method using regression analysis with samples from 63 listed companies in Indonesia that published SR in 2020 as mandated by the financial service authority in Indonesia (OJK) with POJK/51/2017. However, as OJK has just published new guidance in integrating the SR to the annual report through Circular Letter SEOJK/16/2021 and will be effective in the reporting year of 2021, this new regulation has been put as the SP basis to assess the readiness of companies in fulfilling the obligation. On the other hand, financial performance was measured by price-to-book value or market-to-book ratio because it is found to prove the market sentiment [9]. The provision EA will be the moderating variable and scored as one if it was available and zero if it was not. In order to ensure robustness, control variables were used, such as company size, leverage, industry, company ownership, and return on assets. Ultimately, this study tried to prove two hypotheses, 1.) sustainability performance is positively affecting financial performance; 2.) external assurance is strengthening the positive effect of sustainability performance and financial performance.

2. RESULT AND DISCUSSION (including conclusion)

Descriptive statistics suggested that most of the samples have disclosed the information based on the upcoming regulation, Circular Letter SEOJK/16/2021. Still, only a small part of the sample provided EA. Meanwhile, the regression analysis showed that the relationship between SP and FP was insignificant; hence the first hypothesis was rejected. This condition

might happen because SP was industry-specific, while the framework based on Circular Letter SEOJK/16/2021 was universal and applicable to a broad range of industries. Thus, the new regulation might not be able to highlight the industry's challenges and opportunities, failing to address the investor's concerns. This finding was supported by Ihsani et al. [10] and Muallifin & Priyadi [11], which studied SP and FP in multi-industries. Nevertheless, SP was based on the upcoming regulation and voluntarily applicable when samples were taken. Therefore, it was possible that the market considered SP based on the new regulation as weak signals.

In contrast, regression analysis of the second model found that EA enhanced the positive effect of SP and FP; hence the second hypothesis was accepted. The decision to provide EA rose from the information asymmetry in the market and highly sustainable companies addressed it to show their superiority. The difference in the first and second hypotheses was the provision of EA that suggested being able to moderate the previously insignificant relationship. It implied that voluntary EA is a strong, credible, and influential signal for investors in making decisions. Although these two hypotheses might be considered conflicted, they were in line with research from Kim et al. [12], which studied the relationship between CSR and market value with EA as the moderating variable using samples from US companies. Kim et al. projected the relationship to future periods and concluded that SP was an intangible effort; thereby an immediate effect cannot be expected in the same year. Because the market proved to be reactive towards assured SR, this study provides implications for regulators to take active approaches to formalize the regulatory basis for mandatory EA that will be resulting in more consistent and comparable SR, as supported by Qian et al. [13], which found the motivations for uptake the sustainability reporting to be regulatory requirements, reputation, and management commitment.

Sensitivity analyses were performed to ensure the robustness of the findings with two different proxies for FP, price-to-book value with the original sample and firm value based on Tobin's Q. Results from two sensitivity analyses with two other FP variables were consistent with the primary analyses that rejected the first hypothesis and accepted the second hypothesis.

With the development of IFRS sustainability standards and the possibility of future convergence, SR will be more important than ever in communicating sustainability disclosures to investors. Thus, ASEAN regulatory bodies should consider improving its

reliability and comparability through mandatory EA because it has been proven as a credibility enhancement mechanism that influenced market reaction. On the company side, this study brought a literature contribution to the relationship between SP and FP; thereby companies could choose the appropriate sustainability strategy to attract investors.

Sustainability performance and financial performance did not show a significant relationship unless the sustainability report was externally assured. The assurance was found to positively moderate the previously insignificant relationship; hence external assurance was considered a relevant, strong, and credible signal for investors.

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Rehabilitation Strategy for Restoration of Riverbank Protection Function in the Merawu Watershed, Banjarnegara Regency

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ABSTRACT

The riverbank is a buffer zone for the river ecosystem and the surrounding land. The significant rate of land use change and land cover reduction in the Merawu Watershed has put pressure on the riverbank area and threatened the sustainability of its protection function. Thus, this study aims to 1) identify the ecological status of riverbank, 2) identify its Protection Carrying Capacity (PCC), 3) determine the indicative location of rehabilitation, and 4) develop a rehabilitation strategy for restoring the protection function of the riverbank. The result of the ecological quality assessment using the Riparian Quality Index (RQI) method shows that human activities have already worsened the quality of the riverbank. The protection carrying capacity analysis shows that the entire main riverbank of the Merawu Watershed has been damaged. The indicative map for rehabilitation riverbank is made by overlaying RQI, PCC, critical land, and slope parameters. Four sub-districts become the indicative locations for the rehabilitation, namely Kalibening (6.90 ha), Pejawaran (32.85 ha), Karangkobar (49.80 ha), and Wanayasa (122.70 ha). Recommended rehabilitation activities include planting and applying soil conservation techniques that need a participatory approach to increase the success rate.

Keywords: Rehabilitation strategy, Soil and water conservation, Watershed management, Riparian zone, Carrying capacity, Riparian Quality Index, Critical land, Riverbank ecology

1. INTRODUCTION

The riverbank is an essential part of the river system with specific ecological conditions as a transition zone that can support and connect various interactions between land and water components, so it is crucial to maintain biodiversity on the riverbank (Ward et al., 2002; Corenblit et al., 2007). The riverbank system is a buffer zone with environmental services as an absorbent and filtering agent for sediment, erosion, and pollutants (Gurnell and Petts, 2002; Naiman et al., 2005; Corenblit et al., 2008). Vegetation cover on riverbanks

significantly reduces surface runoff and peak discharge (Suryatmojo and Kosugi, 2021). Therefore, disturbances in this area can interfere with other ecological components (Susetyaningsih, 2012) and induce environmental problems, such as erosion, sedimentation, landslides, and floods as the negative response (Rahayu et al., 2009). Various kinds of disturbances on the ground surface due to the influence of human activities on the riverbank will cause soil compaction, decrease porosity, and eventually affect the infiltration level (Gysi et al., 2000; Cameira et al., 2003; Osunbitan et al., 2005).

Nowadays, the need for land due to population growth will cause pressure on the riverbank area and turn into agricultural land (Maryono, 2007; Hladyz et al., 2011). Based on Syahli (2015), as much as 50% of land use in the Merawu Sub-Watershed has been turned into agricultural land from 1994 to 2014. Land conversion and intensive tillage at the site can lead to land degradation and critical land status that takes time and a high cost in the recovery efforts (Rachman, 2017). The lack of implementation of conservation techniques and the uncontrolled use of resources on the land can reduce the physical quality and function of the riverbank as a local protection area. Therefore, conservation efforts are needed to maintain and restore its protection function.

The Riparian Quality Index method (Tanago and Jalon, 2011) is used in this research to determine the riverbank ecological status of the Merawu Watershed in the context of diagnosis and monitoring riparian zones for conservation efforts through unique rehabilitation designs. The scoring system is based on three physical attributes of the river boundary structure (land dimensions, longitudinal continuity, and vegetation structure) and four attributes related to their function (natural regeneration, riverside conditions, lateral connectivity, and substratum conditions). The total score of all these attributes will be interpreted to determine the recommended management design based on the ecological status of the riverbank.

The concept of natural resources and land management based on carrying capacity is an effort to limit excessive utilization and prevent ecosystem damage by focusing on the existence, sustainability, and function of spatial status (Nugraha et al., 2013; Nugroho et al., 2018). Bidarti (2020) explained that exceeding the ability of the land to support environmental needs can occur if there is population pressure. These conditions will indirectly reduce the area's function, especially if there are intensive processing activities that can reduce the quality and productivity of the land. This aspect of the carrying capacity of

the protection function can be measured through the approach of the ability of the riverbank area to maintain the balance of its ecosystem while supporting various human activities (Muta'ali, 2012). Furthermore, implementing the management concept based on the quality of the protection carrying capacity of the riverbank can be a rehabilitation scheme that focuses on the severe area.

No research has focused on rehabilitating the riverbank to restore its protection function in Indonesia, especially in the Merawu Sub-Watershed. Therefore, the goals of this research are to 1) identify the ecological status of the riverbank, 2) identify its Protection Carrying Capacity (PCC), 3) determine the indicative location of rehabilitation, and 4) develop a rehabilitation strategy for restoring the protection function of the riverbank. The indicative locations for riverbank rehabilitation are needed to determine the priority of critical land that must be rehabilitated immediately. In addition, ecological status and insufficient protection carrying capacity in high slope classes are used to create the indicative location map. This map will be analyzed to develop the rehabilitation strategy for the riverbank to restore its protection function by considering the environmental characteristics.

2. RESULT AND DISCUSSION

Vegetation

Bareland was founded due to agroforestry activity in forest plantation land use. Based on the ground survey, the mixed plantation programs are less successful than agroforestry. Invasive and pioneer species are found in secondary dryland forests along the river.

Soil

The quick field test results show that the soil structure in location samples is mostly silty clay loam. The highest bulk density is in plot seven which means there is high human activity in the salak (Salacca zalacca) plantation that affects the soil compaction. Moreover, there is sand mining found in this riverbank plot.

Slope

Wanayasa Sub-district is the largest area with steep (2,283.16 ha) and very steep (6,132.87) topography. This region has the most significant risk of erosion and landslide events.

Critical land status

Batur (1,248.14 ha), Pejawaran (3,091.89 ha), and Wanayasa Sub-district (3,961.30 ha) have a high proportion of very critical land area. In contrast, the total area of non-critical locations is only 0.65% of the total area of the Merawu Sub-Watershed. The most extensive area of critical and very critical land is Wanayasa Sub-district on a very steep slope (class V), in the dryland agriculture land use.

RQI

The RQI score of 18 plots shows that there are six plots with the bad riparian status in mixed dryland agriculture and dryland agriculture plots. The land cover of those plots is less than 10%. Therefore, the management options for riparian systems in locations indicative that has similar conditions to those six plots need rehabilitation or restoration measures to reintroduce or gradually improve hydrological and ecological riparian functions. The government should reduce pressures and impacts as much as possible and ameliorate the social perception of river degradation.

PCC

Protection carrying capacity analysis shows that the entire main riverbank of the Merawu Watershed has been damaged. The lowest PCC score is 0.21 found in 3 sub-districts, i.e., Kalibening (0.54 ha), Banjarmangu (19.74 ha), and Pagentan Sub-district (21.01 ha). However, Wanayasa Sub-district is the severe widest area (106.62 ha) with a PCC score is 0.35 and the most damaged land use is mixed dryland agriculture.

Location Indicative

The analysis results show that rehabilitation of the riverbank should prioritize Kalibening (6.90 ha), Pejawaran (32.85 ha), Karangkobar (49.80 ha), and Wanayasa Sub-district (122.70 ha) . The most extensive critical and very critical land of Wanayasa Sub-district in steep and very steep slopes are found in the dryland agriculture land use.

Rehabilitation Strategy

Regulation of the Indonesia Minister of Environment and Forestry No. P.59 / MENLHK / Setjen / Kum.1 / 10/2019 concerning Planting in the Context of Watershed Rehabilitation states that the riverbank is one of the rehabilitation planting sites outside the forest area, while watershed rehabilitation planting within the forest area should not be carried out within the Perhutani work area. However, at the study site, differences in land cover were found on

the riverbank in the high-sloped Perhutani area. According to Suryatmojo and Kosugi (2021), it is better for the plantation forest riverbank to have a high land cover that is adjusted to the management plan and target of Perhutani to reduce surface flow and potentially decrease land productivity. Listyaningrum et al. (2017) stated that the percentage of vegetation cover area that reaches 50% percent of the riverbank is not enough to ensure that the riverbank is safe from danger.

According to Hadjowigeno and Widiatmaka (2015), one of the directions for managing riverbanks can be carried out with nonstructural mitigation such as education, training, counseling, spatial planning, and relocation. Education and counseling have targeted children or learners in formal or informal schools. Counseling targets all communities, especially adults. Furthermore, spatial planning and relocation are carried out through mapping the regional spatial plan. Nonstructural mitigation will work well if it involves an institutional role, especially spatial planning and relocation.

The low success rate of rehabilitation is generally due to the lack of community participation, so watershed management is needed by empowering local communities through a participatory approach that pays attention to local institutions, local inputs, and local technology (Ministry of Forestry, 2010). The high cost, effort, and time required for rehabilitation activities is a reason for farmers not to apply soil and water conservation techniques because they are not proportional to the economic benefits obtained. Low economic conditions are the main factor of the low conservation practices, so that community involvement in rehabilitation activities must be able to provide sustainable benefits in the long term, both for the state and society (Adimiharja, 2008; Hani and Levina, 2019).

Based on Indonesia Minister of Environment and Forestry Regulation No. P.39 / Menhut-II / 2010, rehabilitation efforts have an approach through ecosystem aspects that must be based on the watershed framework as a management unit by considering land carrying capacity, land suitability, and species diversity. The riverbanks that are the object of this study are primarily areas outside the state forest. Still, the designation has a protected function, so the type of land rehabilitation that will be carried out is aimed at maintaining and improving the function of water system protection, as well as the prevention of natural disasters of floods and landslides. According to the regulation, the existence of cultivation activities around the riverbank that are not in accordance with the ability and suitability of the land requires that

rehabilitation still accommodates the culture of local community farming in accordance with the class of land capability. In addition, local governments must also strive to develop patterns of incentives for the community, including seed assistance, technical assistance, and tax relief related to rehabilitation programs in the region.

According to the Indonesia Minister of Environment and Forestry Regulation P.105/Menlhk/Setjen/Kum.1/12/2018, The rehabilitation of riverbanks is aimed at restoring or restoring river functions and protecting river areas from activities that interfere with the sustainability of river functions. The target of this activity is critical land, both inside and outside the forest area located on the riverbank. The rehabilitation procedure refers to the Annual Forest and Land Rehabilitation Plan (RTn-RHL), which consists of the design of planting activities and the application of soil conservation techniques. Land and Forest Rehabilitation (LFR) planting activities consist of reforestation and green program. Those programs require a plant maintenance program until the third year. Reforestation is an effort to plant forest tree species in damaged forest areas. In contrast, a green program is an effort to restore critical land outside the forest area to restore land function, maintain and improve the function of water system protection, prevent natural disasters of floods and landslides, and increase land productivity. The design of rehabilitation activities in indicative locations is by applying soil conservation techniques. It can be carried out vegetatively by mulching and planting deep-rooted native or multi-purpose tree species in an agroforestry program. Technical soil and water conservation in structural and non-structural buildings should be applied as both locations have steep and very steep slopes. Thus, applying terrace, gully-plug, and silt pit are suggested to strengthen the river dike and reduce the surface run-off, sediment, and erosion risk.

3. CONCLUSION

The result of the ecological quality assessment using the Riparian Quality Index (RQI) method shows that human activities have already worsened the quality of the riverbank. The protection carrying capacity analysis shows that the entire main riverbank of the Merawu Watershed has been damaged. The indicative map for rehabilitation riverbank is made by overlaying RQI, PCC, critical land, and slope parameters. Four sub-districts become the indicative locations for the rehabilitation, namely Kalibening (6.90 ha), Pejawaran (32.85 ha), Karangkobar (49.80 ha), and Wanayasa (122.70 ha). Recommended rehabilitation activities

include planting and applying soil conservation techniques that need a participatory approach to increase the success rate.

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National Industry Participation in Nuclear Power Plant Program to Support Indonesia's Net Zero Emission Target

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ABSTRACT

To achieve the net zero emission target by 2060, the Indonesian Government's plans to use nuclear energy begin around 2045. This study focuses on national industries' participation in developing Indonesia's nuclear power plants. The success and sustainability of the construction and operation of nuclear power plants (NPP) depend on the strong supply chain of international and domestic industries. Understanding the supply chain is one of the things that must be fulfilled by the parties who will build a nuclear power plant. The map organizes nuclear plant components into four main groups: nuclear islands, turbine islands, plant accounts, and site development and construction. The domestic industry has long experience constructing various non-nuclear power plants, and these capabilities are essential to support the construction of nuclear power plants. From the analysis results, the national industrial groups that probably support the construction and operation of nuclear power plants are Civil Heavy Equipment, Civil Building Materials, Civil EPC & Engineering Services, Machinery & Equipment, Electronic Equipment, Electrical Equipment, Computers, and Office Equipment. However, to increase national industry participation, several essential factors must be addressed, mainly developing strong small & medium industries and the availability of vital industrial services.

Keywords: Energy security, Sustainability assessment, Energy collaboration, Nuclear Power Plant, Indonesia, National Industry Participation

1. INTRODUCTION

Indonesia has set a target of 2060 to achieve net zero emissions. In that year, most of the contribution will come from renewable energy, and there will be a portion of nuclear power plants of 35 GW. The Indonesian government plans to operate the nuclear power plant in around 2045. The participation of the national industry in the development of the nuclear

power plant is crucial because of its role in the value of the level of domestic manufacturing components in the nuclear power plant development project. Mapping all aspects that influence the participation of national industry in the development of nuclear power plants, such as safety standards, codes and international standard components, and national industrial capabilities, are the primary keys to the success of nuclear power plant development. From the earliest stages of development, the successful construction of nuclear power plants (NPP) depends on a robust supply chain of nuclear manufacturers. NPPs comprise hundreds of components and subcomponents, whose construction will require a deep and diverse supplier base. Understanding this supply chain has become one of the things that must be fulfilled by the parties who will build the NPP. This supply chain map aims to help new suppliers identify where their products fit among the components and subcomponents of an NPP and to inform them of the quality requirements for these components. The supply chain map also aims to understand the broad array of manufactured components required for an NPP. The map organizes the components of a nuclear plant into four main groups: nuclear island, turbine island, the balance of plant, and site development and construction. These groups are further broken down by system (e.g., secondary steam or electrical equipment). From there, the groups are divided into components and subcomponents. Components whose manufacturing requires a quality assurance program should be under attention. The supply chain map of NPP is used to calculate national industry participation.

2. RESULT AND DISCUSSION

Capabilities of National Civil Construction Industries

For civil construction service industries, potential large industries with experience in conventional power plant development are PT. Waskita Karya, PT. Hutama Karya, PT. Adhi Karya, PT. Nindya Karya, PT. Wijaya Karya, PT. Housing Development, PT. Total Bangun Persada, and PT.Krakatau Engineering is engaged in EPC. The code requirements and material standards for nuclear power plants (e.g., AP 1000) require reinforcing materials for general use using ASTM A615 grade 60 and steel structures using ASTM A572 grade 50 and ASTM A36 for general use. Steel and steel structures that generally have ASTM A36 and ASTM A 572 are PT. Krakatau Steel, PT. Gunung Steel Group, PT. Krakatau Wajatama, PT. Cilegon Fabricators, and PT. Gunawan Dian Jaya Steel. Based on the BATAN-KHNP cooperation document, the most suitable type of cement in Indonesia for NPP construction is Type V Portland Type which is resistant to corrosion. Providers of type V portland cement

are PT. Semen Padang, PT. Semen Tonasa and PT. Semen Gresik. Cement industries that are available today include PT. Semen Padang, PT. Semen Gresik, PT. Semen Tonnasa, PT. Semen Andalas, PT. Semen Holchim Indonesia, PT Indocement Tunggal Perkasa.

Capabilities of National Mechanical Industries

Some mechanical industries have potential capabilities, such as PT. Siemens Indonesia, PT. Nusantara Turbin dan Propulsi, PT. PINDAD, PT. Barata Indonesia, PT. Boma Bisma Indra. PT. Siemens Indonesia has a potential capability because it has supplied a condenser to Finland for NPP - EPR 1,600 MWe. All condensers for a capacity of 1,600 MWe are made in Indonesia with a total weight of 1,500 tons and were shipped via an industrial port in Banten. Besides making condenser, PT. Siemens can also make outer and inner casings for large-capacity steam turbines, generator cashing, and stationary blade range for turbines. The ability of PT. Siemens is capable of manufacturing steam turbines with capacities of 450 HP and 2 MWe, with local content of 89%, and has been tested up to 5000 revolutions per minute (rpm). A turbine with a power of 7 MWe has been produced by PT Nusantara Turbine Propulsion (PT NTP), Bandung, West Java. Some national companies, such as CV. Alpha Omega, PT.Boma Bisma Indra, and PT. Barata Indonesia is competent in making some BOP components mainly related to heat transfer and storage systems.

Capabilities of National Electrical Industries

The ability of the domestic electrical industry can be seen from the experiences of several industries, among others, PT. Alstom Power Energy System Indonesia has experience producing power supply, PV solar modules, batteries, inverters, HRSG (heat recovery steam generator), and others. PT Schneider Indonesia is experienced in producing various instrumentation and control equipment and various low & medium voltage electronics products. PT Hitachi Power System Indonesia is experienced in producing CB (circuit breaker) & switch gear. Some industries are experienced in producing transformers, such as PT CG Power System Indonesia, PT Trafoindo Prima Perkasa & PT Asata Utama Electrical Industries. Industries experienced in producing specialty cables include PT Nobi Putra Angkasa, PT Kabelindo Murni & PT First Cable Industries. Based on the experience and quality of production from various electrical industries, Indonesia can be optimistic about targeting high domestic component levels in electrical areas. The domestic electrical industry's potential to develop includes MMI components (man-machine interface), especially those based on modern digital technology.

Experience in Nuclear Installation

Development Indonesia has no experience building nuclear power plants but has had experience building nuclear research reactors and their supporting facilities. This facility is built in the Puspiptek Serpong complex Banten forms Multipurpose GA Siwabessy Reactor with 30 MWth power capacity. The level of local content in the construction of research reactors and supporting laboratories is 35.7% (civil construction & electrical-mechanical installation 25.2%, equipment & infrastructure 8.8%, and engineering supervision 1.7%). In its construction implementation, a local contractor for civil works on RSG-Siwabessy Reactor was PT. Hutama Karya, who works on reactor foundation, PT. Waskita Karya for Reactor building and PT. Adhi Karya for building / operational building. The local contractor for mechanical work is PT. Truba Jurong Engineering. Local contractor area can be detailed as follows: Detailed design for auxiliary building by PT Architen, foundation work of reactor building by PT. Hutama Karya, civil works of reactor building by PT. Waskita Karya. Detailed design for operation building by PT. Architen, Civil works for operation building by PT. Adhi Karya, and cooling tower installation by PT. Waskita Kary.

Local Content Level

The Basic Law of domestic component level (TKDN) refers to the Regulation of the Minister of Industry of the Republic of Indonesia No: 16 / M-IND / PER / 2/2011 on "Provisions and Procedure for Calculating TKDN." Ministry of Industry regularly publishes a List of Inventory of TKDN Certified Domestic Production Goods. TKDN for the sustainable development of NPP in Indonesia can continue to follow the pattern used by South Korea. In South Korea, the first phase nuclear power plant was able to record 8% TKDN for equipment, but in stage 3, it has been able to reach 79% TKDN for equipment and 95% for the design. The phase of nuclear technology acquisition in Korea can be divided into 3 phases: Phase Technology Dependency, which uses Turn Key; Phase Technology Accumulation using Non-Turn Key; and the Self-Reliance Technology Phase using Non-Turn Key. For Indonesia, several studies of TKDN for NPP have been conducted by BATAN, among others: NEWJEC (1992-1994) study, BATAN / BPPT / MHI / Westinghouse Study (1996), General Electrical & BATAN Study (1996 - 1997), BATAN & MHI Study (1998), BATAN & KEPCO (1998), and the study between BATAN & UGM study (2004). Based on the NEWJEC study, the estimation of the TKDN level for Phase 1 PLTN project is 32,59%, and stage 2 is 39,3%.

3. CONCLUSION

The successful construction of nuclear power plants (NPP) depends on a robust supply chain of nuclear manufacturers. NPP comprises hundreds of components and subcomponents whose construction will require a deep and diverse supplier base. Understanding this supply chain has become one of the things that must be fulfilled by the parties who will build the nuclear power plant. This supply chain map aims to help new suppliers identify where their products fit among the components and subcomponents of an NPP and to inform them of the quality requirements for these components. The supply chain map also aims to promote understanding the broad array of manufactured components required for a plant. The map organizes the components of a nuclear plant into four main groups: nuclear island, turbine island, the balance of plant, and site development and construction. These groups are further broken down by system (e.g., secondary steam or electrical equipment). From there, the groups are divided into components and subcomponents. Components whose manufacture requires a quality assurance program should be under attention. The supply chain map of NPP is used to calculate national industry participation. The capacity of NPP in the world will increase in the coming years, especially to meet the needs of developing countries. The growing question is how much they need for raw materials for the construction and operation of NPP. Sufficient raw materials available worldwide must support the growth of nuclear power plant capacity. NPP is a large and complex facility requiring large raw materials for infrastructure and fuel. The vendors have not fully disclosed raw material requirements for NPP Gen III and Gen III +, but raw material requirements have been established. Based on these requirements, the need for raw materials can be estimated, especially in new NPP construction projects. The raw material requirements for the sophisticated Gen IV, nuclear power plant is not yet known because of the absence of a Gen IV NPP. Other raw material requirements from nuclear power plant development are land area and water volume. The land area and water volume are separate considerations if there is a need for comparisons between different types of power plants to analyse the feasibility of nuclear power plants. In the framework of Increasing the Use of Domestic Products (P3DN) as mandated by Article 85 Act No. 3 the year 2014 on Industry and Presidential Instruction Number 2, the Year 2009 on the Use of Domestic Products in the Procurement of Government Goods / Services, the Ministry of Industry has compiled a list of inventories of manufactured local content level (TKDN) Year 2011 - 2016. Industrial groups that support the construction and operation of nuclear power plants are Civil Heavy Equipment, Civil Building Materials, Civil EPC & Engineering Services, Machinery & Equipment, Electronic

equipment, electrical equipment, computers, and office equipment. Mapping the potential of these industries is essential to support the NPP. In a mission to become a newly developed industrialized country, Indonesia's industrial sector must meet several essential criteria, among others:

High role and contribution to the national economy,
Small & Medium industries have the comparable ability with Large Industries,
Strong industrial structure (complete Industrial structure),
Advanced technology has led to market development and creation,
Vital industrial service that supports the international competitiveness of the industry Competitiveness.

The participation of the national industry is crucial in the construction of the NPP in Indonesia, especially for the sustainability of the nuclear energy program. Mapping all the influential aspects of national industry participation in NPP development, nuclear safety standards, international codes, and standards for NPP components, and national industry capabilities are keys to successful NPP development. Selecting the right NPP vendor will also determine the opportunities for the realization of the TKDN target that is possible to be achieved by the national industry as well as the realization of the technology transfer target at the next NPP stage (post first NPP). The issues of quality management, supply accuracy, conditions of payment, and work ethic of the vendors are some things that should be taken into consideration in the selection of vendors. Vendors with experience in reliability and safety should be selected for NPP in Indonesia.

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Relationship Analysis between Human Behavior and Air Quality - Effect of COVID-19

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ABSTRACT

To discuss the effect of human activities to air quality and evaluation of environmental risk exposing to air pollutant in the urban area, relationship between time-change of human behaviour and air quality has been investigated in two downtown area in Kanazawa City, Japan. Hourly monitored concentration data of suspended particulate matter (SPM), nitrogen dioxide (NO2) and carbon monoxide (CO) obtained by air quality monitoring stations and data on human behaviour, such as estimated population from Mobile Spatial Statistics (MSS), traffic volume from probe data, and consumption of city gas and electricity suggested that the air quality could be associated with the various factors on human behaviour. The relationships among the factors on air quality and human behaviour varied according to the social activities and the air pollutant.

Keywords: Human behaviour, Mobile phone location data, COVID-19, Air quality, Health Risk Assessment

1. INTRODUCTION

Because the human activities are strongly related with air quality in two meanings, human as pollutant source and as recipient. Therefore, the health effects and risks in an environment contaminated by pollutants have been discussed only based on environmental indices are not enough for control. Currently these two focusing points are studied individually as so-called inventory analysis and exposure analysis. As a preliminary phase of the authors' challenge on dynamic risk assessment including both, we obtained the public government data of air pollutant and mobile location data of 2019 and 2020 to compare with. We have tried case studies focusing on two downtown areas, Musashi as a high traffic area for various people as businesspersons, tourists, and students and Katamachi as more restaurant and

bar area in Kanazawa City. We also checked the gas consumption in the city area to discuss the effect of cooking in the restaurants in the downtown areas.

2. RESULT AND DISCUSSION (including conclusion)

We found lower correlation between suspended particulate matter (SPM) mass concentration and estimated population than nitrogen oxides (NOx) which suggests the strong relationship between traffic amount and human movement. We found the effect of COVID-19 was not apparent to SPM but to NOx. We will report the further effect of traffic, cooking and other behaviours on air pollutants.

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Pyrolytic Analysis of Chemical Components from the Bark of Eucalyptus pellita F Muell

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ABSTRACT

The utilization of E. pellita bark as waste is still not widely carried out due to a lack of information about the chemical content. Therefore, the current study aimed to analyse the chemical content of the bark of E. pellita using pyrolysis–gas chromatography-mass spectrometry (PyGCMS). The results showed the total extractive content of _E. pellita_mixed-bark was 14.85%, The total inner bark extract was 12.17%, and 16.19% outer bark extract. The holocellulose content of E. pellita mix-bark was 65.45%, while the inner bark and outer barks were 60.68% and 59.29%. The Alpha cellulose content of E. pellita bark was 57.97%, while the inner and outer barks were 56.43% and 54.14%, The lignin content of the clason mix-bark of E. pellita was 25.39% for the inner bark and outer bark, respectively, 28% and 26.72%. The results of pyGCMS showed that the bark of E. pellita was catechol, 3-methyl-catechol, resorcinol, 3,5-Dimethoxy-4-hydroxytoluene, and (E)-3,3'-Dimethoxy-4,4'-dihydroxystilbene.

Keywords: py-GCMS., soxhletation, bark, pyrolytic analysis, Eucalyptus pellita

1. INTRODUCTION

Indonesia's pulp and paper industries require around 41.4 million tons of wood per year as raw materials [1]. So far, fiber sources from the pulp and paper industry have been dominated by _Acacia mangium_Willd [2]. However, the acacia trees are susceptible to pests and diseases, with a disease distribution area of up to 71.5% [3]. Therefore, the plantation forests (HTI) use _Eucalyptus pellita_F Muell as raw material for pulp because the potential for pest attack on E. pellita is lower when compared to A. mangium [4]. Thus, the HTI is currently replacing _A. mangium_plantation and shifting to _E. pellita_as the primary raw material for pulp and paper industries [5]

The location of the HTI, which is not concentrated in one area, causes E. pellita logs to be sent to pulp and paper mills, which are still limited in existence. Before the shipping process, it is necessary to debark logs of E. pellita because the presence of bark will cause additional transportation weight, resulting in additional costs. One ton of bark waste from E. pellita will take up 1.41 m3of space [6], which reduces the volume efficiency of wood required for pulp and paper use. The utilization of _E. pellita_bark as waste is still not widely carried out due to a lack of information about the chemical content. Therefore, the current study aimed to analyze the chemical content of the bark of E. pellita using pyrolysis–gas chromatography-mass spectrometry (PyGCMS).

2. RESULT AND DISCUSSION

The barks of E. pellita were prepared in three samples: (1) Outer bark; (2) inner bark: and (3) mixed bark (non-separated bark). The extraction was conducted with soxhletation using n-hexane, ethyl acetate, and methanol The results showed the total extractive content of _E. pellita_mixed-bark was 14.85%, with the most extract produced by methanol solvent of 5.89%. The total inner bark extract was 12.17%, with the highest extract in methanol solvent and 16.19% outer bark extract, with the highest extract produced by ethyl acetate solvent. Total extractives from the bark part were higher than that of the wood part [7], even higher than the maximum yield using the heat treatment method [8]. This shows that extraction with a graded solution produces more extract when compared to one type of solvent.

The holocellulose content of E. pellita mix-bark was 65.45%, while the inner bark and outer barks were 60.68% and 59.29%, respectively. The Alpha cellulose content of E. pellita bark was 57.97%, while the inner and outer barks were 56.43% and 54.14%, respectively. The lignin content of the clason mix-bark of E. pellita was 25.39% for the inner bark and outer bark, respectively, 28% and 26.72%. The results showed that the holocellulose, alpha-cellulose, and lignin levels in the bark of E. pellita were lower than the holocellulose and lignin levels in the wood of E. pellita in the previous study [7].

The chemical component of bark samples was evaluated by PyGCMS analysis. The pyrogram generated the pyrolysis product peaks corresponding to carbohydrate and lignin. In more detail, lignin is a combination of p-coumaryl unit (Lignin-H), coniferyl alcohol or guaiacol (Lignin-G), and synapyl alcohol or syringol (Lignin-S) [9]. PyGCMS analysis fragmented a macromolecule (carbohydrate, lignin) into macromolecules called pyrolysis products [10].

Pyrolysis products originating from carbohydrates were detected at the beginning of pyrogram, as readily fragmented, followed by lignin pyrolysis products. The extractive derivatives of pyrolysis product originated from the bark of E. pellita were catechol, 3-methyl-catechol, resorcinol, 3,5-Dimethoxy-4-hydroxytoluene, and (E)-3,3'-Dimethoxy-4,4'-dihydroxystilbene. In general, pyrolysis comes from polyphenolic compounds such as tannins and flavonoids. Both tannins and flavonoids have potential as antioxidants or antimicrobials, and anti-insecticides [11,12]. Further analysis to characterize the tannin compound of extractives for the bark of E. pellita also were conducted by PyGCMS. Catechol has been detected as the main peak originating from the B-ring of tannin in all samples, and 4-methyl-catechol was only founded in Inner-bark MeOH extract and Mix-bark MeOH extract. Another B-ring tannin pyrolysis product, pyrogallol also detected in all samples except EA extract for Outer and mix-bark samples. Based on pyrolysis product results, Inner-bark (EA/MeOH) and MeOH of Outer and mix-bark samples are assumed to have chemical structures as the proanthocyanidin and prodelphinidin classes.

3. CONCLUSION

The chemical characteristics of E. pellita bark were lower than that of E. pellita wood from holocellulose, alpha-cellulose, and lignin content. However, the extractive substances produced by the bark of E. pellita were more than those of E. pellita. The results of pyGCMS showed that the bark of E. pellita was catechol, 3-methyl-catechol, resorcinol, 3,5-Dimethoxy-4-hydroxytoluene, and (E)-3,3'-Dimethoxy-4,4'-dihydroxystilbene.

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Emissions Reduction Potential in Building Sector in 2030: Gyeonggi Province case

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ABSTRACT

This study aims to analyse GHG emissions reduction potential in the building sector of Gyeonggi province under Korea's NDC. GCAM-GG is used for the 'NDC scenario,' which includes 1) using clean electricity and 2) increasing building energy performance. Results show that energy use increases by 7.81%, and the GHG reduction potential is 35.68% in 2030 compared to 2018 in the building sector. Increasing building energy performance could save building energy. However, it cannot explain this phenomenon. Therefore, using clean electricity is a significant reason for decreasing GHG emissions. It is essential to focus on indirect emissions to decrease building sector emissions in the Gyeonggi province.

Keywords: Building Energy, GCAM-GG, Decarbonization potential, Province-level Modeling, NDC

1. INTRODUCTION

In Korea, the Local government has become a significant player in carbon neutral society. The Korean government has passed a law to mitigate and adapt climate change [1]. Like the central government, local government should make ten years plan for mitigation and adaptation every five years in the law. For that, local governments make local ordinances for the law and should formulate strategies based on national strategy [2,3]. The local government should forecast GHG emissions amounts and plan a strategy to reduce emissions for sectors such as transformation, industry, building, transport, and waste. Then, how much do the province's emissions decrease potential by the national plan (NDC)?

This study analyses emissions reduction potential under the NDC scenario in the building sector in Gyeonggi province. GCAM-GG, a detailed province-level integrated assessment model based on GCAM, is selected for analysis of the potential of NDC.

2. RESULT AND DISCUSSION (including conclusion)

The simulation shows that the final energy use in the building sector increase by 7.81% in 2030 compared to 2018. Gas and liquids use increase by 2.80% and 0.75% in 2030 compared to 2018. Electricity use increases by 8.90%, which leads to more than half of the final energy share. Coal decrease by 75%, and biomass increase by 41.94%, but those two fuels' final energy shares in 2018 are only 0.41% and 6.41%. However, though total energy consumption is increasing, the result shows that emissions reduction potential in the building sector is 35.68% in 2030 compared to 2018. In the scenario, direct emissions increase by 0.23% because of gas and liquids.

It is analysed that the clean generation in the scenario drives GHG emissions reduction potential in the building sector. High-performance buildings could minimize energy use in the building sector. However, it could not explain the emission reduction in the scenario result. Therefore, using clean electricity is a significant reason for decreasing GHG emissions. Population growth and floor space increase in Gyeonggi province makes direct emissions increase even building energy per floorspace decrease by 6.16% in 2030 compared to 2018. Focusing on indirect emissions is essential to reduce the emissions in the Gyeonggi province building sector.

The result could be reached by 1) using clean electricity and 2) increasing building energy performance. It would be efficient for the local government to focus on electrification to decrease direct emissions and install building PV to decrease indirect emissions.

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Determination of Particulated Matters and Total Suspended Particles Emit from Incense Burning

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ABSTRACT

Incense burning is an important ceremonial ritual in Buddhism. It is frequently burned in homes, temples, stores, and offices. It is well recognized that incense smoke has negative health effects, which may be caused by the emission of submicron particles, including ultrafine and nanoparticles. Hence, in this study, the concentration of particulate matters (PMs) and total suspended particles (TSPs) emitted from incense burning were determined from 4 incense sticks brands. S1 and N1 represent the long incense stick, while S2 and N2 stand for the short incense stick. The experiment was conducted in a room with a volume of approximately 146m^3 using two instruments: an HV sampler and a Nano Sampler. The highest TSPs concentration from long sticks and short sticks were S1 (319.03 µg/ m^3) and N2 (439.75 µg/ m^3), respectively. High mass concentration was found in the ultrafine particles range for S2 (117.30 µg/m^3) and N2 (117.30 µg/ m^3). In contrast, S1 and N1 exhibited high concentrations in the coarse particle mode (PM2.5-10) at 79.28 µg/ m^3 and 86.75 µg/ m^3, respectively. Although the mass concentration for short sticks was higher than for long sticks, the amount of mass collected on the long sticks' filters was greater than on the short sticks' filters.

Keywords: Incense burning, Particulate matters, Total Suspended Particles, Air pollution, Indoor air quality

1. INTRODUCTION

Incense is an aromatic biotic material that emits fragrant smoke when burned. Incense is available in a variety of shapes and sizes all around the world [1]. In Cambodia, Buddhism is officially recognized and promoted by the government as the state religion [2]. Therefore, the use of incense is unavoidable as incense is referred to as a "divine odor" by Buddhists,

and its aroma is meant to conjure the presence of Buddhist deities [3]. In the Khmer Lunar calendar, there are 4 Sila days per month. In those days, Buddhists burned incense sticks in their houses or pagoda. The burning of incense releases smokes which contains particulate matter (PMs), gas products, and other organic compounds that are dangerous to respiratory health [4,5]. Particulate matter is a mixture of solid and liquid aerosol particles that come in a variety of sizes and chemical compositions [6]. Small particles may interfere with human respiration due to the slow deposition velocities that cause them to stay in the air for prolonged periods [7]. Exposure to incense smoke has been linked to a variety of negative health outcomes, including cancer, dermatitis, mutagenesis, genotoxic effects, respiratory morbidity, central nervous system impairment, and lung irritation [8,9]. This study would be the first study about the emission of PMs and TSPs from incense burning. The objectives of this study are: To understand people's habits through online surveys and to determine the PM10, PM2.5, PM1, PM0.5, PM0.1, and TSP mass concentration from incense burning.

2. METHODOLOGY

This study consists of three phases: Survey questionnaire, Sampling, and Pollutant analysis. In the survey questionnaire phase, the survey aimed to determine the number of incense sticks to burn, and the product's origin based on the majority of responses. The duration of the survey was opened for one week from 20 March 2022 to 27 March 2022.

In the sampling phase, the incense burning experiment was conducted in a laboratory room with a volume of about 146 m^3 . Three incense sticks were ignited and placed around 0.9m, while the sampling instruments were placed 0.76m above the ground and 0.3m from the burning position which is the typical praying position mentioned by [10]. The sampling instruments used in these experiments were a High-Volume sampler (Sibata Model HV500F) [11] and a Nano Sampler [12].

In the Pollutant Analysis phase, the mass concentration of PMs and TSPs were determined gravimetrically. The filters were sent back to Kanazawa University, Japan to weigh their mass. Before weighing, the filters were stored in the chamber at 20±5◦C and humidity of 35±5◦C for 48 h and weighed subsequently. The mass concentration was determined using the following formula:

$C = (m_f - m_i) \times 10^3/V$

Where C is the concentration of PM or TSP,

m_i is the initial mass of the filter before sampling (mg),
m_f is the final mass of the filter after sampling (mg),
V is the total volume of an air sampled (m^3), and
10^3 is a factor of the conversion from milligrams to micrograms

3. RESULT AND DISCUSSION

Survey Responses

Throughout the one-week online survey campaign, 100 responses were collected. According to the survey, most people used incense 4 times per month, and they burned 3 sticks each time. Although there are many incense sticks sold in the market, people opted for locally made products over imported brands, meaning the made-in-Cambodia incense sticks.

TSP concentration

The mass concentration of TSP obtained from the HV sampler is shown in Figure 1. The concentration for long scented sticks (S1) and short scented sticks (S2) samples were 314.80 µg/m^3 and 354.40 µg/ m^3, respectively. Whereas the concentration of long (N1) and short (N2) normal or unscented sticks were 316.64 µg/ m^3 and 439.75 µg/ m^3, respectively. However, the mass collected on filters of S2 and N2 was found to be lower than on the filters of S1 and N1. This implies that shorter sticks emitted less amount of TSP than the longer sticks.

Physical characteristics of Particulate matter concentration

Since the nano sampler did not operate at the standard flow rate (40L/min), there are shifts in cut-off size for each impactor stages. The operating flow rate is shown in the bracket. From Figure 2, short incense sticks released the highest concentration in the nanoparticle range, which was 112.27 µg/ m^3 for S2 and 117.30 µg/ m^3 for N2. Since ultrafine particles have a large surface area that may absorb a wide range of harmful substances, it is typically considered that they have extremely high toxic characteristics. Most studies have found that inhaled PM0.1 is harmful to human health, but there is still little knowledge on the relationship between PM0.1 and health risk [13]. For the long incense sticks S1 and N1, the highest concentration was found in the range of PM2.8-11 for S1 (79.28µg/ m^3) and PM3.1-12.6 for N1 (86.75µg/ m^3). Out of the 4 incense sticks brands, N2 had the highest concentration in almost all size ranges compared to the other 3 brands.

In conclusion, the determination of mass concentration of PMs and TSPs emit from incense burning was conducted in a room with a volume of approximately 146 m^3 using two instruments: an HV sampler and a Nano Sampler. Based on the findings, in the short incense sticks category, N2 released higher TSP and PM concentrations especially in the nanoparticle range. On the other hand, the long incense stick N1 emitted more concentration in the coarse particle mode compared to S1. Although the mass concentration for the short incense sticks is higher than the long sticks, the amount of mass collected on the long sticks' filters was greater than on the short sticks' filters.

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Ten Years Behavior of Airborne Particles in Phnom Penh, Cambodia

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ABSTRACT

The long-term behaviour of mass concentration of ambient particulates that were fractionated into 6 different fractions was discussed on samples collected at a site located in Phnom Penh City, Cambodia for the period between 2011-2020. A cascade air sampler that can collect $PM_{0.1}$ (<0.1 μm) has been used at a site located on a roof floor of a 5-story building in the campus of Institute of Technology of Cambodia (ITC) located near the central part of Phnom Penh City. Chemical components in the PM0.1fraction, or, carbonaceous components, WSOC and in-organic water-soluble ions were analysed to discuss influences of emission sources and events.

Keywords: Air quality, Nanoparticle, carbonous components, ions, WSOC, hotspots

1. INTRODUCTION

The sampling site was installed on the rooftop of the 3-story building (~2018) and 5-story building (2018~) of ITC located nearby (11°34'14.8"N, 104°53'53.4"E). Characteristics of samples collected at both sites were confirmed to be almost identical. ITC site is surrounded man roads, or the Kim IL Sung Blvd. in the east and the Russian Blvd. in the south. These roads are very busy with traffics. This location can be classified as a representative of the busy city area of Phnom Penh city.

A cascade air sampler that can separate ambient particles into <0.1/0.1-0.5/0.5-1/1-2.5/2.5-10/>10 μm based on the aerodynamic diameter has been used. Particles were collected on quartz fibrous filters. Particle-bound carbonaceous components were analysed by the thermal/optical method following the IMPROVE-TOR protocol. WSOC and inorganic water-soluble ions were also analysed by TOC analyser and ion chromatograph, respectively.
The information on number and distribution of hotspots was obtained through MODIS (MODIS, 2021). The air mass backward trajectory was evaluated using HYSPLIP 4 (AYR, 2021).

2. RESULT AND DISCUSSION (including conclusion)

Increasing mass concentrations of PM have been observed for a decade in most of size ranges of particles except 0.1-0.5μm. This was particularly clear in $PM_{0.1}$ and its fraction to total suspended particles ($PM_{0.1}$/TSP) also have been constantly increasing for a decade along with another fraction of > 10 μm of a slight increase in the mass concentration. Emissions from fossil fuel burning and soil dust resuspension probably by increasing constructions may attribute to such behaviours in PM. soot-EC has been gradually increasing while OC fraction has been decreasing. Such behaviours suggest changes in the social parameters as the number and type of automobiles and the energy share by fuel types. For example, soot-EC was preliminary correlated to the number of all registered cars, successfully. Decreases in OC and other parameters as char-EC were shown to be partially described by a decrease in wood fuel and charcoal in the household fuel share. K+, a typical parameter of biomass burning, was shown to increase in periods of peaks in the number of hotspots shown, indicating the large scale open filed burning could also affect the air pollution in the urban area of Phnom Penh.

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Fine and Nano Particles in the School Environments and the Respiratory Deposition Doses to Schoolchildren in a Middle City of Jambi, Indonesia

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ABSTRACT

This study performed an ambient field sampling in the five public junior high schools near roadside in a middle city of Jambi (Indonesia), three schools in urban (U1; U2; U3) and two schools in suburban (SU1 and SU2). The respiratory deposition doses (RDD) in headways (HD), tracheobronchial (TB), and alveolar (AL) regions of schoolchildren for PM0.1 and PM2.5 were also determined, comparing between male and female, which we assumed in the "light exercise" condition. Whole PM2.5 mass concentrations in the U3, SU1, and SU2, respectively, exceeded the guidelines both at SG and SY during weekdays and weekend, while only one in U2 the PM2.5 mass at SG during weekdays exceeded and in the U1 was still below the standard limit. Two couples of PM mass concentration at SG during weekend of SU1 (PM0.1: 16.8 µg/m3; PM2.5: 66.6 µg/m3) and SU2 (PM0.1: 17.4 µg/m3; PM2.5: 63.9 µg/m3) were the highest, while the lowest was also happened at SG during same period in the U1 (PM0.1: 2.0 µg/m3; PM2.5: 12.4 µg/m3) and U2 (PM0.1: 1.3 µg/m3; PM2.5: 13.6 µg/m3). The RDDs for PM0.1increased from HD to AL but decreased for PM2.5, which demonstrated size of particles to have most influenced to RDDs.

Keywords: nanoparticles, fine particles, school environments, respiratory, doses, pollution management

1. INTRODUCTION

During improvement of COVID-19 cases in Indonesia, in the late of 2021 while school activities have been allowed to start in the school environment, exposure assessment to fine particles, identically for nano-size particles (PM<0.1) should be an interest. Fine particles entered deeper into the body and deposited in the bronchi and alveoli [1]. The PM0.1 can reach about 50% or more into the extra thoracic, alveolus, and thoracic regions, which then pass through the respiratory tract to penetrate the alveolar-capillary barrier and be distributed throughout the body by bringing greater quantities of hazardous metals and

organic compounds [2, 3]. While children who are still in the developing of respiratory and immune systems [4], the higher physical activity and faster inhalations possibility lead higher exposure and harmful pollutants doses [5].

We performed an ambient field sampling during January to February 2022 in the five public junior high schools located near roadside in a middle city of Jambi (Indonesia), comprised of three schools in urban (U1; U2; U3) and two schools in suburban (SU1 and SU2). The school environments were at the school gate near to roadside and at the schoolyard near classes. Two ambient nano samplers (ANS) developed by [6] were utilized simultaneously for 24 hours at the school gate (SG) and schoolyard (SY), three days in weekdays and one day in weekend. In addition, respiratory deposition doses (RDD) in headways (HD), tracheobronchial (TB), and alveolar (AL) regions of schoolchildren for PM0.1 and PM2.5 were also determined, comparing between male and female, which we assumed in the "light exercise" condition. The RDD was popularly used to estimate the deposition doses of particles with their size entering human respiratory [7].

2. RESULT AND DISCUSSION

Schooling in Indonesia was allowed to be performed three times a week for ± 4 hours per day in the class after almost 1.5 years online. Students were being at school with some procedures applied, such as must use mask, checking body temperature before going to school, and who were unhealthy must stay at home. During field sampling, roadside transportation was possibly being the most influence source compared with other sources, such as combustion activities from trash burning and cooking by school canteen, which were not observed. Figure 1 shows mass concentration of PM0.1 and PM2.5 in comparison with WHO guidelines on PM2.5 while for PM0.1 is still no standard available. Whole PM2.5 mass concentrations in the U3, SU1, and SU2, respectively, exceeded the guidelines both at SG and SY during weekdays and weekend, while only one in U2 the PM2.5 mass at SG during weekdays exceeded and in the U1 was still below the standard limit. In average, concentration range of PM0.1 to PM2.5 was between 3.5 – 7.2, except in the SU2 at SY during weekdays about 8.5 (PM0.1: 2.4 µg/m3; PM2.5: 20.5 µg/m3) and at SG during weekend reached 10.2 (PM0.1: 1.3 µg/m3; PM2.5: 13.6 µg/m3). Two couples of PM mass concentration at SG during weekend of SU1 (PM0.1: 16.8 µg/m3; PM2.5: 66.6 µg/m3) and SU2 (PM0.1: 17.4 µg/m3; PM2.5: 63.9 µg/m3) were the highest, while the lowest was also

happened at SG during same period in the U1 (PM0.1: 2.0 µg/m3; PM2.5: 12.4 µg/m3) and U2 (PM0.1: 1.3 µg/m3; PM2.5: 13.6 µg/m3).

Figure 1. Comparison between PM0.1 and PM2.5 and air pollution standards.

The RDDs of children for PM0.1 and PM2.5 comparing between female and male were also discussed, which reveals different trend as shown by Figure 2. Male children had higher RDDs than female children. The RDDs for PM0.1increased from HD to AL but decreased for PM2.5, which demonstrated size of particles to have most influenced to RDDs.

Figure 2. The RDDs between PM0.1 and PM2.5 in headways, tracheobronchial, and alveolar regions.

3. CONCLUSION

This work has become the first study of PM assessment down to PM0.1 focused on ambient school situations in Indonesia during social restriction relaxation which was planned by government of Indonesia in 2022. Most of PM2.5 in the schoolyards (U3, SU1, and SU2) exceeded the standard limit which positively were influenced by school gate that near to roadside as the most contributor source of fine particles which exceeded the limit in the U2, U3, SU1, and SU2, respectively. Furthermore, the RDDs were influenced most by particle size which increased from HD to AL for PM0.1but decreased for PM2.5.

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Workers' Perceptions of Occupational Heat Stress – A Survey Among Garment Workers in Phnom Penh, Cambodia

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ABSTRACT

Heat stress is projected to reduce well-being, increase heat-related illnesses and risk accidents, and workers' productivity. This study aims to investigate the perceptions and coping mechanisms of heat stress among garment workers, and to determine whether different demographics and heat exposure leads to different impacts of heat stress. A survey was conducted in February 2022 at three garment factories in Phnom Penh, with 385 participants coming from the sewing department. Linear and logistic regression were used to determine the influence of demographic and heat exposure at work on the impact of heat on health and productivity. More than half of the participants (58.84%) experienced feeling hot in the workplace. More than two-thirds of the participants (67.01%) reported having heat stress symptoms, including thirst (49.87%), and heavy sweating (30.39%) among many others. About six in ten participants (59.22%) reported having a negative impact of heat on their productivity. The most common practice for coping with the heat at work is increasing water intake (86.23%). The study did not find a strong correlation between demographic and heat stress. People who got exposed to heat at work are likely to report heat stress symptoms ($p<0.01$) and have a greater number of symptoms ($p<0.01$).

Keywords: Perception, Occupational heat stress, Workplace heat exposure, Garment workers, Coping strategies, Cambodia

1. INTRODUCTION

The increased heat stress predicted by climate change is anticipated to have a negative impact on human health, and the economy of the world's poor and low-income countries [1,2]. The term heat stress refers to the externally-based heat load created from a summation of climatic conditions, metabolic rate, and clothing adjustments [3]. Previous studies have

indicated that working under high temperatures without sufficient protection could reduce well-being [4,5], increase the occurrence of heat-related illnesses [4] and risk of accidents [5], and negatively affect workers' willingness to work and their productivity [5]. Generally, two methods were employed to assess the impact of heat stress: 1) establishing a model of heat stress [5-8], and 2) using the self-rated health assessment through a survey questionnaire [9-11]. Heat stress could affect both outdoor [12] and indoor workers if the temperatures at the workplace are not properly regulated [13]. Occupational heat stress is, however, manageable and avoidable. Workers' perceived and real knowledge, awareness, and comprehension of heat-related dangers limit the effectiveness of heat adaptation programs and the management of the effects of occupational heat stress [14,15]. The objectives of this paper are to investigate the perceptions and coping mechanisms of occupational heat stress among garment workers, and to determine whether the different demographics and heat exposure could lead to different impacts of heat stress.

The questionnaire was adapted from the High Occupational Temperature Health and Productivity Suppression (HOTHAPS) questionnaire, the Singapore Heat Safe Project's questionnaire, and previous studies [15-17]. The questions are closed-ended. The questionnaire was modified and translated to the local language, Khmer. The questionnaire consisted of seven sections that elicited information about the demographic characteristics, type of work, heat exposure at work, the impact of heat on health, impact of heat on productivity, the impact of clothing on heat stress, and coping mechanisms. The survey was conducted at three garment factories in Phnom Penh in the February of 2022. The total sample size was 385, estimated by Cochran's method [18] with CI=95% and a marginal error of 5%. The ethics clearance was obtained from the National Ethics Committee for Health Research (NECHR). Participants who had pre-existing medical conditions (diabetes, hypertension) were excluded from the survey. Based on their willingness to participate, the participants were informed about the study and asked to sign the informed consent letter. A team of engineering students from the Institute of Technology of Cambodia (ITC) was recruited to help with the surveys. The team was trained and asked to conduct the pilot surveys. The trained surveyors were then assigned to conduct face-to-face interviews with every participant to ensure a 100% response rate and the quality of the data. The R-statistical software was used for statistical analysis. Descriptive statistics (frequency counts, percentages, means, and standard deviation) were used to describe results, e.g., demographics of participants. Linear and logistic regression were used to determine the influence of independent variables (age, gender, BMI, working near a direct heat source,

well-ventilated workplace, and having been informed how to act during hot months) on dependent variables (having heat stress symptoms, number of heat stress symptoms, and impact on productivity).

2. RESULT AND DISCUSSION

Demographic: Nearly all participants were female (97.40%). The mean age was 32.51 years (min=19, max=55, SD=6.78), and the mean Body-Mass Index (BMI) was 23.16 kg/m2 (min=16.41, max=35.32, SD=3.37). The participants were sewing workers (91.68%), assistants (3.90%), and team leaders (4.42%). The mean employment duration was 45.33 months (min=0.5, max=293, SD=36.38). Participants reported having finished primary school (47.27%), secondary school (37.40%), and high school (12.47%). Only 2.86% were illiterate.

Heat exposure at work: A few participants (8.83%) reported working near a direct heat source, i.e., ironing machines, and feeling uncomfortable with the workplace temperature. Twenty-four participants (6.23%) claimed that the workplace is not well ventilated. Nearly half of the participants (41.16%) said they never felt hot/uncomfortably hot in the workplace. More than half of the participants experienced feeling hot in the workplace in 1-3 months (47.76%), and 4-6 months (10.55%). The participants were asked to judge the thermal environment in the last 3 months, and the responses were cold (6.49%), slightly cold (22.86%), neither cold nor hot (58.70%), slightly hot (8.05%), hot (3.38%), and very hot (0.52%). Over half of those who participated in our survey said to have been informed how to act during hot months through written and oral news (40.78%) and safety courses or training (11.43%).

Heat impact on health: More than two-thirds of the participants (67.01%) reported having heat stress symptoms in the last 3 months. The most common symptoms include thirst (49.87%), heavy sweating (30.39%), feeling hot (27.53%), and headache (26.75%) along with others (Data not shown).

Heat impact on productivity: About six in ten respondents (59.22%) experienced a negative impact of heat on their work productivity in the forms of losing motivation to complete tasks (50.39%), speed of task completion (42.34%), ability to do physical work (37.14%), focus on

tasks (31.69%), maintaining usual productivity (29.87%), taking more time to complete the same task (28.05%), quality of work (25.19%), and understanding of tasks (17.92%).

Coping strategies to cope with heat: Just under two-thirds (57.40%) claimed to take the traditional diet (e.g., watermelon, sugarcane juice, chai basil seeds, etc.) to cope with the heat. Other strategies used during working hours included increasing water intake/hydration (86.23%), resting in front of a fan (30.91%), pouring water over the head (19.22%), drinking slushies/crushed ice/frozen sport drinks (16.10%), resting in a restroom (5.97%), and resting in an air-conditioned building (2.60%).

Influence of demographic and heat exposure at work on health and productivity: Table 1 shows the influence of demographics and heat exposure at work on the impact of heat on health, measured by if there are any reported heat stress symptoms and the number of heat stress symptoms, and impact of heat on productivity, measured by if there is any reported impact on productivity. The study did not find any strong correlation between demographic and heat stress impact. People who work near direct heat sources are likely to report heat stress symptoms ($p<0.01$) and have a greater number of symptoms ($p<0.01$). People who have not been informed how to act during hot months are likely to report heat stress symptoms ($p<0.1$), have more symptoms ($<p<0.01$), and report the impact of heat on productivity ($p<0.01$).

Table 1. Influence of demographic characteristics and heat exposure at work on the impact of heat on health and productivity

	Dependent variable		
	Having heat stress symptoms Logistic regression	No. of symptoms Linear regression	Impact on productivity Logistic regression
Age	0.426(1.728)	0.032*(2.052)	0.004(0.016)
Gender (male)	0.014(0.017)	-0.031(0.841)	-0.659(0.704)
BMI	0.546(0.648)	-0.005(0.042)	-0.030(0.033)
Near direct heat source	1.972***(0.743)	1.772***(0.482)	0.921**(0.446)
Well-ventilated workplace	-1.482*(0.759)	-2.590***(0.563)	-0.574(0.497)
Having been informed	-0.398*(0.226)	-0.914***(0.269)	-0.490**(0.213)

* p < 0.1, ** p < 0.05, *** p < 0.01

3. CONCLUSION

This study helps to understand the heat impact has on garment workers' health and productivity, and their coping mechanisms. The study shows that majority of workers reported the heat impact on both their health and productivity. Increasing water intake or

hydration is the most commonly used strategy to cope with the heat. People who are working near a direct heat source and have not been informed how to act during hot months are likely to report heat stress impact.

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Analysis of Thermal Performance of Naturally Ventilated Residential Building in Tropical Climate: Case Study of Phnom Penh, Cambodia

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ABSTRACT

Comfort of the building is one the important factors that is hard to achieve for architects and engineers as it depends on both physic and psychological parameter. In this paper, we discuss these two aspects on the thermal performance of residential building in context of hot-humid climate. Three different types of residential buildings including townhouse, detached house and apartment building in Phnom Penh, Cambodia were chosen as the case studies. The analysis of thermal performance of each house is based on (a) the measurement of physical parameters (air temperature, relative humidity, air velocity), (b) occupants survey to compare with data from the measurement and (c) interview with the occupants to know about their satisfaction and sensation to the physical parameters. Impact of different designs of houses on thermal performance and the importance of influential physical parameters for tropical climate is analysed. Comparison of results to the Fanger's model is also discussed to further evaluate the thermal performance of chosen buildings.

Keywords: Thermal comfort, building, tropical climate, natural ventilation, parameters

1. INTRODUCTION

To design a building that provides comfort to occupants is still a challenge especially with the climate change nowadays. One of the factors that is hard to achieve for architect or designer is thermal comfort as it is a state of mind and can be different from one person to another even, they are in the same room [1]. In the past decade, air-conditioning has become the main solution that were put into place for the concern of thermal comfort in the building in region with hot-humid climate conditions. As an example, residential building that have been built in Phnom Penh between 2000s until now are more focused the aesthetic and the construction budget than on the comfort that the building would provide to occupants. The rate of using air conditioner is 15% in Phnom Penh and with economic growth, it is expected to increase rapidly in the near future [2].

Even though there are plenty of research on thermal performance of building that have been done for tropical climate, a case study for newly constructed residential building in Cambodia hasn't been done yet. As people's mind and feel playing an important factor for thermal comfort, tradition and occupant's behaviour can provide a different impact of thermal performance for building in Cambodia.

In this paper, we aim to investigate on building performance of residential building in hot-humid climate region discussing on both influence physical parameter and occupant's behaviour for both rainy and dry seasons. Residential buildings in Phnom Penh, Cambodia were chosen as the case study which concentrate on three different types of residential buildings that mostly can be found now in the suburb and urban area, such as townhouse (flat), detached house (villa) and apartment building. The chosen case study buildings will also allow us to identify different design of housing influencing the thermal performance of building as well.

2. RESULT AND DISCUSSION (including conclusion)

The air temperature is normally higher than standard comfort for all case study buildings in both seasons while the relative humidity during the day stays within the range of acceptable comfort standards for tropic region.

Overall, as the temperature and relative humidity are similar between each house, the air velocity plays an important role to make a difference in the thermal performance of the building. If we compare to the standard, besides the detached house, the air velocity in other case study buildings in the living room in natural ventilation conditions is below the acceptable range. Therefore, with the help of air velocity, the detached house would have a better thermal performance than the others.

From the occupant's survey, people in hot-humid region can really adapt to the higher temperature than the international standard comfort temperature from 3 °C to 4 °C. However, it highly depends on air velocity and outdoor environment. 90% of the data that we received saying that they are "comfortable in that temperature" is observed during the early morning and late night, when there is cold breeze coming into the house.

In conclusion, even if people from tropical region can adapt to a higher temperature, the naturally ventilated residential building still can't provide enough thermal comfort to

occupants. Air velocity appears as a factor that highly contributes to the comfort of occupants in naturally ventilated houses in the hot-humid environment. As a result, even with higher temperatures the occupants in the detached house are described to feel more comfortable than the others as it has better performance of airflow and the highest air velocity. Nevertheless, the use of electrical fan is still necessary even if the air velocity stays within the comfort to make the occupant feel thermally comfortable and when the air temperature is too high during the afternoon. An acceptable value of physical parameters for female occupant comfort has also been defined from the survey with temperature of 29 to 30 °C and humidity of 73 to 75% in natural ventilation. And with the help of electrical fan of air speed of 1.4 to 2.33m/s, people can tolerate to air temperature of 31.5 to 32.5 °C and relative humidity of 67 to 75%. However, a much larger scale of survey needs to be done to make sure that this standard is applicable.

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Enhancement of Hydrodearomatization Catalyst by Brönsted Acid Site of Alumina Support for Clean Diesel Production

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ABSTRACT

Exhaust from diesel engine contributes a main part in both PM10 and PM2.5 problem. Polycyclic aromatic hydrocarbons (PAHs) in diesel fuel should be considered because of their toxicity. Worldwide Fuel Charter recommends the PAHs content less than 2 wt.% for less toxic of diesel exhaust. Nickle Molybdenum Sulfide over Gamma alumina ($NiMoS/Al_2O_3$) catalyst is ganerally used in hydrotreating processes of petroleum refinery. PAHs are saturated by hydrogenation reaction to be mono-aromatic or non-aromatic, called Hydrodearomatization (HDA) process. However, $NiMoS/Al_2O_3$ catalyst has a lower HDA activity, compared to noble metal catalysts, such as Pd-Pt catalyst. Gamma- Al_2O_3 has been generally used as catalyst support due to its low cost, high surface area and high thermal stability, which possesses only Lewis's acidity. This work focuses on surface modification of gamma- Al_2O_3 by ammonium fluoride to generate Brönsted acidity. All gamma-Al_2O_3 supports were characterized by In-situ pyridine adsorption coupled to Diffuse Reflectance Infrared Fourier Transform spectroscopy (In-situ pyridine-DRIFTs). Increment of fluorine content in modified gamma- Al_2O_3 leads to increase Brönsted acidity of modified gamma-Al_2O_3. The NiMoS over modified gamma- Al_2O_3 supports exhibits higher HDA activity than the non-modified one. Generation of Brönsted acidity on gamma-Al_2O_3 support can enhances the HDA activity of NiMoS catalyst for clean diesel production.

Keywords: Brönsted acidity, PAHs in diesel fuel, Hydrodearomatization, NiMoS catalyst, Surface modification of gamma alumina

1. INTRODUCTION

Air pollution caused by particulate matter (PM) has been being realized since a past decade. Exhaust from diesel engine contributes a main part in both PM10 and PM2.5 problem. Diesel fuel quality has been continuously amended from Euro-2 (500 ppm sulfur) to Euro-5 (10 ppm

sulfur) to improve air quality and reduce the PM from diesel engine exhaust emission. Polycyclic aromatic hydrocarbons (PAHs) in diesel fuel should also be considered because of their toxicity.[1] More PAHs in diesel fuel leads to incomplete combustion and make the PM from diesel exhaust more toxic. The PAHs content in diesel fuel were reduced from 11 wt.% in Euro-4 to 8 wt.% in Euro-5 but Worldwide Fuel Charter recommends the PAHs content less than 2 wt.% for less toxic of diesel exhaust. Nickle Molybdenum Sulfide over Gamma alumina (NiMoS/gamma-Al_2O_3) catalyst has been widely used in hydrotreating processes of petroleum refinery because of inexpensive and sulfur tolerant. Hydrodearomatization (HDA) is one of hydrotreating processes, in which PAHs are saturated by hydrogenation reaction to be mono-aromatic or non-aromatic. However, NiMoS/gamma-Al_2O_3 catalyst has a lower HDA activity, compared to noble metal catalysts, such as Pd-Pt catalyst.[2] Thus, NiMoS catalyst requires improvements of the HDA activity. Studies report many approaches to improve the catalytic activities of NiMoS catalyst in hydrotreating processes, such as adding promoters in catalyst preparation and using different supports. [3-4] gamma-Al_2O_3has been generally used as catalyst support due to its low cost, high surface area and high thermal stability, which possesses only Lewis's acidity. This work focuses on surface modification of gamma-Al_2O_3 by ammonium fluoride to generate Brönsted acidity for enhancement of HDA Catalyst.

2. RESULT AND DISCUSSION (including conclusion)

The gamma-Al_2O_3 support was modified with fluorine content at 2 wt.% (2F-Al_2O_3) and 5 wt.% (5F-Al_2O_3) then these modified gamma-Al_2O_3 were used as supports for NiMoS catalysts. All gamma-Al_2O_3 supports were characterized by In-situ pyridine adsorption coupled to Diffuse Reflectance Infrared Fourier Transform spectroscopy (In-situ pyridine-DRIFTs) to investigate Brönsted acidity of supports.[5] The result indicates that Brönsted acidity of gamma-Al_2O_3 is increased with the increment of fluorine content in modified gamma-Al_2O_3. All catalysts were evaluated HDA activity using trickle bed reactor at 250-325 °C, WHSV at 8 mL/(g·h), 40 bar and 150 mL/min of H_2 flow rate. The HDA activity of the NiMoS over modified gamma-Al_2O_3 supports were compared with that of the NiMoS over non-modified gamma-Al_2O_3. The results show that the NiMoS/5F-Al_2O_3 catalyst exhibits the highest HDA activity among the catalysts in this study. Generation of Brönsted acidity on gamma-Al_2O_3support can enhances the HDA activity of NiMoS catalyst for clean diesel production.

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Decolorization of Synthetic Slaughterhouse Wastewater using Aerated Electrocoagulation-Floatation with Fe, Al, and Ti Electrode

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ABSTRACT

This present work aimed to investigate the development and evaluation of compact electrocoagulation (EC) combined with the floatation process in batch mode for the decolorization of synthetic slaughterhouse wastewater, named the integrated electrocoagulation-floatation reactor (ECFR). The colour of slaughterhouse wastewater was prepared by using reactive dye powder (mg) mixed with tap water to make the standard curve of colour function with the concentration of dye powder. The factors affecting the ECF process, such as voltage supplied, inner gap, gas flow rate, and operation time, were investigated. One pair of iron, aluminium, and titanium electrodes were used in this ECF experiment with different units of factor effects. The performance of the ECF was found to be affected by all factors affects. Finally, the optimum conditions for the electrocoagulation process for colour removal in this study were 30 V of voltage supplied, 2 cm of electrode gap, 0.5 L/min of gas flow rate, and 70 min of operation time by using Fe electrodes, and the maximum removal efficiency of colour removal was 87.32%.

Keywords: Slaughterhouse wastewater (SWW), Electrocoagualtion-floatation (ECF), Optimization, newly design reactor, Synthetic

1. INTRODUCTION

Population growth has augmented meat products and consequently resulted in enlarging of slaughterhouse wastewater (SWW) volume [1]. SWW comprises various pollutants including fat, manure, urine, meat tissues, and blood substances, which require proper treatment before discharge into the environment [2]. In Cambodia, slaughterhouse wastewater is not well managed, and modern slaughterhouse is rare [3]. Discharge of untreated wastewater from industries, for example, textile and dyeing operations, mining, coal processing operation, paper production, and food processing may add substantial coloration to water in the receiving stream. Hence, the high colour of wastewater from dyeing operations or food processing operations is not only an antagonistic aesthetic effect

but also carcinogenic, mutagenic, and generally detrimental to our environment. It could lead to the long-term impairment of the ecosystem. Various technologies have been applied for dye effluent treatment such as coagulation, adsorption, and conventional biological process (aerobic and anaerobic) [4]. Chemical coagulation requires chemical addition, which results in the production of a large amount of sludge.

Electrocoagulation-floatation (ECF) concept is a treatment process of applying electrical current to treat and flocculate contaminants without adding chemical coagulation. In the ECF process, pollutants are impinged up towards the surface of the ECF cell by tiny bubbles of hydrogen gas. In recent years, the electrocoagulation (EC) process has been interested in studying different types of effluents from the industries [5]. Even though EC has been applied on the industrial scale for over a century, the limitation on the mechanism and process optimization for target pollutant removal is still the main challenge. Hence, this study aims to optimize the reactor configuration and operation condition of colour by using a new design electrocoagulation-floatation reactor (ECFR) from slaughterhouse wastewater.

2. METHODOLOGY

The reactor used in this study is made of clear acrylic in a cylinder shape with a diameter of 15 cm and a height of 100 cm, and the diameter of the inner cylinder is 9 cm and a height of 70 cm. It also has other components such as an electrode plate, air diffuser, air pump, and air flow meter. For the electrode plate, it was used iron aluminium and titanium with dimensions of 5 cm x 0.1 cm x 20 cm, which connected to the DC power supply of 5 A and 30 V. For colour value, was measured by using a portable photometer model HANNA HI97727C. To archive the objective of this study, it will be mainly divided into two parts, i.e., preparation of synthetic wastewater, and optimization for colour removal.

3. RESULT AND DISCUSSION

The main finding of this experiment was the optimum condition of ECFR for colour removal using Fe, Al, and Ti electrode plates. The main effect plots of colour removal by iron, aluminium, and titanium electrodes showed the effect of inner electrode gap, gas flow rate, the voltage supplied, and operation time. The main effect plot is very important while several types of factors are likely to figure out which one effluence the response the most. For the iron plate, the optimum condition is 2 cm of electrode gap, 0.5 L/min of gas flow rate, 30 V of voltage supplied, and 70 min of operation time. In the previous study, Yusof (2017) [4]

reveal that increasing the voltage supplied and operation time helped to improve the treatment performance, and [6] the gap is between 1.25 and 3.75 cm, for the optimum condition is 2.5 cm. In this experimental work, a 2 cm of electrode gap was obtained for all plates. The optimum condition of colour removal by aluminium is 2 cm of electrode gap, 1 L/min of gas flow rate, 20 V of voltage supplied, and 70 mn of operation time. And the optimum condition of colour removal by titanium is 2 cm of electrode gap, 0.5 L/min of gas flow rate, 10 V of voltage supplied, and 70 min of operation time.

4. CONCLUSION

In conclusion, we tried to investigate the treatment efficiency of synthetic slaughterhouse wastewater by electrocoagulation-floatation (ECF) and to determine the optimal operation condition. In this study, the removal efficiency of colour from wastewater was affected by voltage supply, inner electrode gap, gas flow rate, and operation time. The optimum treatment efficiency is achieved for iron and aluminium plates by increasing the voltage supplied, operating time, gap, and decreasing gas flow rate. And the optimum condition of the titanium plate was by increasing the inner gap, operation time, and decreasing of gas flow rate and voltage supplied. The optimum condition for the electrocoagulation process for colour removal in this study was 30 V of voltage supplied, 2 cm of electrodes gap, 0.5 L/min of gas flow rate, and 70 min of operation time by using Fe electrodes, and the maximum removal efficiency of colour removal is 87.32%.

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Destabilization of Emulsion Oil Separation by using Chemical Coagulation Process: Preliminary Investigation for Effective Analysis

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ABSTRACT

Removal of pollutants produced by industrial plants requires to reuse of water and access to the environment standard. The chemical coagulation process is a convectional method for wastewater treatment to reduce chemical oxygen demand and total suspend solids. The objective of this work is to study the effect of initial pH, coagulant type, and chemical dosage used on the separation performance at different initial oil concentrations. Based on the result, 800 mg/L of aluminium sulphate could remove up to 80% of 1g/L and 2g/L residual oil in wastewater, whereas residual 3g/L of that in wastewater with pH ranging from 7 to 8 could be removed up to 90%. In the instance of ferric chloride, the high removal efficiency of residual oil in wastewater could be achieved by utilizing a coagulant concentration ranging from 500 mg/L to 900 mg/L. Results show that, 700 mg/L of ferric chloride could remove up to 90% of residual oil in synthetic wastewater (1 g/L, 2 g/L, and 3 g/L). However, the aluminium sulphate could only remove 60-85 % of the total oil within the same dosage. In summary, further study on the possibility of ferric chloride in removing residual oil from wastewater could be considered.

Keywords: Emulsion oil, Coagulation, Preliminary, Destabilization , COD

1. INTRODUCTION

Under the current context, there is a rapid development of different types of industry, which proportionally generated a large amount of oily wastewater [1]. Improper treatment of stabilized oily-emulsion wastewater can increase the chemical and biochemical oxygen demand in the water body and reduce the sunlight penetration into the water through its forming as a layer on the water surface and thus disturb the aquatic ecosystem [2]. In Cambodia status, oily wastewater may be another new challenge and environmental issue in the nearest future due to the growth of petrochemical production and the discovery of oil

in 2020. Therefore, stabilized oily-emulsion wastewater must be treated before discharging into the environment. There are various common separation techniques used for oil separation. The chemical coagulation process is a promising technique that is usually applied through agglomerating colloidal particles, using chemicals such as ferric chloride, aluminium sulphate, ferrous sulphate, and aluminium chloride. Involves adding a chemical coagulant for conditioning the suspended, colloidal, and dissolved matter for subsequent processing by flocculation or to create conditions that will allow for the subsequent removal of particulate and dissolved matter [3]. Even though this process is conventional, its development and other separation processes, such as the flotation concept, are another limitation that requires a unit process investigation. However, the present study will be a preliminary investigation of the chemical coagulation process only, and other integration process optimization parts will be shared elsewhere after completing the overall project study. Hence, this work aims to study the effect of initial pH, coagulant type, and chemical dosage used on the separation performance at different initial oil concentrations.

This preliminary study was divided into two parts: synthetic oily wastewater and separate oily wastewater by the coagulation process. It should be noted that the lubricant oil was selected to use for synthesizing oily wastewater in this study. This oil type is frequently found in wastewater generated from industrial sectors. Lubricant oil was mixed in tap water with an anionic surfactant to prepare the stabilized oily-emulsion wastewater. Sodium dodecyl sulphate at one critical micelle concentration (CMC) was used in this experiment. For oil separation performance analysis, chemical oxygen demand (COD) was selected to represent the oil concentration in the emulsions since it has been suggested as a valuable parameter to indicate the amount of oil in wastewater. The COD analysis followed the standard 5220-C closed reflux titration method and was digested by Hach DRB 200.

The effects of initial pH, coagulant, and coagulant dosage on separation efficiency were investigated using a jar test. The standard 6-paddles jar test apparatus was used with the addition of ferric chloride and aluminium sulphate as the coagulant. The initial pH of oily wastewater varied at 6.0, 7.0, and 8.0 and was adjusted by diluted sodium hydroxide and sulfuric acid solutions. Coagulants, i.e., ferric chloride and aluminium sulphate, varied between 100 to 900 mg/L. It should be noted that the experiments were conducted as a series of rapid mixing for 1 minute followed by 20 minutes of slow mixing before decantation, as suggested by a previous study [4].

2. RESULT AND DISCUSSION (including conclusion)

Figure 1 shows the varied oil representation as COD concentration removed using ferric chloride operating at different pH values, whereas Figure 2 presents the oil separation using aluminium sulphate coagulant. Overall, it was found that utilizing ferric chloride as a coagulant to destabilize residual oil had no effect on pH (6, 7, and 8) variation in wastewater. In contrast, if aluminium sulphate was utilized as a coagulant, the pH change in wastewater affected the oil separation efficiency. Furthermore, 800 mg/L of aluminium sulphate could remove up to 80% of 1g/L and 2g/L residual oil in wastewater, whereas residual 3g/L of that in wastewater with pH ranging from 7 to 8 could be removed up to 90%. In the instance of ferric chloride, the high removal efficiency of residual oil in wastewater could be achieved by utilizing a coagulant concentration ranging from 500 mg/L to 900 mg/L. In this range, residual oil could be removed at rates ranging between 60% to 90%. In summary, ferric chloride outperformed aluminium sulphate regarding steady removal efficiency at varying pH levels in wastewater. Furthermore, 700 mg/L of ferric chloride could remove up to 90% of residual oil in synthetic wastewater (1 g/L, 2 g/L, and 3 g/L). However, the aluminium sulphate could only remove 60-85 % of the total oil within the same dosage.

This research aims to examine the influence of pH, coagulant type, and chemical dose on separation performance at different initial oil concentrations. After the longer operation, the oil removal efficiency fluctuated, followed by the change of pH level in wastewater, while ferric chloride could perform a steady removal efficiency. Furthermore, 700 mg/L of aluminium sulphate could remove oil 60-85%, while ferric chloride could remove up to 90%. To sum up, further study on the possibility of ferric chloride in removing residual oil from wastewater could be considered. In the next step of this study, there will be an investigation of this chemical coagulation integrated air flotation to complete the unit process development and application.

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Optimization of Electrocoagulation Process for Color Removal from Synthetic Textile Wastewater using Response Surface Design

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ABSTRACT

The removal of pollutants from industrial effluents by electrocoagulation has become an attractive method in recent years. This work aimed to optimize the electrocoagulation process for the elimination of colour matter from textile effluent as a batch experiment using response surface design (RSD) and design of experiment (DOE) methodology. The experiment was conducted on a lab scale with a batch test and operated in a beaker of 1 litre to treat a colour of 2500NTU from synthetic wastewater. The effects of voltage supply, treatment time, initial pH, type of electrode, and the arrangement of electrodes on the decolorization efficiency have been investigated. Furthermore, Minitab software was used for statistical analysis and for the design of experiments. The optimal conditions for the EC process to achieve 99.96% colour removal efficiency were obtained at 46.2V of DC generator, 60min of operation time, and initial pH at 9 with iron as the electrode and monopolar for electrode arrangement.

Keywords: Electrocoagulation, Textile wastewater, Optimization, Decolorization, Response surface design

1. INTRODUCTION

Industrial sector is great importance for the economic development of the country. Simultaneously, this growth also discharges pollution into the environment [1]. Textile industries are among the most polluting industries in terms of the volume and the complexity of treatment of its effluents discharge. Moreover, the dyes used in this manufacturing are the main sources of environmental pollution. The textile industry wastewater varies extensively in term s of composition due to the regular impurity in fibres and the chemicals used in different processes. The main contaminant in textile wastewater is colour matter, which was recently reported that colour causing substances are micro toxic biota [2]. Strong colour wastewater from dyeing operations has not only unfavourable aesthetic effects but also carcinogenic, mutagenic, and generally detrimental to the environment [3] which must be

eliminated before the effluent is discharged into the aquatic ecosystem. Without proper treatment, the coloured effluent creates an aesthetic problem, and its colour discourages the downstream use of wastewater. Thus, removal of colour from the textile industry wastewater is needed to prevent environmental pollution.

Various studies have been reported in the literature on colour removal techniques. There are several methodologies that developed for colour removal such as conventional biological processes (aerobic and anaerobic), coagulation with alum, ferric chloride also magnesium and adsorption process [4]. However, those methods require high cost by using chemical composition for the treatment. Electrocoagulation (EC) is a simple and efficient method and has been used for the treatment of many types of industry effluents. Since it is capable of simultaneously eliminating very wide variety of pollutants. These include, among other refractory organics, colloidal particles, suspended particles, turbidity, colour or even ion (heavy metals, nitrates…) [5]. It combines in fact a very wide variety of remediation mechanisms, such as coagulation, precipitation, and adsorption, but also electro-reduction and electro-oxidation. Electrocoagulation method consists of pairs of metal sheets called electrodes, that are arranged in pairs of two anodes and cathodes by connecting with electrical charge. Although EC method has been widely used and successfully employed for the treatment of water and wastewater. Nevertheless, the optimal setup for the operations condition is still challenging. Consequently, the objective of this work is to optimize EC process for elimination of colour mater from textile effluent as a batch experiment using response surface design (RSD) of design of experiment (DOE) methodology.

2. METHODOLOGY

The experiment was conducted on a lab scale with batch test and operated in beaker of 1 litre. Three types of electrodes, i.e., iron, aluminium, and titanium, were selected for this study in a size of 10 cm x 5 cm x 0.1 cm. The arrangement of the electrodes was bipolar and monopolar with 2 cm of electrode gab. A DC power supply was chosen to support electricity to the electrode plates with capacity from 20 – 60 V and the electrolyze time was from 20 to 60 min. Dye solution were prepared by dissolving desired amount of dye in 1 litter of tab water and used for treatment with 2500 NTU. Furthermore, the initial pH of synthetic wastewater was adjusted to 7.0, 8.0, and 9.0 to evaluate the effective of the pH on the performance of EC process. Minitab software was used for statistical analysis and for design

of the experimental. For colour and pH of the synthetic wastewater were measured using colorimeter (model HANNA HI97727) and pH meter (model HORIBA pH1100) respectively.

3. RESULT AND DISCUSSION

The removal efficiency of the colour was study respected to true colour. Furthermore, the design matrix containing the study factors, their range and the response which is the removal efficiency (%) of colour. The result obtained were then evaluated with RSD for the development of the model regression equation. The fitness of the model was investigate using the analysis of variance at 95% confidence interval. The significant and insignificant of each tern in the model were determined by the fisher's F-test and P-value. From Figure 1 it can be inferred that the individual effects of the factor (voltage, electrode type and electrode arrangement) on the removal efficiency of colour were more dominant that the effect of operation time and pH of synthetic colour. The optimum condition of power supply by DC generator is 42.6 V which is similar to the result of previous study also showed the effect of voltage from DC generator to the performance of EC process for treatment of Lead and Zinc from battery industry, the removal efficiency increased with increasing current density [6]. The operation time and initial pH of the wastewater in the main affective plot was slightly associated with the mean of removal efficiency but not significant affected to the EC process follow by two-way ANOVA result.

Another study also investigated about the different connections and type of electrode in electrocoagulation for textile wastewater treatment [7] and demonstrate that electrode arrangement with mono-polar received the high efficiency for the removal of colour and turbidity than arrangement in bi-polar, the same to the finding, electrode arrangement in monopolar give the better removal efficiency than bipolar. In addition, electrode material is one of the most important factors in EC [8]. In most literature studies on electrocoagulation, both electrodes are made of the same material. Moreover, In the colour removal process iron and aluminium electrode plate give the high removal efficiency. In the previous study [9], it was found that aluminium and iron have similar performance for organic compound remove due to the coagulating properties of its multivalent ions. From the result, it can be concluded that the removal efficiency of colour by electrocoagulation process is highly dependent on the arrangement of electrode, electrode type and voltage supply from DC generator.

4. CONCLUSION

In this study, the optimization set up for Electrocoagulation process for colour removal with five different factors (voltage, operation time, pH electrode type and electrode arrangement) were optimized with the help of Minitab software. The optimum condition to remove colour with the initial concentration 2500NTU from synthetic textile wastewater was obtained at 46.2V of DC generator, 60min of operation time, initial pH at 9 with iron as electrode and monopolar for electrode arrangement with the removal efficiency 99.96%.

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Mapping Enablers for Sustainable Renewable Energy Implementation in ASEAN

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ABSTRACT

Countries from the Association of Southeast Asian Nations (ASEAN) have an abundant renewable energy (RE) potential, yet its utilisation lags the regional target. The ASEAN Plan of Action for Energy Cooperation (APAEC) endeavours for RE to contribute 23% of total primary energy supply, but their current projections shows that it could only reach 17.7%. Therefore, to better understand the problems of RE, the study seeks to map the challenges, opportunities, and recommendations in three categories: economic, social, and policy using a comparative approach among 10 ASEAN Member States (AMS). The results are shown as follows. Economically, there is a lack of funding for RE due to its uncompetitive. But energy efficiency funds, subsidy, and tax exemption could help RE investors. Policy-wise, there is a lack of standards, accreditation, and incentives for private power produces, but recent efforts in new energy metering and reduction of fossil fuel subsidy support RE competitiveness. Lack of skilled labour, business acumen, and other education gaps are also problematic, but some ASEAN countries have started to invest in consumer-friendly information campaigns. These issues could be solved by sharing solutions among AMS that will enable them to resolve these issues and achieve the targets of APAEC.

Keywords: Energy collaboration, Energy and SDGs, RE implementation, ASEAN Energy, Renewable Energy, Sustainability assessment, RE implementation

1. INTRODUCTION

Countries from the Association of Southeast Asian Nations (ASEAN) have an abundant renewable energy (RE) potential, yet its utilisation lags the regional target. The ASEAN Plan of Action for Energy Cooperation (APAEC) endeavours for RE to contribute 23% of total

primary energy supply, but their current projections shows that it could only reach 17.7%. Therefore, to better understand the problems of RE, the study seeks to map the challenges, opportunities, and recommendations in three categories: economic, social, and policy using a comparative approach among 10 ASEAN Member States (AMS). The results are shown as follows. Economically, there is a lack of funding for RE due to its non-competitiveness, but energy efficiency funds, subsidy, and tax exemption could help RE investors. Policy-wise, there is a lack of standards, accreditation, and incentives for private power produces, but recent efforts in new energy metering and reduction of fossil fuel subsidy support RE competitiveness. Lack of skilled labour, business acumen, and other education gaps are also problematic, but some ASEAN countries have started to invest in consumer-friendly information campaigns. These issues could be solved by sharing solutions among AMS that will enable them to resolve these issues and achieve the targets of APAEC.

2. RESULT AND DISCUSSION

Based on the reviews made for ASEAN member countries, the issues were categorized into 3 impact categories in term of economic, policy, and socio towards the challenges, opportunities, and recommendations of renewable energy implementation. For the first category involving economic factors, the main challenge by ASEAN countries to implement renewable energy is financial barrier and lack of budget to support the latest technology in RE. RE is still considered as uncompetitive due to high cost of implementation, which leads to lack of source of funding in RE projects since there is a lack of incentives for commercial investors and international funding. Even though there a few challenges in term of economic, opportunities can also be found. The economies of ASEAN countries have rapidly been increasing as shown in the increasing GDP, which results in increased energy intensity in the region. Such increase in demand could serve as a huge opportunity for RE implementation. There are also grants and energy efficiency fund which focus on subsidy, and tax exemptions for implementing RE sources. Other opportunities like carbon trading and pricing also may play a major factor that bring more investors, funding etc towards the popularity of RE in ASEAN. Other than economic factors, policy also play major roles in the implementation of RE for ASEAN countries. Mainly policy is more towards government policy as this policy will control the overall RE landscape of each country. The main challenges of implementing RE in ASEAN in policy perspectives are the lack of RE development that involves research and development as this need a huge fund and support from investors and government. There is also another policy challenge that is related to lack of standards, accreditation, and

incentives for private power producers to be independent IPP for RE sources. Government authority and limitation also become another policy challenges that limits the capability of government to act in controlling the RE player or industries. Even though there are multiple challenges in policy to implement RE for ASEAN countries, there are also opportunities found such as new energy metering that motivate consumer in general to invest in RE. Other opportunities like unpopular act by government to remove energy subsidy also can be crucial as this will encourage the change from consecutive energy source to renewable energy sources.

Finally, the impact of socio in implementing RE. Basically socio challenges more toward consumer factors such as capability of the consumer to invest in RE because of the RE market size itself that still small and consider not refundable within short time. Other challenges in socio are the limited skilled labour, lack of capability on developing financial plans, low bankable project, and education gaps in relation to RE awareness. Despite the challenges, of course there is opportunities. The opportunities in term of socio category are towards the consumer-friendly policy that a few governments from ASEAN countries toward implementing RE in daily lives. There are several recommendations that can be made for each category based on the reviews. For economic, the recommendation are tax exemptions for import duties on related alternative energy projects, government need to facilitate foreign money transfers to increase demand of RE projects and encourage partial investment grant for start-up company related to RE. Meanwhile for policy, there are some recommendations that can be useful such as by introducing shift subsidy to renewable energy to achieve certain level before removal of fuel subsidy and promote community power plant for grassroots economy. Finally, the last categories on socio impact, the recommendation are that government, or any authorities need to emphasis the social acceptance of projects (co-create) on most potential areas on implementing RE projects, and re-skilling and up-skilling affected and relevant stakeholders to popularise RE. In conclusion, ASEAN needs to do more, from economic, policies, and socio, needs collaborative cooperation to make sure that ASEAN can achieve the ASEAN Plan of APAEC.

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Aligning Energy Culture as Part of Sustainable Tourism Ideas

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ABSTRACT

The idea of sustainable tourism is closely related to the aspects of the economy, environment and socio-cultural. In short, sustainable tourism aims to economically empower the people in potential tourism areas without disturbing the balance of natural biodiversity and the established social relations among them. Along with sustainable tourism development, governments are also eager to speed up the use of renewable energy in tourism sites. However, the government tends to increase the installation of modern infrastructure to produce renewable energy for tourist areas. Consequently, the development of sustainable tourism requires more budget and technical coordination between stakeholders, while it might affect the safety of local people. This research proposes the term "energy culture" as an integral part of sustainable tourism. In this concept, the related parties shall encourage the utilization of the energy source from local potential. This energy culture will strengthen the value of sustainability in developing the tourism attraction. It helps the preservation of the material culture of energy, norms, and practices to provide sustainable energy source to the people.

Keywords: energy culture, sustainable tourism, local potential, material, norms, practice, renewable energy

1. INTRODUCTION

Sustainable tourism has become the world governments' top priority to increase the economic performance after the era of global pandemic COVID-19. Many people argue that the period of global pandemic was a good momentum to repose and reflect the extent to which the government and all involved stakeholders implemented a sustainable tourism. According to the report of World Travel & Tourism Council (WWTC), tourism sector contributes approximately 10.3% of global GDP in 2019. It decreased by half in 2020 due to global mobility restriction but succeed to bounce back more than 20% in 2021 (WWTC, 2021). Unfortunately, this industry also shares 5% of all anthropogenic CO2 with almost 60%

carbon emissions are released (UNWTO, 2019). Regarding this issue, the world governments are eager to increase the implementation of sustainable tourism on one side. This idea is supporting global ambition to preserve the sustainability of mother earth by preventing any further negative human behaviour. On the other side, there is also a global transition towards the use of renewable energy all over the nations. Therefore, the national government tends to come in package which emphasize the increase of new and renewable energy (NRE) utilization to support the sustainable tourism.

However, there is a contradictive situation when the government plans to provide the renewable energy sources in tourism area. Heavy dependence on high technology and infrastructure led to the establishment of huge NRE projects in tourist attraction. The government argue that the development of NRE will help to boost the local economic, tourism potencies and electricity rate in the targeted location (De Rosary, 2021). Unfortunately, this effort led to the clash between the government and the society. Consequently, the initiative to commence the NRE project along with the idea to open sustainable tourism should be suspended.

One example, people in Wae Sano, East Nusa Tenggara, Indonesia hardly refuses the geothermal project plan in their village. At the very first time, the Indonesian government stated that the village would be potential to develop eco-tourism, educational system, and job opportunities. Yet, the society claimed that all the project development was executed based on the authority and structural power approach instead of a fully community involvement (De Rosary, 2021). In short, the project will change the social system established in the village. In this case, the idea of sustainable tourism is questioned, is it necessary for the government to enforce the NRE project in the targeted tourism area while it rises social friction with the indigenous people?

Therefore, in this study we assess the compatibility between the energy culture and sustainable tourism by using some tourism attraction in Southeast Asia as case-studies. Our methodology unfolds in two steps: first, we discuss some cases in Southeast Asia tourism, and second, we discuss the result of our analysis. At the end we would like to propose the concept of "energy culture" to be embedded within the idea of sustainable tourism. There are three aspects of the energy culture, namely material culture, norms, and practice (Stephenson, et al., 2010). In general, those aspects emphasize more on the delving of the social identity. Preserving the local energy culture is expected to not disturb the social

system within the community. In addition, this will help to show a new experience for the visitors to learn that providing NRE in a specific local area is in harmony to support the idea of sustainable tourism.

2. RESULT AND DISCUSSION (including conclusion)

we are recently doing the research by analysing the case studies. The research aims to end in mid-August 2022.

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On-Building Management System Architecture to Maximize Self Consumption in University Buildings: A Case Study

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ABSTRACT

Massive integration of renewable energy into fossil-fuelled grid will likely decrease the grid reliability owing to congestion and atypical power flows. One solution to this problem is to increase self-consumption. Demand side management and the addition of energy storage can help in increasing self-consumption. This study specifically chose a university building as the case study object because of its distinct characteristics. Unlike other buildings, room occupancy schedules in university buildings are random, and the occupants' activity levels are diverse. These conditions result in complex building dynamics and uncertainty in the power consumption of the building, making any attempt in increasing self-consumption more challenging. This paper proposed a recommendation for an enhanced system architecture to increase self-consumption in university buildings. An enhancement was made by introducing a data-driven controller to the deployed system. The controller in the proposed architecture yields two outputs for the building system. Both control actions play an important role so that the building leverages the maximum possible PV generation while maintaining thermal comfort.

Keywords: self-consumption, photovoltaics, load shifting, battery energy storage system, thermal comfort, university building

1. INTRODUCTION

Indonesia aims to achieve a 23% mix of renewable energy (RE) in primary energy produced by 2025 [1]. Consequently, there will be massive integration of renewable energy into Indonesia's fossil-fuel dominant grid in upcoming years, including solar PV. However, due to the intermittent nature of PV energy generation, grid reliability will likely decrease owing to congestion and atypical power flows [2]. One solution to increase grid reliability is to increase PV Self-Consumption. In the built environment context, Self-Consumption (SC) is the percentage of power consumed compared to the total energy produced by PV. There

are several ways to increase SC, from demand side management (DSM) to load shifting and the addition of energy storage [3].

A university building was chosen as the case study object because of its distinct characteristics. Unlike other buildings, room occupancy schedules in university buildings are random [4], and the occupants' activity levels are diverse [5]. These conditions result in complex building dynamics and uncertainty in the power consumption of the building [6], [7]. In load shifting, aside from considering PV generation, maintaining thermal comfort is necessary [8]. Complex building dynamics make load shifting more challenging as it is strongly linked to thermal comfort [9]. Uncertain power consumption opens a greater probability of supply and demand mismatch given the renewable generation. Therefore, a suitable building management system is needed to tackle the challenges of maximizing SC. This paper proposed a recommendation for an enhanced system architecture to increase SC.

2. RESULT AND DISCUSSION

The Labtech XIX Freeport Indonesia Business Research Centre (FIBRC) building of the School of Business and Management, Institute Technology Bandung, Ganesa Campus, is the object of this paper. The building consisted of 6 stories with a height of 28.3m, containing 3880.45m2 total floor space. The ground floor was primarily filled with office spaces. Floors 1-5 shared similar floor plans, which housed Instructional, laboratory, meeting, administration, and utility rooms, as well as a library. The rooftop area housed the building's 57.6 kWp solar PV panels, supported by a 3-phase grid-tie inverter system, a 192-kWh battery energy storage system, and hybrid inverters.

Energy consumption was measured by Modbus compatible smart energy meters for each floor of the building, with some energy-use intensive rooms given dedicated energy metering. The building HVAC was primarily handled by a central VRF HVAC unit with a BACnet compatible controller. A smart energy meter was used to monitor the central HVAC system exclusively. Rooms with irregular scheduling, such as meeting rooms, instructional rooms, and laboratories, were equipped with room sensor systems. The sensor systems include dry bulb temperature, relative humidity, and occupancy sensors. Information from these sensors was used to operate the room's automated lighting control system actuated via contactors.

According to [10], the required components for a DSM are communication, information, metering, and optimization strategy. Therefore, the above-mentioned components installed in Labtech XIX building have sufficed for a proper DSM. Combined with the available battery energy storage system, which can help to compensate for peak demand [11], it is possible to increase SC. However, components such as weather monitoring devices are yet to be installed, which prevents the system from predicting failure due to weather constraints.

In addition to the deployed system, we proposed an enhanced system architecture which integrated a data-driven controller. This type of controller was chosen for its ability to work under unknown building dynamics [12], [13], thus minimizing the possibility of resulting false control actions due to uncertainties. Figure 1 shows the proposed system architecture. From the building system, the controller was designed to sense the states of PV generation, battery storage system, and thermal zones. Simultaneous sensing from the microgrid and air conditioning system allows the controller to be informed about the supply and demand conformity while maintaining thermal comfort in each thermal zone. The gathered information is used to calculate the objective functions, i.e., maximizing self-consumption and keeping thermal comfort in the desired range. The controller in the proposed architecture yields two inputs for the building system. The input to the microgrid system controls the scheduling of the battery storage system, while the input to the air conditioning system controls the temperature of the thermal zones. Both control actions play an important role so that the building leverages the maximum possible PV generation while maintaining thermal comfort.

3. CONCLUSION

Implementing a data-driven controller in the university building's management system that binds the microgrid and the HVAC system together can allow for better control of its loads so that self-consumption increases, and the occupants' comfort is maintained.

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Enhanced Power Generation at Zn-air Battery using Plasma-treated Carbon Electrode

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ABSTRACT

Metal-air battery is promising electric power generation device due to its high-power density. It is now commercially used for compact medical devices, such as hearing aid. However, still there are many problems to solve to expand its usability. Among them, it is desirable to improve the reactivity at electrodes. In this study, single-walled carbon nanotube known as superior material having extremely high electric conductance and flexibility is used as air cathode. Especially, the surface of the carbon nanotube was treated by dielectric barrier discharge plasma in atmospheric air. By this treatment, the carbon surface will obtain functional groups doped with O and N. As a result, the carbon surface can be catalytic for some electrochemical reactions. By this surface treatment, the electric power generated by a Zn-air battery became about five times larger than the one with non-treated electrode. Compared with a surface treatment using vacuum plasma, the abovementioned plasma treatment seemed significantly more effective, resulting that the enhancement effect to improve power generation of the battery become more than twice. Based on some surface analysis such as XPS, the key factor to improve the reactivity for high power generation of the battery by the plasma treatment seems to be the species of the functional groups generated on the carbon surface.

Hydrothermal Deamination of Protein-Rich Algal Biomass

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ABSTRACT

Significant progress on the development of renewable energy can be observed recently to address issues related to climate change and to contribute to the attainment of carbon neutrality by 2050. Biomass-derived fuels are promising alternative energy sources. Emphasis has been placed on the use of microalgae-derived bio-oil due to the less stringent cultivation requirements for this feedstock as compared to the traditional crops. However, most of microalgal species consist of mainly proteins (55~67%), which contain high concentrations of nitrogen. The presence of nitrogen-containing compounds in fuels will affect the properties and will also contribute to the production of environmentally hazardous NOx compounds when burned. In this present work, hydrothermal method was applied to convert microalgae into bio-oil, incorporating it with supercritical CO2 and carbon-based catalysts to reduce N-containing products. Graphene oxide and its derivatives were used as carbon-based catalysts. The concentrations of the components of bio-oil, were analysed using GC-MS, and the catalysts were characterized using techniques such as FT-IR and XRD. The effects of reaction time, temperature, and catalyst loading on the yield and quality of bio-oil were investigated. Results indicated that the number of aliphatic compounds in bio-oil increased with temperatures up to 250°C. The addition of supercritical CO2 promotes protonation due to the formation and dissociation of carbonic acid, which helps to reduce N-containing products by about 5% within the investigated temperature range. The addition of graphene oxide also increased the rate of reaction, but no significant effects on the number of N-containing compounds were observed. This presentation will also highlight our recent work on amino acid, which serves as a model for N-containing compounds to further elucidate the mechanism.

Keywords: biochemical processes, biofuels, biorefineries, algal biomass, proteins

Is Ground Source Heat Pump the Future of Space Cooling in Southeast Asia?

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ABSTRACT

Space cooling is one of the fastest-growing energy sectors in the world. The demand for air conditioner has increased rapidly in Southeast Asia, accelerated by population and economic growth, climate change, and a higher demand for comfort. In the region, the residential sector accounts for the second-highest electricity demand after the industrial sector, growing at an average annual rate of 7.5%, primarily due to the increasing number of electrical appliances. The ever-increasing energy and electricity demand, including in the space cooling sector, has led to a growing concern about future energy sustainability in the region. In addition, Southeast Asian countries, have established strict roadmaps toward achieving the 2050 net-zero carbon emissions. Therefore, introducing an efficient space cooling technology becomes essential.

Keywords: Energy efficiency and conservation, ground source heat pump, space cooling, Energy collaboration, Energy resources assessments

1. INTRODUCTION

The Japan Refrigeration and Air Conditioning Industry Association reported that in 2018, Indonesia, Vietnam, and Thailand were respectively the first, second, and third highest countries for air conditioner demands in Southeast Asia, with a total of 2.3 million, 2 million, and 1.5 million units per year. Further, the annual regional air conditioner demand increased from 12.2 million units in 2011 to 16.4 million units in 2016, equivalent to an average annual growth rate of 6.1%. Japan leads the Southeast Asian air conditioners market, followed by South Korean and Chinese manufacturers. The Ground Source Heat Pump (GSHP) has been proven as an efficient way to reduce energy consumption compared to Air Source Heat Pump (ASHP) or typical air conditioners. However, It remains unknown whether GSHP could perform efficiently over a long period under Southeast Asian climate and specific geological conditions.

2. RESULT AND DISCUSSION

The GSHP application in Southeast Asia encounters several challenges, such as: Technical challenges Ø Limited knowledge of how GSHP performs in the tropical climate for a longer period Ø Only for cooling; no thermal balance between heat rejection and extraction Ø High ground temperature

Financial challenges Ø High investment cost Ø A Long & uncertain payback period and Market is not available Ø Regular AC is easier to be installed and maintained Ø Electricity price is low (with subsidy from the government) Ø No government incentives and policies

Social challenges Ø Lack of information on GSHP (about the technology, cost, benefits, etc) Ø Lack of awareness on Energy saving Researches on GSHP Application In Southeast Asia

To study the applicability of GSHP in Southeast Asia, research collaborations have been established between the National Institute of Advanced Industrial Science and Technology, AIST and several institutions in Thailand and Vietnam. Under collaboration with Chulalongkorn University and the Department of Mineral Resources of Thailand, three GSHP systems were installed. While a system was installed in Hanoi in partnership with Vietnam Institute of Geoscience and Mineral Resources (VIGMR). The installed GSHP systems gather essential data regarding the short-term and long-term performance of GSHP under the respective climate condition for further analysis and optimization. In addition, the systems also serve as exhibitions to introduce the GSHP technology to local communities. In addition, cost analysis has been carried out to project the economic feasibility of the long-term GSHP application. It is found that the GSHPs can provide between 40.3% to 15.1% of electricity savings compared to ASHP. The variation of the electricity savings is mainly affected by the seasonal climate variation. Further analysis implied that the payback time of the GSHP system against the ASHP system could be achieved between 6.5 years to 20 years, depending on the different initial cost reduction scenarios and local production of the heat-pump system [1]. The expected result is that Singapore's energy transition agenda per se, as outlined in its Low Emissions Development Strategy and Green Plan, is unlikely to have a negative impact on trade and investment flows between Singapore and the Arab Gulf states over the next two decades.

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Street Dining: Lighting as Co-producer of the Performative Event in Pasar Lama Tangerang

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ABSTRACT

This paper studies the lighting arrangement and street dining layout as part of the overall spatial qualities of street vendors. While studies of street vendors and their implications within the urban environment have been done, this study aims to contribute to the discussion by investigating the placement, intensity, and perceptions of the surrounding lighting of night-time street vendors. The findings of this study indicate that there are intrinsic production qualities in street dining layout based on the placement, intensity, and perceptions of its surrounding lighting. There are three aspects of lighting as a co-producer of a performative dining out event: to accentuate food as a product to be enjoyed and consumed, to showcase food-making and food serving as a spectacle, and to create ambience for the festivities of dining outdoors communally. These aspects convey and oscillate between a permanent and temporal existence. The oscillations, however imperceptible, contribute to the performative and narrative aspects of the spatiality of street dining, especially at Pasar Lama Tangerang. This study expands the current understanding of night-time and night-time economy by showing that everyday night-time street dining in relation to outdoor lighting offers a new perspective on the adaptability of existing streets.

Keywords: street dining, lighting, co-producer, performative event, street vendors

1. INTRODUCTION

This paper studies the lighting arrangement and street dining layout as part of the overall spatial qualities of street vendors. While studies of street vendors and their implications within the urban environment have been done, this study aims to contribute to the discussion by investigating the placement, intensity, and perceptions of the surrounding lighting of night-time street vendors. This investigation occurred at Pasar Lama Tangerang, where outdoor dining is celebrated daily.

The night-time economy is a terminology to describe an expansion of the economic system of daytime into night-time and, thus, a 24-hour cycle [1]. This phenomenon is due to

electrification, which invited people to create public nightlife on the streets [2], [3]. The perception of users was shifted from where the night previously was seen with negative associations [3] to engaging the street as the place for interaction, communication, transportation, social and commercial activities for the public [4]. Moreover, proper street lighting is crucial in enhancing the feeling of safety [5], including the existence of outdoor dining. Hence, the positive perceptions of safety mainly contribute to the increasing activity of eating out [6] [7], indoor or outdoor.

Generally, street food is defined as "anything sold by peddlers carrying baskets and other portable containers, various kinds of vehicles, temporary or permanent" [7]. Historically, there were negative perceptions of street vendors as pollution to urban and city soundscapes [8] and their perceived place based on their operational hours [9]. Additionally, in some studies, street vendors are also seen as a challenge to the walkability of its neighbourhood due to its expansive and expanding space where people regularly walk [10]. Contrarily, the act of dining out is recently regarded as a performative event [11], cooking and dining as forms of public art [12], and dining as dramaturgical encounters [13].

2. METHODOLOGY

The location of Pasar Lama Tangerang (Tangerang Old Market) is along Jalan Kisamaun, Tangerang, in Banten province, Indonesia. The night market entrance starts at the intersection of Jalan Kisamaun and Jalan A. Damyati, marked by a stone monument. The street is barricaded on the east and west elevations by multi-story shophouses housing various retailers.

The research focuses on a market segment consisting of street vendors selling food. Some vendors provide seating arrangements behind their "facades" where visitors have the option to dine in or take away (Figure 1). The location was visited six times with various observation hours from 2.30 PM to 7.30 PM between March and July 2022. Variations in the survey hours were intentional to capture differences in traffic users, the flow of circulation between users, their street dining layout, and spatial qualities.

Figure 1. The existing condition of street dining at Pasar Lama, 2022. Source: Authors

The observation is conducted through nightwalking to discover certain aspects of street dining based on their lighting and spatial relations in itself or between vendors and visitors.

The observations were captured and recorded using a DSLR camera with a tripod. Additionally, the dining out events were recorded to capture certain aspects of the observation where limitations of night photography might hinder an in-depth understanding of the existing street dining layout.

3. RESULT AND DISCUSSION (including conclusion)

The findings of this study indicate that there are intrinsic production qualities in street dining layout based on the placement, intensity, and perceptions of its surrounding lighting. There are three aspects of lighting as a co-producer of a performative dining out event: to accentuate food as a product to be enjoyed and consumed, to showcase food-making and food serving as a spectacle, and to create ambience for the festivities of dining outdoors communally. These aspects convey and oscillate between a permanent and temporal existence. The oscillations, however imperceptible, contribute to the performative and narrative aspects of the spatiality of street dining, especially at Pasar Lama Tangerang.

This study expands the current understanding of night-time and night-time economy by showing that everyday night-time street dining in relation to outdoor lighting offers a new perspective on the adaptability of existing streets. The study also suggests the possibility of learning various strategies and tactics for enhancing events in public spaces. In addition, this study raises further questions on the possibility of future adaptations in the creative and adaptability of urban design.

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Performance Evaluation of Anaerobic Baffled Reactor and Filter for Treating Medium-strength Wastewater using Natural Sludge Growth and Different Hydraulic Retention Times

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ABSTRACT

This work aimed to investigate and compare the removal performance of anaerobic baffled reactor (ABR) and anaerobic filter (AF) operating at different hydraulic retention times (HRT) for treating medium-strength wastewater. Both reactors are composed of five compartments with 71-liter and 51-liter working volume for ABR and AF, respectively. The daily wastewater is fed directly into reactors by letting the sludge grow naturally. 24h and 12h HRT were performed by both reactors to observe the distinguish removal efficiency. According to the findings, there is no noticeable difference between the treatment performances of ABR and AF for COD reduction at start-up time, with corresponding COD reduction rates of 50 and 56%. TSS and VSS reduction for ABR are within 80% of what AF attained, while AF performed roughly 90% better than ABR. Since neither reactor had reached steady state, it was impossible to compare their performances. Meanwhile, an additional buffer to avoid acidic conditions in each reactor was recommended to maintain the system's pH normal.

Keywords: Medium-strength Wastewater, Anaerobic baffled reactor, Anaerobic filter, Hydraulic retention time, Natural sludge growth

1. INTRODUCTION

Anaerobic digestion (AD) is a non-energy consuming process incorporating several active microbes that might also metabolize complex polymers, including proteins, nucleic acids, carbohydrates, and lipids, into end metabolic products such as methane and carbon dioxide [1]. Many different anaerobic digesters have been developed, and some are widely used for various purposes such as wastewater treatment (high, medium, and low strength) and methane gas production. However, conventional anaerobic digestion has been utilized for over two centuries; the full-scale systems still experience poor performance and system failure due to inadequate operational management and a lack of process monitoring and control. In this case, using an anaerobic buffer reactor (ABR) and anaerobic filter (AF) instead

of the conventional septic reactor, which utilizes hanging and standing baffles to partition the reactor into distinct compartments and flow zones, was considered. High concentrations of biomass in each compartment, which tend to settle and rise with horizontal flow stream and gas production, cause the reactor to operate at a relatively high solid retention time and low hydraulic retention time, resulting in a higher treatment rate, greater resilience to organic and hydraulic shock loads, longer biomass retention times, and lower sludge yields than other anaerobic treatment systems [2]. But research on ABR and AF performance was rarely undertaken in a single study. Thus, evaluating their performance in wastewater treatment was difficult since various research areas might result in varied growth of active microorganisms in each compartment, leading to different performances. According to the abovementioned issue, this study's purpose was to evaluate and compare the removal performance of medium-strength wastewater utilizing the ABR and AF with a natural sludge growth and various hydraulic retention times (HRTs).

2. RESULT AND DISCUSSION (including conclusion)

The ABR is made of acrylic material and measures 120 cm in length, 25 cm in width, and 30 cm in height. It has 5 compartments and a working volume of 71 L. Except for the similar compartments, the AF has a working volume of only 51 L with dimensions of 95 cm, 25 cm, and 30 cm.** Furthermore, the feeding wastewater originates from the Institute of Technology of Cambodia's sewage system (ITC). Influent and effluent **pH, ORP, EC and TDS were measured using HACH HQ40d multimeter, where total suspended solids (TSS) and volatile suspended solids (VSS) were analysed, followed by standard method 2540-D and E, respectively. For chemical oxygen demand (COD) analysis followed by 5220-C closed reflux Titration Method, 5210B for biochemical oxygen demand (BOD), 2320-B for volatile fatty acid (VFA) and alkalinity, whereas total nitrogen (TN) and total phosphorus (TP) were analysed using the colorimetric method, which was performed and digested by HACH DRB 200 and indicated by HACH DR 1900.

Depending on the source of daily wastewater entering the system, the initial pH of wastewater fluctuates between 4.6 and 8.9. There is no substantial influence on active microbes in each system within this range since Wu (2021) [3] demonstrated that a pH of 6.5-7.6 is required for an efficient AD system. In contrast, a VFA to alkalinity ratio of 1.0-4.6 was observed in all anaerobic systems after the long operation, which could inhibit methanogenesis reaction in each reactor because Khanal (2009) [4] revealed that only a VFA to alkalinity ratio of 0.1-0.25 could be favourable for anaerobic digestion without the risk of

acidification. In this situation, the methanogenesis bacteria that consume VFA and produce by products of methane and carbon dioxide may be stopped working, and an acidic condition could develop; however, no additional buffer was introduced. It was because high COD removal rates of 50-90 % were only found during the early stages of operation (weeks 1-6). However, during weeks 7-9, this performance was reduced by 30% and 20% for the ABR working under an HRT of 12 hr and 24 hr, while the AF was identified by 25% and 33%, respectively.

The decreased removal performance of both anaerobic systems may also cause by the increase in organic loading rate (OLR), which reduces the system's maximum removal performance. Ghaniyari-Benis (2009) [5] also demonstrated that an increase in OLR brought about the accumulation of VFA, causing the pH drop-down when alkalinity, not balance, leads the system inhabited where the methanogens stage cannot take place. The BOD removal is lowered for both reactors, and conditions were below 50% removal for ABR-24h, AF-24h and AF-12h. Moreover, ABR-12 showed a better performance than others but dropped down rapidly at week 5 to below 50% removal, this is due to the system running in naturally sludge growing and not reach to the stable condition yet, and it also needs at least 2-4 months for sludge growing reach to the stable condition and the over OLR together [4]. Around 70-80% TSS and VSS removal was achieved for ABR-24h and ABR-12h; by the way, AF-24h and AF-12h showed a better reduction in between 80-90% were since AF has sponge media act as a filter that could help removal suspended solids. To summarize, the performance comparison of the ABR and AF could not be concluded since both systems have not yet reached a steady state. However, to eliminate the acidic condition in each reactor, an additional buffer, such as sodium bicarbonate, should be introduced to the system.

In summary, pH, VFA and alkalinity are the main parameters for the anaerobic digestion controlling system. Based on the results, the treatment performance of both ABR and AF does not show a significant difference for COD reduction within start-up time, with about 50% and 56% for ABR and AF, respectively. TSS and VSS removal are within 80% for ABR, and AF achieved better performance, about 90% than ABR. The performance of both reactors could not be compared since neither reactor had attained the steady-state condition. Otherwise, supplementary buffer to prevent acidic conditions in each reactor was suggested after 9 weeks of operation.

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