International Conference 2022

ENERGY, ENVIRONMENT, and CLIMATE CHANGE

26 - 28 October 2022   Jomtien Palm Beach Hotel and Resort, Pattaya, Thailand

PROGRAMS AND ABSTRACTS

ICUE 2022

ASIAN INSTITUTE OF TECHNOLOGY · 1959 ·

CONTENTS

RATIONALE OF THE CONFERENCE

Sustainable development is based on three interlinked criteria: economic development, social progress, and environmental protection. It is the state of development that seeks to produce sustainable economic growth while ensuring future generations' ability to do the same by not exceeding the regenerative capacity of nature. This conference focuses on three main topics that relate to sustainbale development namely energy, environment, and climate change. In the energy area, the technical, economic, and social dimensions of energy utilization, its effect to the environment and to climate change will be covered. Considering the environment side, the current major concerns include the status and remediation measures through technology and policy of air, water, and soil pollution, and issues related to waste and plastic management. Lastly, climate change is focused on as it is one of the major threats to human survival due to increasing green house gas emissions. The conference will broadly discuss topics related to climate science, green house gas mitigation and climate change impacts and adaptation in terms of technology aspects, policias, case studies, and measures to address the challenges.

This ICUE 2022 conference will be a venue to exchange research ideas, experiences, technical, social, financial, economic and policy issues covering greening energy utilization. Here, academicians, members of the private sector and industry sector, businesspersons, energy professionals, policy makers, non government organizations, engineers, international and regional institutions, consulting agencies, and research scholars/students, will have a platform to showcase research findings, technological innovations, transformative emerging technologies, and even to discuss burning global, regional and national issues in energy utilization for development and environment policies and programmes.

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Sustainable Energy Transition Program

Department of Energy, Environment and Climate Change

Asian Institute of Technology (AIT)

Regional Energy Resources Information Center (RERIC)

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Mr. Zheng Li

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THE ASIAN INSTITUTE OF TECHNOLOGY (AIT)

The Asian Institute of Technology (AIT) is an international English-speaking postgraduate institution, focusing on engineering, environment, and management studies. AIT's rigorous academic, research, and experiential outreach programs prepare graduates for professional success and leadership roles in Asia and beyond.

Founded in 1959, AIT offers the opportunity to study at an institution in Asia which possesses a global reputation. Going forward, AIT will be stressing its globalconnections, injection of innovation into research and teaching, its relevance to industry, and its nurturing of entrepreneurship, while continuing to fulfill its social impact and capacity building role. Sitting on a beautiful green campus located just north of Bangkok, Thailand, AIT operates as a multicultural community where a cosmopolitan approach to living and learning is the rule. You will meet and study with people from all around the world.

Today, AIT's internationally recognized engineering, environment, and management graduates are highly sought after by employers in their home countryand elsewhere. Across many walks of life in Asia, AIT alumni have distinguished themselves as CEO's of private and state enterprises, as business owners, as well-respected researchers and faculty, and assenior university and government officials.

Vision
AIT will strive to become a leading and a unique regional multicultural institution of higher learning, offering state-of-the-art education, research and training in technology, management, and societal development.

Mission
The mission of AIT in the context of the emerging environment is "to develop highly qualified and committed professionals who will play a leading role in the sustainable development of the region and its integration into the global economy".

Guided by the above clear, timeless vision and mission, the dedicated students, faculty and staff of AIT are set to steer the Institute along its path of becoming:

- A trailblazer in advanced education in the region, with leadership in IT and new types of multidisciplinary programs
- An exemplary institution, with an emphasis on academic quality in terms of courses and other aspects of operation
- A leader in professional development programs
- A hub for the implementation of regional and transnational research projects, and a research facility for academic professionals. A nexus for networking with other academic and research institutions in the region and the world

- A model international citizen
- A collaborator and partner of national postgraduate institutions
- A financially viable, self-sustaining institution, able to draw support from donors the private sector and individuals, with good governance and strong leadership
- A strong partner to its alumni, who are principal stakeholders through the AIT Alumni Association (AITAA)

Awards and Recognitions

- **1987 Science and Technology for Development Award** presented to AIT by the United States Agency for International Development and the National Research Council for effectively transferring industrial technology and skills to the developing world, by training scientists and engineers from Asian countries.
- **1989 Ramon Magsaysay Award for International Understanding** presented to AIT for shaping a new generation of engineers and managers committed to Asia, in an atmosphere of academic excellence.
- **1994 Development Management Award** presented to AIT by the Asian Management Awards for fostering manpower development, technological change and sustainable growth in the region, through advanced education and research.
- **1996 DAAM International Vienna Awards** presented by the Danube Adria Association and Manufacturing (DAAM) International Vienna, Austria, to express appreciation to AIT and its high-technology experts from the Industrial Systems Engineering Program of the School of Advanced Technologies for their significant contribution in the field of technical sciences and international scientific cooperation within the framework of DDAM, on the occasion of the 7th DAAM international symposium to celebrate the 1000th anniversary of Austria.
- **2006 Friendship Order** was awarded to AIT in the area of international relations that have contributed to human resource training for Vietnam and to the development of friendly relations between Vietnam and other countries.
- **2016 Gold medal in Thai Research Fund (TRF) Ratings** was awarded to AIT for bagging the most perfect scores (seven scores of '5' each) among all universities in Thailand.

Key Facts and Figures

- 1607 Students from 40+ countries
- 23,932 Alumni from 100+ countries/territories
- 125 Faculty members from 20+ countries
- 34 Board of trustee members from 16 countries
- 30+ Fields of study

- 1078 Graduate courses
- 38000+ Short-course trainees from 100+ countries
- 300+ ongoing research project
- 200+ Partners Worldwide
- 3 Schools
- 551 Research and Support Staff

AIT Offers

- Masters degrees: MBA, MEng, MSc
- Executive Master Degree Programs
- Doctoral Degrees: DEng, DTechSc, PhD
- Diploma and Certificate Programs
- An intensive English language and academic Bridging Program
- Non-degree continuing education courses for practicing professionals

ABOUT RERIC

The Regional Energy Resources Information Center (RERIC) was established in 1978 as a result of recommendations made at various meetings held in Asia, and particularly those made at a meeting of experts in solar and wind energy utilization held in 1976 under the energy program of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP).

RERIC is the publications arm of the Sustainable Energy Transition Program. It occasionally publishes workshop, project reports, books of some members of the Energy faculty and the long-established International Energy Journal.

The current RERIC staff are as follows:

Director:	Dr. Jai Govind Singh
Research/Information Professional:	Maria Kathrina B. Gratuito
Assistants:	Ms. Jitima Noyneam
	Ms. Sheree Ann-Soriano Gonzales

RERIC regularly publishes the **International Energy Journal (IEJ)** since 1979. It is a journal dedicated to the advancement of knowledge in energy by the vigorous examination and analysis of theories and good practices, and by encouraging innovations needed to establish a successful approach to solve identified problems. IEJ is a quarterly journal that publishes peer-reviewed papers on technical, socio-economic and environmental aspects of energy planning, energy conservation, renewable sources of energy, and electric power transmission, generation and management. The papers are reviewed by world renowned referees. IEJ also maintains an online journal system wherein not only current volumes are available but also archives containing past volumes and past special issues. IEJ is a quarterly publication published in *March*, *June*, *September* and *December* of each year. IEJ also occasionally publishes Special Issues on current relevant topics. The IEJ is proud to be:

- Included in the Emerging Sources Citation Index of **Clarivate Analytics** *(Web of Science™ Core Collection)*.
- It is also indexed and abstracted in the **Scopus** title list
- Listed and ranked in the **SJR** *(SCImago Journal and Country Rank)*.
- It is also listed in the **EI Compendex Journal Source List** (Compendex Database of Engineering Information, Inc.).

The IEJ is also the only Energy-category focused international journal published in **Thailand**. All articles since **1979** are archived in its online database at www.rericjournal.ait.ac.th

RERIC's occasional publications include conference/seminar/workshop proceedings, research reports, directories, environment systems review, and do-it-yourself manuals. RERIC also occasionally publishes some books, workshop reports of some of the faculty members of the Sustainable Energy Transition Program. RERIC also ocassionally organizes training workshops and short online international masterclass.

VENUE

Jomtien Palm Beach Hotel and Resort

The Jomtien Palm Beach Hotel & Resort consists of three buildings surrounded by palm trees, gardens and gold sand. The hotel boasts Lobby Bar, conference rooms, 24-hour room service, restaurants as part of its superior facilities and services. Guests seeking execise or leisure will be pleased to find outdoor pool, snooker club, twelve-pin bowling alley, spa and much more at the hotel. This charming property has long been a favorite in Pattaya for both business and leisure travellers. When you need an event venue, count on **Jomtien Palm Beach Hotel & Resort** to make your meeting a success. Whether you're holding large company strategy session, an **International Conference** or an intimate cocktail party, their meeting professionals approach every event with dedication and enthusiasm, leaving you to rest assured that they have taken care of everything.
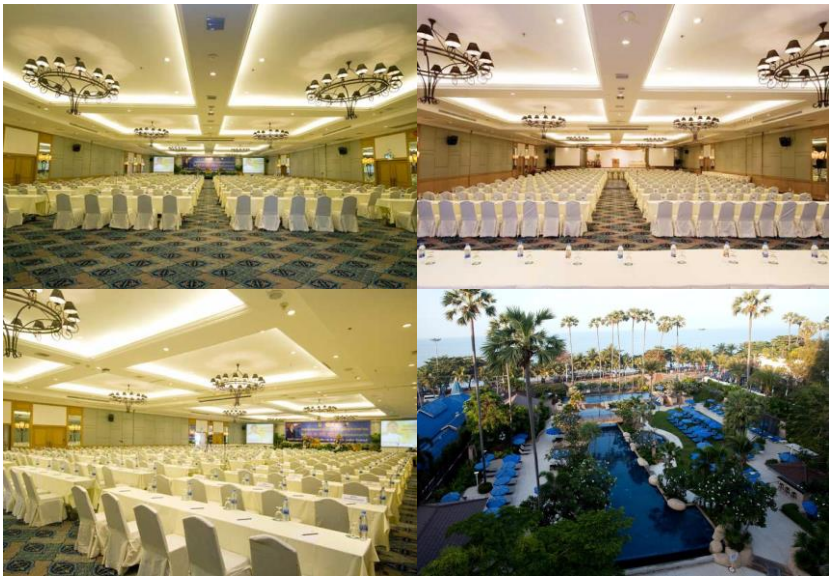
PROGRAM

DAY 1 PROGRAM
26 October 2022, Wednesday

09:00 - 09:05   Welcome remarks and introduction of the AIT President

09:05 - 09:15   OPENING REMARKS by Prof. Kazuo Yamamoto, AIT President

09:15 - 09:20   Presentation of Plaques of Appreciation to ICUE 2022 Sponsors by the AIT President

Gold Sponsor – Bangchak Corporation Public Company Limited (BANGCHAK)
Silver Sponsor – Electricity Generating Authority of Thailand (EGAT)
Technical Collaborators
AIT Earth Observation project (Head, Dr. Ekbordin Winijkul)
South and Southeast Asia Multidisciplinary Research Network on Transforming Societies of Global South, SMARTS@SERD-AIT (Director, Prof. Joyashree Roy)

09:20 – 09:30   Group Photo

09:30 – 10:30   Panel Discussion 1:

Open-Source Modelling of Energy System-Theory and Applications: IDEEA Model Application
Moderator: Prof. Joyashree Roy (Director-SMARTS/SERD@ AIT)
Speakers:
  Prof. Oleg Lugovoy (Environmental Defense Fund, USA)
  Varun Jyoti Prakash (Indian Institute of Science Bangalore, India)
  Sourish Chatterjee (Global Change Program – Jadavpur University, India)

10:30 - 10:45   Coffee/Tea Break

10:45 – 11:45   Panel Discussion 1: ……*continuation*

11:45 – 12:45   Lunch Break

12:45 – 13:30   Keynote Address I

Prof. Xia Huang,
Tsinghua University, China

"Anaerobic MBR: Opportunities and Challenges towards Carbon Neutrality"

13:30 – 15:00	Session A (break-out): Solar Energy I
	Session B (break-out): Climate Change and Agriculture
15:00 - 15:15	Coffee/Tea Break
15:15 - 17:30	Session C (break-out): Water and Wastewater Technology
	Session D (break-out): Energy in Transport
17:30 - onwards	Welcome Dinner at Coral Reef restaurant

DAY 2 PROGRAM
27 October 2022, Wednesday

09:30 – 10:15	Keynote Address II
	Dr. Govinda Timilsina Sustainability and Infrastructure Development Research Group The World Bank, Washington, D.C., USA
	"Would Carbon Tax be Appropriate for Developing Economies?"
10:15 - 10:30	Coffee/Tea Break
10:30 - 12:00	Session E (break-out): Solar Energy II
	Session F (break-out): Climate Policy
12:00 - 13:00	Lunch Break
13:00 - 15:00	Panel Discussion 2:

	Application of Big Earth Data in Support of the Sustainable Development Goals in Thailand
	Moderator: Dr. Wenchao Xue
	   Prof. Junsheng Li (Aerospace Information Research Institute, Chinese Academy of Sciences)
	   Dr. Ekbordin Winijkul (Environmental Engineering and Management, AIT)
	   Dr. Salvatore G.P. Virdis (Remote Sensing and GIS, AIT)

15:00 - 15:15	Coffee/Tea Break
15:15 - 17:15	Session G (break-out): Water Management and Valorization
	Session H (break-out): Carbon Neutral Society
15:00 - 15:15	Coffee/Tea Break

DAY 3 PROGRAM
28 October 2022, Friday

09:00 - 10:30	Session I (break-out): Energy in Buildings
	Session J (break-out): Microgrids
10:30 – 10:45	Coffee/Tea Break
10:45 - 12:00	Session K (break-out): Environmental Management
	Session L (break-out): Renewable Energy
12:00 - 13:00	Lunch Break
13:00 – 13:30	CLOSING CEREMONIES
	Closing Remarks by Prof. Shobhakar Dhakal *(tbc)* AIT Vice President for Academic Affairs
13:30 – 17:00	Technical Field Visit

KEYNOTE SPEAKER 1

Anaerobic MBR: Opportunities and Challenges towards Carbon Neutrality

Prof. Xia Huang
Department of Environmental Science and Engineering, Tsinghua University, Beijing, China

Prof. Xia Huang received her BS in 1982 in Sanitary and Environmental Engineering from Chongqing Institute of Architecture and Engineering, her MS in 1985 in Environmental Engineering from Kyushu Institute of Technology, Japan, and her PhD degree in 1988 in Environmental Chemistry and Engineering from Tokyo Institute of Technology, Japan.

After her PhD education, she joined the Department of Environmental Engineering, Tsinghua University as a lecture in 1989, and became associate professor in 1992 and got the full professor position in Tsinghua University in 1997. As a visiting professor, she visited University of Cincinnati, USA from 4/1994 to 7/1994, University of Leeds, UK from 9/1998 to 10/1998. She worked in Department of Ecological Engineering of Toyohashi Institute of Technology, Japan from 3/1995 to 3/1997 as an associated professor, and worked in Tokyo Institute of Technology and Kyoto University, Japan respectively from 12/1989 to 3/1999 and 7/2007 to 9/2007 as a guest professor. Now she is a Director of Division of Water Environment, Vice Director of State Key Joint Laboratory of Environment Simulation and Pollution Control, and Chair of Academic Committee of Department of Environmental Science and Engineering, Tsinghua University.

She is a member of Management Committee of the IWA Specialist Group on Membrane Technology, and Executive Associate Editor-in-Chief of "Frontiers of Environmental Science & Engineering in China". She was awarded by the National Science Fund for Distinguished Young Scholars and the Yangtse River Scholar reward, and has published more than 100 papers in recent 5 years, and received ES&T 2009 best paper award, two State Science and Technology Progress Awards and several awards issued by Ministry of Education of China.

Her areas of research interests include Hybrid membrane technologies for water and wastewater treatment, Microbial fuel cell for simultaneous electricity generation and wastewater treatment, Novel biological nitrogen and phosphorus removal processes, Excess sludge reduction and resource recovery.

KEYNOTE SPEAKER 2

Would Carbon Tax be Appropriate for Developing Economies?

Dr. Govinda Timilsina
Sr. Research Economist, Development Research Group, World Bank, Washington, DC

Dr. Govinda Timilsina is a Senior Research Economist at the Development Research Group of the World Bank, Washington, DC. He has almost 25 years of experience across a broad range of energy and climate change economics and policies at the international level. His key expertise includes carbon pricing, climate change mitigation, renewable energy, electricity economics, general equilibrium & energy sector modeling, and urban transportation & infrastructure economics. Prior to joining the Bank, Dr. Timilsina was a Senior Research Director at the Canadian Energy Research Institute, Calgary, Canada. At present, he is leading a number of studies, including carbon pricing for developing countries, infrastructure and economic growth, and electricity economics. He also serves as an editor of the *Renewable and Sustainable Energy Reviews* journal.

A brief description of his speech in the conference is as follows: A carbon tax is one of the main pricing instruments for climate change mitigation. Many industrialized countries have implemented it. Developing countries are also showing strong interest in it. However, policymakers are facing several questions regarding the economic and distributional impacts of a carbon tax. The questions include: (i) what type of tax design architecture best suits them, particularly how best to utilize the carbon tax revenues; (b) how does it impact the poor? Can a carbon tax be pro-poor? (c) Does a carbon tax produce fiscal co-benefits? (d) Does a carbon tax help reduce economic informality? (e) Does a carbon tax promote renewable energy (e.g., hydro, solar, wind) without causing additional economic costs? To answer some of these questions, the seminar presents results from three studies on carbon tax for developing economies. Two studies are for low-income countries in Sub-Saharan Africa (Cote d'Ivoire and Ethiopia) and one study is for a middle-income country (China). The findings will be complemented with the speaker's forthcoming review study in the Journal of Economic Literature on carbon taxes.

PANEL DISCUSSION 1

Open Source Modelling of Energy System-Theory and Applications

Moderator - Prof. Joyashree Roy (Director-SMARTS/SERD@AIT)
Speakers:
1. Prof. Oleg Lugovoy (EDF – USA)
2. Mr. Varun Jyoti Prakash (IISC – Bangalore, India
3. Mr. Sourish Chatterjee (GCP – Jadavpur University, India)

Individual countries are increasingly making commitments to reach net zero emissions around midcentury. Recently published IPCC report assessed various models to understand the global net zero future pathways. The announcement needs to be backed by scientific estimate of future resource needs to meet the targets, and the potential outcomes in multiple economic, social, technological dimensions and need be assessed beforehand to enable smooth transition. It will facilitate more informed non-disruptive decision-making and create the capacity to design better energy supply systems with diverse technological alternatives. Many such models are like black boxes where users of the model are not the creators of the model. Open source model breaks that linearity and is a collaborative model building effort so users can change, develop, customize and enhance the models.

India has targeted 2070 and meet fifty per cent of its electricity requirements from renewable energy sources by 2030 is of enormous significance in the global fight against climate change. IDEEA – Indian Zero Carbon Energy Pathways is an energy-optimisation model developed by young researchers collaboratively and customized according to India's priorities, goals, scenarios, and data.

SMARTS centre at SERD/AIT in collaboration with Global Change Program – Jadavpur University (GCP-JU), Indian Institute of Science (IISc)-Bangalore, and Environmental Defense Fund (EDF), would like to welcome you to a join in their session followed by Q&A. The unique nature of this session is that participants get to learn from Dr. Oleg Lugovoy who is an established name in the field basic knowledge on OpenSource Modelling. Long term goal is to train early career researchers from the region who are interested in pursuing their research using open source models. Each Participant will get some useful reading materials, exposure and scope for future participation in hands on trainings and participation certificates.

PANEL DISCUSSION 2

Application of Big Earth Data in Support of the Sustainable Development Goals in Thailand

Moderator - Dr. Wenchao Xue (Environmental Engineering and Management, Asian Institute of Technology)
Speakers:
1. Prof. Junsheng Li (Aerospace Information Research Institute, Chinese Academy of Sciences)
2. Dr. Ekbordin Winijkul (Environmental Engineering and Management, AIT)
3. Dr. Salvatore G.P. Virdis (Remote Sensing and GIS, AIT)

PRESENTATION SCHEDULES

Day 1: 26 October 2022 (Wednesday)

Session A: Solar Energy 1
Time: 13:30 – 15:00
Room Assignment: Marine Ballroom 1

Ref. No.	Title, Authors, Affiliation	Country of Origin
S. A.1 **Student Award Entry**	**Design and Analysis of Hybrid Photovoltaic Installation Schemes for Urban Buildings** *Sirawit Hariwon[1], Panida Thararak[1], Peerapol Jirapong[1], Supanida Kaewwong[1], and Churat Thararux[2]* [1]Chiang Mai University, 239 Huay Kaew Road, Muang District, Chiang Mai, 50200, Thailand. [2]School of Renewable Energy, Maejo University, 63 Nong Han Subdistrict, San Sai District, Chiang Mai, 50290, Thailand.	Thailand
S. A.2	**Design of a Novel Solar Photovoltaic/Thermal System (PVT) for Ladakh Region** *Vipul Raj and Satya Sekhar Bhogilla* Department of Mechanical Engineering, Indian Institute of Technology Jammu, Jammu and Kashmir 181221, India.	India
S. A.3	**Detection of Invisible Solar PV Installations in Power Distribution System: A Review** *Wutthipum Kanchana and Jai Govind Singh* Department of Energy, Environment and Climate Change, Asian Institute of Technology, Klong Luang, Pathumthani, Thailand.	Thailand
S. A.4	**On the Accuracy of Open-Source and Commercial Solar Forecasting Tools** *M.A.R. Shaon and Yahia Baghzouz* Department of Electrical and Computer Engineering, University of Nevada, Las Vegas, Nevada, USA.	USA
S. A.5 (Virtual)	**GWO Controlled SEPIC Converter for Maximum Power Point Tracking of Solar Panel** *Ghozi Alif Kirana, Firilia Filiana, and Happy Aprillia* Electrical Engineering Field of Study, Institut Teknologi Kalimantan, Balikpapan, East Kalimantan, Indonesia.	Indonesia

Session B: Climate Change and Agriculture Time: 10:30 – 12:00 Room Assignment: Oriental Palm I		
Ref. No.	Title, Authors, Affiliation	Country of Origin
S. B.1	**Climate Change Impacts on Hydro-Generation and Land Suitability for Agriculture in Cambodia, Laos and Myanmar** *Olivier Dessens*, Gabrial Anandarajah[1, *], and Jennifer Cronin* *UCL Energy Institute, University College London, Central House, 14 Upper Woburn Place, London, WC1H 0NN, United Kingdom.	United Kingdom
S. B.2 (Virtual)	**Assessment of Climate Change Impact on Water Footprint of Glutinous Rice (RD6) Production and Adaptation Strategies: A Case Study of Udon Thani Province, Thailand** *Choticha Suwannakhot[1, *], Nathsuda Pumijumnong1, Sukanya Sereenonchai[1], Winai Chaowiwat[2], and Noppol Arunrat[1]* [1]Faculty of Environment and Resource Studies, Mahidol University, Nakhon Pathom 73170, Thailand. [2]Hydro-Informatics Innovation Division, Hydro Informatics Institute, Bangkok 10400, Thailand.	Thailand
S. B.3 **Student Award Entry**	**Carbon Sequestration in Soil from Paddy Straw Derived Biochar in India** *Abhijeet Anand, Ravi Kumar, Vivek Kumar, and Priyanka Kaushal* Net Zero Emission Technology Laboratory, Centre for Rural Development and Technology, Indian Institute of Technology Delhi, New Delhi – 110016, India	India
S. B.4 **Student Award Entry** (Virtual)	**Assessment of Carbon Footprint, Water Footprint, Cost and Return of Organic Rice Based on Circular Economy and Original Organic Rice** *Natawan Wanvisesh[1, *], Nathsuda Pumijumnong[1], Sukanya Sereenonchai[1], Uthai Chareonwong[2], and Noppol Arunrat[1]* [1]Faculty of Environment and Resource Studies, Mahidol University, Nakhon Pathom, 73170, Thailand. [2]Thai Telecommunication Relay Service, Bangkok Noi, Bangkok, 10700, Thailand.	Thailand

S. B.5 (Virtual)	**Determinants of Local Adaptation Strategies to Climate Change at Farm Households Level in the Central Region of Vietnam: a Case Study in Flooding Delta Regions of Thua Thien Hue Province** *Dao Duy Minh* and Philippe Lebailly[+]* *Faculty of Economics and Development Studies, University of Economics—Hue University, Thua Thien Hue 530000, Vietnam [+]Department of Economics and Rural Development, Gembloux Agro Bio-Tech, University of Liège,5032 Gembloux, Belgium.	Vietnam
S. B.6 (Virtual)	**Design and Deployment of an IoT-based Landslide Early Warning System** *Yan Liu*, Hemanta Hazarika*[,1], Haruichi Kanaya*, Osamu Takiguchi[+], Masanori Murai[#], Muhammad N. Hidayat*, and Yoshifumi Kochi[&]* *Kyushu University, 744 Motooka, Fukuoka, 819-0373, Japan. [+]ALSENS Inc, Sagamihara, Japan. [#]Shimizu Corporation, 2-16-1 Kyobashi, Tokyo, 104-0031, Japan. [&] K's Lab Inc, 3533-4 Shimoosaba, Yamaguchi, 753-0212, Japan.	Japan

Session C: Water and Wastewater Technology Time: 15:15 – 17:30 Room Assignment: Marine Ballroom 1		
Ref. No.	**Title, Authors, Affiliation**	**Country of Origin**
S. C.1 **Student Award Entry**	**Nitrogen and Phosphorus Removal Capacity of Water Lettuce, Water Hyacinth and Hydrilla in Domestic Wastewater of Sri Lankan Households** *A.M.S.N. Amarakoon *[,1] and W.M.N.M. Wijesinghe[+]* *Department of Energy, Environment and Climate Change, Asian Institute of Technology, Klong Luang, Pathumthani, Thailand. [+]National Water Supply and Drainage Board, New Vishaka Road, Bandarawela, 90100, Sri Lanka.	Thailand

S. C.2 **Student Award Entry** (Virtual)	**The Effect of with and Without Anoxic Period for Removal Synthetic Wastewater Contaminated Cadmium (Cd[2+)] by Sequencing Bath Reactor System (SBR)** *Tanta Suriyawong [*,1], Sasidhorn Buddhawong*, Thanit Swasdisevi[+] and Suntud Sirianuntapiboon[#]* [*]Division of Environmental Technology, School of Energy, Environment and Material, King Mongkut's University of Technology Thonburi, 126 Pracha Uthit Rd., Bang Mod, Thung Khru, 10140, Thailand. [+]Division of Thermal Technology, School of Energy, Environment and Material, King Mongkut's University of Technology Thonburi, 126 Pracha Uthit Rd., Bang Mod, Thung Khru, 10140, Thailand. [#]Office of the Election Commission of Thailand, The Government Complex Commemorating His Majesty, Bangkok, 10210, Thailand.	Thailand
S. C.3 **Student Award Entry**	**Low-cost Devices to Monitor Water Quality Combined with Data Analysis (Location: Chiang Kan, Thailand)** *Braja Manggala*, Chatchawan Chaichana[+,1], Wasin Wongwiali[^], and Wahyu Nurkholis H.S.** *Graduate School of Engineering in Agricultural Engineering, Department of Mechanical Engineering, Chiang Mai University, Chiang Mai, 50200, Thailand. [+]Renewable Energy and Environment Conservation Laboratory, Department of Mechanical Engineering, Faculty of Engineering, Chiang Mai University, 50200, Thailand. [^]Renewable Energy and Energy Efficiency Research Unit, Science and Technology Research Institute Chiang Mai University, Chiang Mai, 50200, Thailand.	Thailand

S. C.4 **Student Award Entry** (Virtual)	**Removal of Manganese from synthetic wastewater with Sequencing Batch Reactor (SBR) systems** *Nopparat Inprasit [*,1], Sasidhorn Buddhawong [+], Thanit Swasdisevi [&], and Suntud Sirianuntapiboon [^]* *School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. [+]Division of Environmental Technology, School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. [&]Division of Thermal Technology, School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. [^]Office of The Election Commission of Thailand, The Government Complex Commemorating His Majesty, Bangkok, Thailand.	Thailand
S. C.5 **Student Award Entry**	**The Use of Neural Network Coupled with Image Processing for Water Quality Assessment (Location: Hot Spring Mae-Khachan, Thailand)** *Wahyu Nurkholis Hadi Syahputra[*], Chatchawan Chaichana [+,1], Wasin Wongwilai [&], Braja Manggala [*]* *Graduate Master's Degree Program in Agricultural Engineering, Department of Mechanical Engineering Chiang Mai University, Thailand. [+]Renewable Energy and Energy Conservation Laboratory Department of Mechanical Engineering Chiang Mai University, Thailand. [&]Renewable Energy and Energy Efficiency Research Unit Science and Technology Research Institute, Chiang Mai University, Thailand.	Thailand
S. C.6 **Student Award Entry** (Virtual)	**A Novel Mechanism to Decrease Water Consumption in Commodes** *Abishek Girish[*,1], Suchithra Selladurai[*], Akshatha Devi Lolla[+] and Prasanth A.S[*]* [*]Department of Mechanical Engineering, PSG College of Technology, Peelamedu Coimbatore, India. [+]Department of Electronics and Communication Engineering, PSG College of Technology, Peelamedu Coimbatore, India.	India

S. C.7	**Total Effective Dose Analysis in Case of LOCA for TMI-2 Nuclear Power Plant** *Muhammad Zubair, Eslam Ahmed, and Ahmad Ababneh* Department of Mechanical and Nuclear Engineering, College of Engineering, University of Sharjah, United Arab Emirates	United Arab Emirates
S. C.8	**Experimental Studies on the Removal of Textile Dyes from Artificially Contaminated Water Using Sorbent Synthesized from Paper Waste** *Monika Liugė, Dainius Paliulis, and Vaida Šerevičienė* Faculty of Environmental Engineering, Vilnius Gediminas Technical University, Vilnius, Lithuania	Lithuania
S. C.9 (Virtual)	**Performance Evaluation of Coagulants for Water Treatment in Emergency** *Rahul Kumar and Anil Kumar Dikshit* Environmental Science and Engineering Department, Indian Institute of Technology Bombay, Mumbai - 400076, India.	India

Session D: Energy in Transport Time: 15:15 – 17:15 Room Assignment: Oriental Palm I		
Ref. No.	**Title, Authors, Affiliation**	**Country of Origin**
S. D.1	**Design of Inductive Resonance Coupling-based Wireless Charging Infrastructure for Electric Vehicles** *Ashok Kumar Loganathan* and Karthikeyan Subramanian[*,1]* *Department of Electrical and Electronics Engineering, PSG College of Technology, Coimbatore 641004, Tamil Nadu, India.	India

S. D.2 **Student Award Entry** (Virtual)	**Quantitative of Real-Driving Emission Factor Based on Vehicle Specific Power from a Selected Diesel Truck in Malaysia** *Chuen Yuen Ang*, Ahmad J. Alimin*, [1], and Fuei P. Chee[#]* *Centre for Energy and Industrial Environment Studies (CEIES), Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia. [#]Faculty of Science and Natural Resources, University of Malaysia Sabah, 88400 Kota Kinabalu, Sabah, Malaysia.	Malaysia
S. D.3 (Virtual)	**Decarbonizing Transport Sector in Thailand Towards 2050** *Bundit Limmeechokchai *, [1], Pornphimol Winyuchakrit *, Piti Pita *, and Hanaoka Tatsuya [+]* *Sirindhorn International Institute of Technology, Thammasat University, Klong Luang, Pathum Thani, Thailand. [+]Center for Social and Environmental Systems Research, National Institute for Environmental Studies, Tsukuba 3058506, Japan.	Thailand
S. D.4	**Assessment of Total Cost of Ownership for Electric Two-Wheelers with Point Charging and Battery Swapping in the Indian Scenario** *Minakshi Patel*, Rhythm Singh*, Pratham Arora*, and Diptiranjan Mahapatra[+]* *Hydro and Renewable Energy Department, IIT Roorkee, 247667, Uttarakhand, India [+]Policy and Strategic Management, IIM Sambalpur, 768019, Odisha, India	India
S. D.5 (Virtual)	**Diesel Fuel Quality Assessment from Selected Filling Stations in Kumasi** *Emmanuela Kwao-Boateng[*,1], Emmanuel G. Ankudey[1], Lawrence Darkwah[1], Kwabena O. Danquah[2], Adjei Domfeh[1], and Anthony N. A. Prempeh[#]* [1]Depatment of Chemical Engineering, Private Mail Bag, Kwame Nkrumah University of Science and Technology, Kumasi-Ghana [2]The Noguchi Memorial Institute for Medical Research, University of Ghana, Legon Accra-Ghana.	Ghana

S. D.6	**Analysis of Energy saving between Bleed Air and Bleed less Environmental Control Systems in a typical Aircraft** *Vinay Pratap Singh Negi, Ashrit Shekhar Tayade, and Chennu Ranganayakulu* Department of Mechanical Engineering, Birla Institute of Technology and Science, Pilani Campus, Rajasthan, India	India
S. D.7	**Adoption of Electric Vehicle in Kolkata - Thumbs Up or Down! —A Pilot Study** *Sarmistha Biswas, Jayanta Saha, and Somesh Sinha Roy* Eastern Institute for Integrated Learning in Management (EIILM), Kolkata, India	India
S D.8	**Electric Vehicle Conversion Software Safety Study by Mean of Model Based System Design (MBSD) Approach** *Ananchai Ukaew*1, and Choopong Chuaypen+* *Development and Research of Innovative Vehicle Engineering (DRIVE) Center, Faculty of Engineering, Naresuan University, Phitsanulok 65000, Thailand. + Faculty of Engineering, Naresuan University, Phitsanulok 65000, Thailand.	Thailand

Day 2: 27 October 2022 (Thursday)

Session E: Solar Energy 2
Time: 10:15 – 12:00 noon
Room Assignment: Marine Ballroom 1

Ref. No.	Title, Authors, Affiliation	Country of Origin
S. E.1	**A Lead-Free All-Inorganic Cs_2SnI_6 Based Ultra-Thin Perovskite Solar Cell Optimized using SCAPS-1D Simulator** *Md. Ashraful Islam*, Nahid Akhter Jahan* and M. Mofazzal Hossain+,1* *Department of Electrical and Electronic Engineering, Southeast University, Dhaka-1212, Bangladesh. #Department of Electrical and Electronic Engineering, University of Liberal Arts Bangladesh, 688 Beribadh Road, Mohammadpur, Dhaka-1207, Bangladesh.	Bangladesh
S. E.2 (Virtual)	**Maximum Power Point Tracking Design Based on Fuzzy Logic Algorithm Under Uncertain Weather Condition** *Happy Aprillia*,1, Asy-Syifa Ainina Amalia*, and Andhika Giyantara** *Electrical Engineering Field of Study, Institut Teknologi Kalimantan, 76127, Balikpapan, East Kalimantan, Indonesia.	Indonesia
S. E.3 **Student Award Entry** (Virtual)	**Optimization and Performance Improvement of $CsSnGeI_3$ All-Inorganic Lead-Free Thin-Film Perovskite Solar Cell through Numerical Simulation** *Tajreen Ferdoush[1], Chaity Saha[1], Mahdee Nafis[2], and M. Mofazzal Hossain[1]** [1]Department of Electrical and Electronic Engineering, University of Liberal Arts Bangladesh, 688 Beribadh Road, Mohammadpur, Dhaka-1207, Bangladesh. [2]Department of Electronics and Telecommunication Engineering, Rajshahi University of Engineering and Technology, Rajshahi 6204, Bangladesh.	Bangladesh

S. E.4 **Student Award Entry** (Virtual)	**Use of SARIMAX Model for Solar PV Power Output Forecasting in Baguio City, Philippines** *Ian Benitez^*[1], Lheander Gerna*, Jessa Ibañez*, Jeark Principe+, and Francisco de Los Reyes#* ^National Graduate School of Engineering, University of the Philippines Diliman. *National Engineering Center, University of the Philippines Diliman. +Training Center for Applied Geodesy and Photogrammetry, University of the Philippines Diliman. #School of Statistics, University of the Philippines Diliman.	Philippines
S. E.5 (Virtual)	**Systematic Study of the Optimization of Cadmium Telluride (CdTe) Thin-film Solar Cell Performance Using Spherical Plasmonic Metal Nanoparticles** *Mustafa M. Shaky, Abrar J. Haque, Rifat B. Sultan, Asif A. Suny, Samina Tohfa and Mustafa H. Chowdhury* Department of Electrical and Electronic Engineering, Independent University, Bangladesh, Plot 16, Block B, Aftabuddin Ahmed Road, Bashundhara R/A, Dhaka-1229, Bangladesh.	Bangladesh

Session F: Climate Policy Time: 10:15 – 12:00 noon Room Assignment: Oriental Palm I		
Ref. No.	**Title, Authors, Affiliation**	**Country of Origin**
S. F.1	**Thailand Nationally Determined Contributions (NDCs): Analysis of Climate Policy for Enhancing Climate Resilience in Infrastructure Construction Sector** *Wichuda Meeros*[,1] and Supattana Wichakul+* *Special Project Business Unit, Civil Engineer, Team Consulting Engineering and Management PCL., Bueng Kum, Bangkok 10230, Thailand. +Water Resource Engineer, Team Consulting Engineering and Management PCL., Bueng Kum, Bangkok 10230, Thailand.	Thailand

S. F.2 (Virtual)	**The Role of Discount Rate and Social Cost of Carbon in Long Term Climate Policy on Renewable Electricity in Thailand** *Bundit Limmeechokchai[1], Pornphimol Winyuchakrit, and Piti Pita* Sustainable Energy and Built Environment, Sirindhorn International Institute of Technology, Thammasat University, Pathum Thani 12121, Thailand.	Thailand
S. F.3 (Virtual)	**Reducing Coal Overcapacity in China: A New Perspective of Optimizing Local Officials' Promotion System** *Qianqian Zhang* School of Urban Economics and Management, Beijing University of Civil Engineering and Architecture, Beijing, China.	China
S. F.4 **Student Award Entry** (Virtual)	**Low Carbon Power Generation in Selected GMS Countries to Achieve the Paris Agreement** *Rathana Lorm and Bundit Limmeechokchai[1]* Sirindhorn International Institute of Technology, Thammasat University Research Unit in Sustainable Energy and Built Environment, Klong Luang, Pathumthani 12120, Thailand.	Thailand
S. F.5 **Student Award Entry**	**Assessment of CO_2 Emissions and Costs of Decommissioning of Commercial Onshore Wind Farms in Thailand** *Watcharapong Tantawat[1], Aumnad Phdungsilp, and Suparatchai Vorarat* Graduate Program in Engineering Management, Dhurakij Pundit University, Bangkok, Thailand.	Thailand
S. F.6	**Understanding Community Adaptation for Climate Disaster (Case Study: Landslide Disaster in Balikpapan City, Indonesia)** *Ariyaningsih Ariyaningsih* Keio University, Japan	Japan
S. F.7 (Virtual)	**Climate Governance in India: A Sectoral Approach** *Shyamli Singh and Anugya Singh* Indian Institute of Public Administration (IIPA), IP Estate, ITO (Ring Road), New Delhi – 110002, India	India

Session G: Waste Management and Valorisation
Time: 15:15 – 17:15
Room Assignment: Marine Ballroom 1

Ref. No.	Title, Authors, Affiliation	Country of Origin
S. G.1	**Biodiesel production from urban and suburban municipal sewage sludges in Tokyo, Japan** *Muhammad Usman, Cheng Shou, and Jeffrey S. Cross[1]* Department of Transdisciplinary Science and Engineering, School of Environment and Society, Tokyo Institute of Technology, 2-12-1 S6-10 Ookayama, Meguro-ku, Tokyo, 152-8550 Japan.	Japan
S. G.2 **Student Award Entry** (Virtual)	**Effect of Aeration rate on Wet- refuse-derived fuel Biodrying process for increasing Heating value and Water content reduction** *Abhisit Bhatsada[*,#], Suthum Patumsawad[+,1], and Komsilp Wangyao[*,#]* *The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. +Department of Mechanical and Aerospace Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand. #Center of Excellence on Energy Technology and Environment (CEE), Ministry of Higher Education, Science, Research, and Innovation (MHESI), Bangkok, Thailand.	Thailand

S. G.3 **Student Award Entry** (Virtual)	**Biogas Generation from the High-Strength Fresh Leachate using Anaerobic Continuous Stirred-tank Reactor** *Sakulrat Sutthiprapa*, Sirinthornthep Towprayoon[*,1], Pawinee Chaiprasert[+], Chart Chiemchaisri[#] and Komsilp Wangyao[*,2]* *The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. [+]Biotechnology Program, School of Bioresources and Technology, Bangkhunthian, Bangkok, 10150, Thailand [#]Department of Environmental Engineering, Faculty of Engineering Kasetsart University, Bangkok 10900, Thailand.	Thailand
S. G.4 **Student Award Entry**	**A Bibliometric Analysis of Methane Emission from Waste Management between Developing Countries and Developed Countries** *Pornnapas Khemthong[*,1], Pawinee Iamtrakul[2], and Wasan Pattara-atikom[3]* [1]Department of Urban Environmental Planning and Development, Faculty of Architecture and Planning, Thammasat University Pathumthani 12120, Thailand. [2]Center of Excellence in Urban Mobility Research and Innovation, Faculty of Architecture and Planning, Thammasat University Pathumthani 12120, Thailand. [3]National Electronic and Computer Technology Center, 112 Thailand Science Park, Pathumthani 12120, Thailand.	Thailand

S. G.5 **Student Award Entry** (Virtual)	**The Situation of RDF Utilization in the Cement Industry in Thailand** *Tanik Itsarathorn[1,4], Sirintornthep Towprayoon[1,4], Chart Chiemchaisri[2], Suthum Patumsawad[3], Komsilp Wangyao[1,4], *, and Awassada Phongphipat[1,4]* [1]The Joint Graduate School of Energy and Environment (JGSEE), King Mongkut's University of Technology Thonburi, Bangkok, Thailand [2]Department of Environmental Engineering, Faculty of Engineering, Kasetsart University, Bangkok, Thailand [3]Department of Mechanical and Aerospace Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand [4]Center of Excellence on Energy Technology and Environment (CEE), Ministry of Higher Education, Science, Research, and Innovation (MHESI), Bangkok, Thailand.	Thailand
S. G.6	**Plastic Recycling in Pakistan and Japan – Learning for Leapfrogging** *Sayaka Ono[1], Safeerul Islam Hashm, and Chettiyappan Visvanathan* Environmental Engineering and Management, Department of Energy Environment and Climate Change, School of Environment Resources and Development, Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand.	Thailand
S. G.7 (Virtual)	**The Reuse Method of Waste Tyre Textile Fibers for Sound Absorption Applications** *Ružickij Robert, Vasarevičius Saulius, Januševičius Tomas, and Grubliauskas Raimondas* Department of Environmental Protection and Water Engineering Vilnius Gediminas Technical University, Vilnius, Lithuania	Lithuania

S. G.8	**Electricity Generation using Organic Waste as the Feed in Microbial Fuel Cells** *Shubham Arun Parwate* Environmental Engineering and Management, Department of Energy Environment and Climate Change, School of Environment Resources and Development, Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand.	Thailand

Session H: Carbon Neutral Society Time: 15:15 – 17:15 Room Assignment: Oriental Palm I		
Ref. No.	**Title, Authors, Affiliation**	**Country of Origin**
S. H.1 **Student Award Entry** (Virtual)	**Transition of Thailand's Power Sector toward Carbon Neutrality 2050** *Achiraya Chaichaloempreecha and Bundit Limmeechokchai[1]* Sirindhorn International Institute of Technology (SIIT), Thammasat University, Klong Luang, Pathummthani, 12120, Thailand.	Thailand
S. H.2	**Reviewing and Comparing International Best Practices in Carbon Neutral Planning for Thailand Power Sector** *Niphit Phothisourinh* and Jai Govind Singh[1]* Department of Energy, Environment and Climate Change, Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand.	Thailand

S. H.3 (Virtual)	**Predicting the Performance of Offshore Wind Farm Using Artificial Intelligence** *Veena Raj*, Petra M I*, Femin V*, Thanihaichelvan Murugathas+, Shereen Siddhara A#, and Sheik Mohammed S.^* *Faculty of Integrated Technologies, Universiti Brunei Darussalam, Brunei Darussalam. +Department of Physics, Faculty of Science, University of Jaffna, Jaffna 40000, Sri Lanka #Research Assistant, inQbe Innovations Pvt. Ltd, Kaloor, Ernakulam, India ^Faculty of Engineering, Universiti Teknologi Brunei, Brunei Darussalam.	Brunei Darussalam
S. H.4 (Virtual)	**Opportunities of Carbon Capture and Utilization in Thailand's Industries Toward Carbon Neutrality 2050** *Pemika Misila, Pornphimol Winyuchakrit, Piti Pita, and Bundit Limmeechockchai[1]* Thammasat University Research Unit in Sustainable Energy and Built Environment, Sirindhorn International Institute of Technology, Thammasat University, Pathumthani 12121, Thailand.	Thailand
S. H.5	**Exploring Different Level of Citizens' Participation on Learning City Building** *Pawinee Iamtrakul[1], Sararad Chayphong[1], and I-Soon Raungratanaamporn[2]* [1]Center of Excellence in Urban Mobility Research and Innovation Faculty of Architecture and Planning Thammasat University [2]School of Transport Engineer, Suranaree University of Technology, Nakornratchasima, Thailand.	Thailand
S. H.6 **Student Award Entry**	**Laboratory Testing and Investigation of TEG Cookstoves and Study of its Performance** *Imlisongla Aier, Ujjiban Kakati, Virendra Kumar Vijay, and Priyanka Kaushal* Net Zero Emission Technology Laboratory, Centre for Rural Development and Technology, Indian Institute of Technology Delhi, New Delhi – 110016, India.	India

S. H.7 (Virtual)	**Life Cycle Assessment of Concrete Manufacturing for Sustainable Production in India** *Yash Aryan and Anil Kumar Dikshit* Environmental Science & Engineering Department, India Institute of Technology Bombay, Powai, Mumbai, India	India
S. H.8 (Virtual)	**A Review of Market Clearing Mechanisms in Peer-to-Peer Energy Trading Market** *Piyapong Prachuab and Weerakorn Ongsakul* Department of Energy, Environment and Climate Change Asian Institute of Technology P.O. Box 4, Klong Luang, Pathumthani 12120	Thailand

Day 3: 28 October 2022 (Friday)

Session I: Energy in Buildings Time: 09:00 – 10:30 noon Room Assignment: Marine Ballroom 1		
Ref. No.	**Title, Authors, Affiliation**	**Country of Origin**
S. I.1	**Impact of Sky Terrace Locations on Pedestrian Ventilation and Air Quality in High-Density Areas using CFD Simulation** *Titi Chauytong [*], Daranee Jareemit [*,1] + Jiying Liu [#]* *Faculty of Architecture and Planning, Thammasat University, 99 Moo18, Klong Luang, Pathumthani 12121, Thailand. +Thammasat University Research Unit in Architecture for Sustainable Living and Environment, Thammasat University, Thailand. #School of Thermal Engineering, Shandong Jianzhu University, Jinan, China.	Thailand

S. I.2 **Student** **Award** **Entry**	**Energy Performance and Thermal Comfort in a Library Building: A Case Study of Dhurakij Pundit University, Thailand** *Auntika Thongsean1, Aumnad Phdungsilp*, Suparatchai Vorarat*, and Rangsit Sarachitti** *Graduate Program in Engineering Management, College of Innovative Technology and Engineering, Dhurakij Pundit University, Bangkok 10210, Thailand.	Thailand
S. I.3 **Student** **Award** **Entry**	**Catbalogan, Philippines, Sky City Mega Project Potential Environmental and Operational Challenges** *Ronald L. Orale*,1 and Doris Montecastro+* *Samar State University, Catbalogan City, Philippines. +Ateneo de Davao University, Davao City, Philippines.	Philippines
S. I.4 **Student** **Award** **Entry**	**Methodology for Integrated Building Energy Modeling and Impact Assessment of Urban Energy System Scenarios** *Nat Nakkorn1, Aumnad Phdungsilp, and Suparatchai Vorarat* Graduate Program in Engineering Management, College of Innovative Technology and Engineering, Dhurakij Pundit University, Bangkok, Thailand.	Thailand
S. I.5 (Virtual)	**Numerical Detection Method of Faulty Valve Inducing Water Hammer Within Long-Distance District Heating Pipeline** *Jingjing Yan*, Huan Zhang*,+, Yaran Wang*,+,1, and Shijun You*,+* *School of Environmental science and engineering, Tianjin University, Tianjin, 300072, PR China. +Tianjin Key Lab of Biomass/Wastes Utilization, Tianjin, 300350, PR China.	China

Session J: Microgrids Time: 9:30 – 10:30 Room Assignment: Oriental Palm I		
Ref. No.	**Title, Authors, Affiliation**	**Country of Origin**
S. J.1	**Optimal Costing of Power Generation in Microgrid Using Particle Swarm Optimization** *Ashok Kumar Loganathan[1], Sampathraja Natarajan, and Veeramanikandan C* Department of Electrical and Electronics Engineering, PSG College of Technology, Coimbatore, Tamil Nadu, India.	India
S. J.2 (Virtual)	**Hybrid Microgrid Optimization for Smart City Planning on Saint Martin's Island in Bangladesh** *M.A. Zaman and Weerakorn Ongsakul* Sustainable Energy Transition, Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathumthani, Thailand.	Thailand
S. J.3 **Student Award Entry** (Virtual)	**Synchrophasor Big Data Architectures, Platforms and Applications: A Review** *Daniel Villegas, Kalana Dharmapala, and Athula Rajapakse* Department of Electrical and Computer Engineering, University of Manitoba, 66 Chancellors Cir, Winnipeg, MB, Canada.	Canada
S. J.4	**Fault Detection and Segmentation in Medium Voltage AC Microgrid by Using Differential Protection Principle** *Sittinan Muanchaona and Jai Govind Singh* Department of Energy, Environment and Climate Change, Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand.	Thailand

Session K: Environmental Management Time: 10:45 – 12:15 Room Assignment: Marine Ballroom 1		
Ref. No.	Title, Authors, Affiliation	Country of Origin
S. K.1 **Student Award Entry**	**Spatial Multicriteria Evaluation for Future Urban Growth in Bangkok Metropolitan Region: BMR** *Apinya Padon[1], Pawinee Iamtrakul[2], Rungroj Jintamethasawat[2], and Jirawan Klaylee[1]* [1]Center for Excellence in Urban Mobility Research and Innovation, Faculty of Architecture and Planning, Thammasat University, Pathum Thani, Thailand. [2]Spectroscopy and Sensors Research Group (SSDRG), National Electronics and Computer Technology Center (NECTEC), Pathum Thani, 12121, Thailand.	Thailand
S. K.2 **Student Award Entry** (Virtual)	**Innovareef Concept for Recovery and Rehabilitation of Coral Reef Ecosystems** *Warut Srisuwan[*,1], Chayodom Sabhasri[+], and Nantarika Chansue[#]* [*]Technopreneurship and Innovation Management Program (TIP), Graduate School, Chulalongkorn University, Chaloem Rajakumari 60 Building, 10th Floor, Phayathai Road, Phatumwan, Bangkok, 10330 Thailand. [+]Faculty of Economics, Chulalongkorn University, 254 Phayathai Road, Pathumwan, Bangkok, 10330 Thailand. [#]Veterinary Medical Aquatic Animal Research Center of Excellence (VMARCE), Chulalongkorn University, 39 Henry Dunant Road, Wangmai, Pathumwan, Bangkok, 10330 Thailand.	Thailand
S. K.3 **Student Award Entry**	**The Water-Energy Nexus of Urban Services in a Tourism City: The Case of Pattaya City** *Surasak Janchai[1], Aumnad Phdungsilp, and Suparatchai Vorarat* Graduate Program in Engineering Management, College of Innovative Technology and Engineering, Dhurakij Pundit University, Bangkok, Thailand.	Thailand

S. K.4	**Watershed environmental management based on SWAT modeling approach and its application in Jiulong River basin of China** *Zheng Li* Environmental Engineering and Management, Department of Energy Environment and Climate Change, School of Environment Resources and Development, Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand.	Thailand
S. K.5	**Spatial Configuration of Carbon Emission in Suburban Area Based on Trend Analysis: A Case Study of Pathumthani Province** *I-soon Raungratanaamporn[*,1], Pawinee Iamtrakul[+], Jirawan Klaylee[+] and Virach Sornlertlumvanich[#]* *Urban planning and urban analysis field study, School of Transportation Engineering, Suranaree University of Technology. Amphoe Mueng, Nakhon Ratchasima 30000, Thailand. [+]Faculty of Architecture and Planning, Thammasat University Rang-sit Campus, Paholyothin, Khlong Nueng, Khlong Luang, Pathumthani 12120, Thailand [#]Faculty of Engineering Thammasat University (Rang-sit Campus), Paholyothin, Khlong Nueng, Khlong Luang, Pathumthani 12120, Thailand.	Thailand
S. K.6 (Virtual)	**Do Innovation Preferences Affect Wind Energy Perception? A Choice Experiment Approach in Southern Italy** *Diana Caporale *, Caterina De Lucia[+], and Pasquale Pazienza[+]* *Polytechnic of Bari, via Orabona 1 - Bari 70125, Italy. [+]University of Foggia, Foggia 71100, Italy.	Italy

	Session L: Renewable Energy Time: 10:45 – 12:00 noon Room Assignment: Oriental Palm 1	
Ref. No.	**Title, Authors, Affiliation**	**Country of Origin**
S. L.1 **Student Award Entry**	**Experimental Investigation on the Performance of a Hybrid Hydrokinetic Turbine having Straight-Bladed Darrieus Rotor and Helical-Bladed Savonius Rotor** *Md. Mustafa Kamal and Rajeshwar Prasad Saini* Department of Hydro and Renewable Energy, Indian Institute of Technology, Roorkee, India.	India
S. L.2 **Student Award Entry** (Virtual)	**Vortex Characteristic of The Conical Basin for Gravitational Vortex Water Turbine (GVWT)** *Erna Septyaningrum, Sutardi[1], and Ridho Hantoro* Sepuluh Nopember Institute of Technology, 60111, Surabaya, East Java, Indonesia.	Indonesia
S. L.3 **Student Award Entry** (Virtual)	**Innovative Process of Amorphous Cellulose – Graphene Oxide Hybrid structure bead** *Kongkiat Phuphantrakun*, Achara Chandrachai[+], and Sanong Ekgasit [#,1]* *Technopreneurship and Innovation Management Program (TIP), Graduate School, Chulalongkorn University, Chaloem Rajakumari 60 Building, 10 th Floor, Phayathai Road, Phatumwan, Bangkok, 10330 Thailand. [+]Chulalongkorn Business School, Chulalongkorn University, Phyathai Road, Pathumwan Bangkok 10330 Thailand. [#]Sensor Research Unit (SRU), Department of Chemistry, Faculty of Science, Chulalongkorn University, Pathumwan, Bangkok 10330, Thailand.	Thailand

| S. L.4 (Virtual) | **Assessment of Conventional Acid-Clay Method in Reclaiming Waste Crankcase Lubricating Oil in Ghana**
Patrick Opoku-Mensah, James N. Gyamfi, Adjei Domfeh, Emmanuel Awarikabey and Emmanuela Kwao-Boateng
Kwame Nkrumah University of science and Technology, Private Mail Bag, University Post Office, Kumasi-Ghana. | Ghana |
| S. L.5 | **Single-Walled Carbon Nanotubes (SWCNTs) Nanoparticles for R134a and R152a Refrigerants Evaluating Thermophysical Properties and COP**
Zafar Said *,+, S.M.A. Rahman *,+, and Maham Aslam Sohail *
*Department of Sustainable and Renewable Energy Engineering, University of Sharjah, P.O. Box 27272, Sharjah, United Arab Emirates
+U.S. Pakistan Center for Advanced Studies in Energy (USPCAS-E), National University of Sciences and Technology (NUST), Islamabad, Pakistan | United Arab Emirates |

DETAILED ABSTRACTS

Session A: Solar Energy 1

Time: 13:30 – 15:00
Room Assignment: Marine Ballroom 1

S. A.1

Student Award Entry

Design and Analysis of Hybrid Photovoltaic Installation Schemes for Urban Buildings

Sirawit Hariwon[1], Panida Thararak[1], Peerapol Jirapong[1], Supanida Kaewwong[1], and Churat Thararux[2]
[1]Chiang Mai University, 239 Huay Kaew Road, Muang District, Chiang Mai, 50200, Thailand.
[2]School of Renewable Energy, Maejo University, 63 Nong Han Subdistrict, San Sai District, Chiang Mai, 50290, Thailand.
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Installing photovoltaic (PV) systems in dense urban buildings with limited space cannot produce enough electricity to meet the building's needs and have low efficiency due to the shading effect of neighboring buildings and high ambient temperature. Developing a suitable PV installation scheme for the buildings poses a challenge for designing PV installations to increase electricity generation and promote renewable energy utilization. This paper develops a new hybrid building applied photovoltaic (BAPV) and building integrated photovoltaic (BIPV) design methodology to offer flexibility in increased installation space and enhanced PV performance. The optimal PV installation is determined based on the performance parameters, including yield energy (YE), yield factor (YF), yield reference (YR), performance ratio (PR), global incident irradiation on the collector plane, shading losses, and PV loss due to temperature. BAPV/BIPV installation models are created with building information modeling and analyzed using PVsyst software with the technical aspect. The comparative case studies compare the performance of BAPV/BIPV installations for urban building applications with c-Si PV technology. The simulation results show that the proposed hybrid scheme implemented with BAPV/BIPV installation can generate 54.29% and 74.98% more energy than those from BAPV-only and BIPV-only installation, respectively.

S. A.2   **Design of a Novel Solar Photovoltaic/Thermal System (PVT) for Ladakh Region**

Vipul Raj and Satya Sekhar Bhogilla
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The principle aim of this paper is to design a real-life solar Photovoltaic/thermal system (PVT) system for the Ladakh region, India. In this analysis, a novel thermal model for a PV/T system is designed for the month of February, June and September in Ladakh region. The designed numerical model is quite detailed accounting for the impact of contact resistance between the layers of a PV/T system and variation of wind speed, solar irradiation and ambient temperature which are very crucial to mimic the actual conditions. To protect the panel from getting heated especially during the summer season, a coolant is circulated to enhance the electrical efficiency. As Ladakh records lower ambient temperatures, below 0ºC during the winter season, ethylene glycol (50 % by weight) is employed as a coolant. In the present study, the proposed model is assessed for its performance through parameters such as, thermal energy, electrical efficiency etc. It was noticed from the present study that the electrical efficiency, thermal energy varies between 15-17%, 8.2 MJ -10.5 MJ respectively.

S. A.3   **Detection of Invisible Solar PV Installations in Power Distribution System: A Review**

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Climate change has squeezed people to have massive coordination in carbon neutrality. Clean energy must prevail over power demand to achieve our goal. The net zero carbon emission roadmap encourages the energy sector to produce energy from alternative energy resources. Solar Photovoltaic (PV) systems, a distributed energy resource, are a promising solution to produce power with less carbon emissions. However, the high adoption of solar PV systems can cause negative impacts on distribution networks. The network operators should realize the capacity of distributed energy resources in their systems to maintain power supply and perform active local energy management. This study aims to fill the gap in the detection of invisible solar PV installations. In this paper, proposed PV identification and PV capacity estimation techniques are investigated. The processes of study are determined and summarized. The coming steps of this research area will be discussed in possible ways.

S. A.4 **On the Accuracy of Open-Source and Commercial Solar Forecasting Tools**

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This paper evaluates the performance of some solar forecasting tools that are available publicly over a 24-hour time horizon. These tools include one open-source, namely PVlib-python, and two commercial ones, each with different time resolutions. These tools are evaluated in terms of the forecasted direct normal irradiance (DNI) and global horizontal irradiance (GHI) which were compared to the measurements made locally, under both clear-sky, partly cloudy-sky and cloudy-sky conditions. Standardized metrics, including mean bias error, mean absolute error, mean absolute percent error, and root mean square error are used for comparison purposes. The goal is to determine how accurate these tools are for day-ahead solar forecasting, without resorting to sky imaging or ground-based irradiance monitoring.

S. A.5
(Virtual) **GWO Controlled SEPIC Converter for Maximum Power Point Tracking of Solar Panel**

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The utilization of solar power using photovoltaic (PV) modules is highly disrupted by weather changes that affect irradiation exposure to the modules. This condition later reduces the amount of harvested power and financial benefit of the PV system. Thus, maximum power point tracking (MPPT) is researched to increase the performance of PV systems. The proposed MPPT consists of a Single-Ended Primary-Inductor Converter (SEPIC) converter and Grey Wolf Optimizer (GWO) algorithm. SEPIC converter is used to provide lower ripple-power output while GWO is used to optimized the duty cycle of the SEPIC converter. The performance of the proposed method is compared to the Particle Swarm Optimization algorithm. To yield optimal power, the proposed method is proven to have optimal efficiency of 95.21% with a standard deviation of 0.182 after 50 iterations.

Session B: Climate Change and Agriculture
Time: 10:30 – 12:00
Room Assignment: Oriental Palm I

S. B.1   **Climate Change Impacts on Hydro-Generation and Land Suitability for Agriculture in Cambodia, Laos and Myanmar**

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This paper quantifies and analyses the impacts of climate change on water availability and land suitability for key crops in three least developed countries in the Greater Mekong Sub-region, namely, Cambodia, Laos and Myanmar. The method used for the climate study is supported by the inter-sectoral model inter-comparison project (ISIMIP database). The recent ISIMIP input dataset, ISIMIP2b, outlines simulation scenarios divided into different emissions pathways (or "Representative Concentration Pathways" known as RCPs). This paper focuses on the two extreme RCPs, specifically RCP2.6 and RCP8.5, which would result in global average temperature increases of approximately 1.6 and 4.3°C respectively. Th analysis concentrates on the difference between the historic period and the end of the century (toward 2100) for the climate conditions for the future. The fuzzy logic global land suitability model has been used to calculate the suitability of the land to support growing crops as well as to investigate how the climate changing could impact this. The analysis shows that quite significant changes in hydro-generation potential can occur depending on the region: Laos and Cambodia show decrease when Myanmar shows increase in output potential between present and RCP2.5 and RCP8.5 respectively. Quite significant increases or decreases in land suitability can occur depending on the region and the crop.

S. B.2
(Virtual)   **Assessment of Climate Change Impact on Water Footprint of Glutinous Rice (RD6) Production and Adaptation Strategies: A Case Study of Udon Thani Province, Thailand**

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Water is the most important variable in Thailand's agricultural sector. In particular, rice cultivation necessitates a large amount of water during the growing season. Therefore, the objectives of this study were to estimate the water footprint (WF) and the impact of climate change on glutinous rice (RD 6) crop water use (CWU) and to investigate farmers' climate change adaptation

strategies in Cha Lae Sub-district, Kumphawapi District, Udon Thani Province. Under rain-fed and irrigated conditions, the CROPWAT8.0 program was used to calculate the WF and CWU values under the SSP245 and SSP585 scenarios based on the CMIP6 model at three time periods: near (2015-2039), mid (2040-2069), and far (2070-2100). The results showed that the total WF values under rain-fed and irrigated conditions in the baseline scenario were 4140.87 m3ton-1 and 3707.10 m3ha-1, respectively. While in the SSP245 and SSP585 scenarios, total CWU values will rise by 1.20 to 6.63% in the near, mid, and far future due to higher temperatures resulting in increased evapotranspiration. Meanwhile, 96.97% of farmers perceived that climate change has been changing, and 81.82% believed climate change had an impact on their farms. The most popular and effective climate change adaptation strategies were increasing irrigation, changing fertilizer application rates, and planting drought-tolerant rice varieties.

S. B.3

Student Award Entry

Carbon Sequestration in Soil from Paddy Straw Derived Biochar in India

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The present research aimed to quantify the environmental benefits of the paddy straw - biochar system for carbon sequestration in India. The estimates showed that 135.5±1 MT of gross paddy straw is annually produced in the country, of which 41±1.1 MT is burned in-situ. In-situ burning of paddy straw releases 47,336±680 Gg pollutants having a 71.7±1.1 MT CO_2e environmental footprint. Biochar conversion has been considered an alternative to the in-situ burning of paddy straw and estimated that 16.8±0.5 MT of biochar could be produced from available paddy straw. Biochar application in paddy fields could sequestrate 66.2±1.2 MT CO_2e carbon, reduce 62,798±18,624 T NPK fertilizer consumption & 0.63±0.12 MT N_2O & CH_4 emissions and increase 0.6±0.14 MT CO_2 emissions from paddy cultivation. paddy straw collection, field transportation, biochar conversion, material handling and spreading would impart a 21.9±0.8 MT CO_2e environmental footprint. Overall, biochar conversion of paddy straw and its application in soil for carbon sequestration could reduce 135.6±4.5 MT CO_2e environmental footprint from paddy cultivation which is about 6 % of annual GHG emission from India in 2019. The results of the present study would help develop an environment-friendly and sustainable management system for paddy straw in the country.

S. B.4

Student Award Entry

(Virtual)

Assessment of Carbon Footprint, Water Footprint, Cost and Return of Organic Rice Based on Circular Economy and Original Organic Rice

Natawan Wanvisesh[1,], Nathsuda Pumijumnong[1], Sukanya Sereenonchai[1], Uthai Chareonwong[2], and Noppol Arunrat[1]*
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Although original methods of organic rice farming are environmentally friendly, a circular economy concept is a new trend being applied in organic rice production. The objectives of this study were: (1) to evaluate the carbon footprint (CF) and water footprint (WF) throughout the entire process of original organic rice farming (OG-NonCE) and organic rice farming based on a circular economy approach (OG-CE), and (2) to assess cost and return of OG-NonCE and OG-CE productions. All data were collected by using a questionnaire survey with organic farm owners in Phichit province, Thailand. The concept of CF based on cradle to gate was employed to estimate GHG emission, while CROPWAT8.0 program was used to calculate the WF.

The results revealed that CF intensities of OG-CE and OG-NonCE were 1.68 and 1.16 kg CO_2/kg rice yield, respectively. The total WF of OG-CE production was 1543.3 m3/ton, consisting of 612.4, 85.8, and 845.1 m3/ton for green, blue, and grey WFs, respectively. Meanwhile, the total WF of OG-NonCE production was 552.5 m3/ton, including 223.0, 31.2, and 298.3 m3/ton for green, blue, and grey WFs, respectively. Under OG-CE production, it generated a return of 5793 Baht/rai, while total cost was approximately 1760 Baht/rai. The return of OG-NonCE production was 9929 Baht/rai, with a total cost of 1408 Baht/rai. Higher total WF and CF, and lower return were found under OG-CE compared with OG-NonCE due to the lower rice yield. Although OG-CE farms applied high amounts of organic fertilizer to increase rice yield, using low quality rice seeds caused low yield. This study recommended that providing knowledge and technology to produce good quality rice seed are necessary for organic rice production.

S. B.5
(Virtual)

Determinants of Local Adaptation Strategies to Climate Change at Farm Households Level in the Central Region of Vietnam: a Case Study in Flooding Delta Regions of Thua Thien Hue Province

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Global climate change poses risks to human and natural systems on a global scale, while Vietnam is considered one of the regions experiencing heavy impacts of climate change. Thus, this study aims to determine the different perceptions, barriers, and driving parameters of local households to adapt to climate change. A total of 350 respondents in local regions were considered for the survey. The Multi-Logis Regression (MLS) model was applied to determine the driving parameters affecting the choice methods. A majority of farm households realized the huge impacts of climate change and actively planned to adapt. The findings also indicated that farm households applied widening solutions (11 methods) to adapt to climate change; importantly, production diversification was reported as the most important solution. While there was still a minor percentage that did not apply, at least a choice (6%). The results from the MLS model indicated that the adaptation process is driven positively and significantly by several factors, including age of the household head, gender of the household head, typology of household, and perception of climate change. Based on the research findings, a number of short- and long-term recommendations were developed to improve the efficiency of climate change adaptation and reduce the negative impacts of climate change at farm level.

S. B.6
(Virtual)

Design and Deployment of an IoT-based Landslide Early Warning System

Yan Liu*, Hemanta Hazarika*[,1], Haruichi Kanaya*, Osamu Takiguchi[+], Masanori Murai[#], Muhammad N. Hidayat*, and Yoshifumi Kochi[&]

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The occurrence of rainfall-induced landslides is observed worldwide. National and local government authorities have implemented monitoring systems to mitigate landslide disasters. However, most of these systems use complex devices that are high-cost and require a constant power source to transmit data to the servers. This research designed and deployed an IoT-based landslide early warning system (EWS). The architecture is divided into three layers—

Datacollection, Data transmission and Data display and analysis. For the tier of data collection, an off-the-grid solar energy-powered integrated platform with various portable and low-cost sensors was built; For the tier of data transmission, mobile routers were used to support the sensor platform; In terms of data display and analysis, research provided an open architecture to analysis data and proposed a method for predicting landslides with multiple indicators. The framework is tested, extended and tuned by the model test. Results presented accurate predictions, all warning times are before the occurrence of the landslide. Then the proposed EWS was put into an embankment slope in Fukuoka, Japan by considering geological conditions and sensor suitability. This research qualitatively guarantees the accuracy of landslide predictions while operating in a low-cost, sustainable manner. It presents how IoT-based EWS can generate a positive impact on disaster mitigation work**.**

Session C: Water and Wastewater Technology
Time: 15:15 – 17:30
Room Assignment: Marine Ballroom 1

S. C.1

Student Award Entry

Nitrogen and Phosphorus Removal Capacity of Water Lettuce, Water Hyacinth and Hydrilla in Domestic Wastewater of Sri Lankan Households

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Domestic wastewater is one of the major issues for eutrophication due to its high nutrient content. To address it, the wetland wastewater treatment system can be applied as a low-cost and onsite treatment method. The current study focused on the households of Sri Lanka. Nitrate and Phosphate removal capacity of the three macrophytes; Water Lettuce, Water Hyacinth, and Hydrilla were observed on the laboratory scale in rainy and non-rainy seasons. In the non-rainy season, 1:1 dilution is needed for raw domestic wastewater to enter the wetland system because macrophytes tend to die off without dilution due to high nutrient concentration. Water Lettuce > Water Hyacinth > Hydrilla effectively removes the Nitrate concentration in 90%, 78%, and 52% respectively, and Phosphate concentration in 85%, 72%, and 68% respectively within a 9-day retention period. In the rainy season, 1:1 dilution was used and macrophytes took a 3-day retention period to get nutrient removal until reaching permissible levels. Water Lettuce > Water Hyacinth > Hydrilla removed the Nitrate concentration at 88%, 80%, and 64% respectively, and Phosphate concentration at 91%, 80%, and 70% respectively. Water Lettuce is the most

effective nutrient removal macrophyte within these three macrophytes which can treat domestic wastewater up to the permissible level within a 9-day retention period in the non-rainy season and a 3-day retention period in the rainy season.

S. C.2
Student Award Entry
(Virtual)

The Effect of With and Without Anoxic Period for Removal Synthetic Wastewater Contaminated Cadmium (Cd^{2+}) by Sequencing Bath Reactor System (SBR)

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The objective of this research is to evaluate the performance of a lab-scale sequencing batch reactor system (SBR) with and without anoxic period to treat synthetic wastewater contaminated cadmium (Cd^{2+}). The SBR operation cycle 12 hours (h), the reaction phase 9 h, Hydraulic Retention Time (HRT) 5 days, and the mix liquor suspended solids (MLSS) 2,000 mg/L. The reactor-I controlled oxic period only, while the reactor-II and reactor-III controlled reaction phase had an anoxic period of 5 h and 7 h, respectively. The result of this study showed when increased anoxic period of the SBR system the cadmium and the total nitrogen removal efficiency increasing due to the system operated anoxic and oxic conventional occurred denitrification and nitrification process, theses process released nitrogen compounds. The SBR system increased the anoxic period the cadmium removal efficiency increasing. The oxygen limited of the system that respiratory of aerobic bacteria related to the removal efficiency of BOD5 and COD decreased when increasing anoxic period. Yet, the COD and BOD5 efficiency of all systems is more than 90%. The performance of the SBR with an anoxic period showed suitable growth for denitrification and nitrification bacteria. That is an alternative for treated heavy metals contaminated wastewater.

S. C.3
Student Award Entry

Low-cost Devices to Monitor Water Quality Combined with Data Analysis (Location: Chiang Kan, Thailand)

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Monitoring and controlling water quality is one of the essential things that must be done so that water remains safe for consumption and use. Only relying on lab-scale devices to evaluate water quality is no longer suitable for modern rapid assessment. Those methods are mostly time-consuming, costly, and require skilled users. Water quality test kits are currently used to cover the drawback of laboratory equipment in the field. However, this method lack precision due to color reading. This research attempts to transform analog color to corresponding RGB values using image processing methods and data analysis processes to provide precision values of water parameters. A set of water quality test strips photos is used and divided into training and testing groups. This method was shown an accuracy of nitrate, total hardness, total alkalinity, and pH of 0.66%, 0.89%, 0.89%, and 0.80%, respectively. In addition, the presence of geo-tagging improves the traceability and reliability of this method. This technique allows integration with cloud data systems, accelerating the data transfer process in the future.

S. C.4
Student Award Entry
(Virtual)

Removal of Manganese from synthetic wastewater with Sequencing Batch Reactor (SBR) systems

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Nowadays, the population is increasing as a result, there is more demand for consumer goods and transportation. At the same time, the industry needs to expand its production base to meet the needs of the population. It causes pollution and heavy metal contaminants in the wastewater that is harmful to life and the environment. One of the dangerous heavy metals is manganese. Therefore, the researcher is interested in studying the removal of manganese from wastewater to reduce toxicity before it is released into the environment. The objective of this research was to study manganese removal efficiency with a Sequencing Batch Reactor (SBR) system using bio-sludge from an excess bio-sludge storage tank of a central sewage treatment plant, Bangkok, Thailand (Sripaya plant). It is the microbial sludge from the activated sludge treatment system type of stabilization. SRB system is a biological treatment system that requires less treatment space and low cost because the aeration system and the sedimentation tank are the same tank. For manganese-contaminated wastewater, it is the smooth synthetic wastewater from metal castings industry. The results showed that the SBR system was oxic: anoxic under hydraulic retention time (HRT) at 3 days and mixed liquor suspended solid (MLSS) at 2,000 mg/L was able to remove up to 96.1% of manganese. It was also able to remove 95.2%, 94.3%, and 92.0% of BOD, COD, and TKN, respectively.

**S. C.5
Student
Award
Entry**

The Use of Neural Network Coupled with Image Processing for Water Quality Assessment (Location: Hot Spring Mae-Khachan, Thailand)

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Water plays an important role in life, including in the agricultural sector. One of the water sources for crop irrigation is surface water such as rivers. The quality of water used for irrigation affects the quality and yield of crops. Therefore, it is necessary to conduct periodic water quality assessments. Several methods for quantitatively assessing water quality in large areas have been developed, such as geographic information system (GIS) technology based on remote sensing (RS) using unmanned aerial vehicles (UAVs). However, the application of this technology requires special skills and is expensive. Some water quality parameters that are generally assessed are pH, alkalinity, total hardness, nitrate, and nitrite content are important to determine the quality of agricultural irrigation water. Water quality testing strips are popular for testing the water quality. The use of this instrument in combination with GIS utilizing geo-tag locations allows for the interpretation of water quality data for large area. In addition to the low price, this tool is very easy to use. However, bias due to colour reading from different users exists. In this study, the evaluation of water quality with image processing coupled with the Neural Network model is purposed. Water quality is assessed using testing strips. Images of the strip are taken by mobile phones. The test-strip image contains coordinates of the location provided by smartphone. Then, colour-space transformation, image enhancement, and regions of interest (ROI) are carried out as part of the image processing stage. Conversion Image from RGB broadband to HSV to recognize the characteristics of the image. Finally, the ANN algorithm is used to obtain water quality predictions based on the results of image analysis. ANN-multi layer perceptron (MLP) with three hidden layers was evaluated in this study. Based on the results of the analysis, the R2 value are 0.80, 0.85, 0.86, and 0.80 for the estimated parameters of pH, alkalinity, total hardness, and nitrate respectively. This research shows that the image processing method coupled with ANN has the potential to get a more precise estimation value for water quality assessment. For future work, the geo-tagging application meets with the data centre system in this study offers periodic monitoring of water quality in a large area.

S. C.6
Student Award Entry

A Novel Mechanism to Decrease Water Consumption in Commodes

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and Prasanth A.S[*]

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Human waste management is a water intensive yet, essential activity. In an average household, flushing is the largest water intensive task, accounting for over 30% of the overall water consumption. A reduction in water consumed in commodes will not only enable the conserved water to be utilized for other vital activities such as agriculture, but also be of monetary benefit in terms of electricity conservation. The S-trap of the commode is identified as the component that entails high water consumption. The S-trap works by creating a depth seal, which is impermeable to the toxic gasses from the sewer. In this experimental study, a novel mechanism is developed to functionally replace the water intensive S-trap of a commode. The hyperboloid valve, essentially, a silicone membrane that alternates between a smooth conduit and an air-tight constriction, is triggered by a simple twisting action. An impermeable seal is formed when the membrane is twisted close, and a free passage when it is twisted open. The overall mechanism comprises a flexible silicone tube, threaded adapters, a gear-based actuation system and a programmable motor. A 1:1 model of the system was fabricated. The quantity of water used, time of valve open, time between valve open and flush actuation, slope, and water retained in the bowl were the vital input parameters recorded as part of the study. To precisely adjust these parameters, a microcontroller was used to trigger the flushing action. Experimentation with solid waste mock ups such as vegetable dices revealed that the smooth conduit permits free passage of waste unlike the S-trap design. In order to minimize the number of trials during experimentation without compromising on the quality of data collected, a Taguchi L16 array was employed. A quadratic regression equation revealed that for an effective flush, a threshold quantity of water of approximately 1.2 litres is required. Additionally, the weight of waste flushed out was maximum when the valve opening and flush actuation were in synchrony. Three dimensional surface and contour plots were generated to visualize and draw inferences about the effect of the input parameters on the amount of waste flushed. This novel design can be implemented in squat and sitting commodes alike. With a simple yet robust design, the hyperboloid mechanism vies to make flushing a more sustainable process. A large-scale adoption of the same is envisaged to lead to global water and energy savings.

S. C.7   **Total Effective Dose Analysis in Case of LOCA for TMI-2 Nuclear Power Plant**

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The TMI-2 power plant, a pressurized water reactor, had 93.1 metric tonnes of fuel stocked in 177 fuel assemblies that were enclosed in the core, with a maximum fuel burnup of 55,000 MWd/MTU intended. This paper will present an assessment of individual and collective doses around TMI-2 site during the Loss of Coolant Accident (LOCA). The radioactive release during accident was extracted for the gaseous forms. The HOTSPOT health physics computer code used to calculate the atmospheric dispersion of radioactive material during LOCA conditions. This codes use a Gaussian dispersion air transport plume model to simulate the atmospheric dispersion of radionuclides in different atmospheric stability classes, wind speeds and directions. Data collected near the reactor site is also analyzed and applied to meteorological data on atmospheric stability conditions, wind speed, and the frequency distribution of wind direction. The results showed the maximum Total Effective Dose Equivalent (TEDE) values for the general public and workers in the vicinity of the TMI-2 site. This will allow the regulatory bodies to implement essential safety measures to protect the employees and the general public.

S. C.8   **Experimental Studies on the Removal of Textile Dyes from Artificially Contaminated Water Using Sorbent Synthesized from Paper Waste**

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Nowadays, organic dyes widely used in various industries such as textile, paper dyeing, plastics or cosmetic have posed a serious threat to the water resources. Most of textile dyes with nonbiodegradable, toxic and carcinogenic features could cause adverse effects for ecosystems and human health. A little studied sorbent – aerogel – a substance with a low density in the solid state was used in experiments. This material is lightweight and has a large surface area. Aerogels obtained not from petroleum but from cellulose, chitosan, lignin or pectin have good sorption properties for removing organic pollutants from wastewater. The aim of this study was to determine the adsorption efficiency of the removal of naphthol green B from artificially contaminated water using sorbent synthesized from paper waste. Cellulose aerogel, which was prepared from office paper and cardboard waste, was used in experimental research. Adsorption capacity values ranged from 0.12 mg/g to 0.83 mg/g. It can be stated that the change in the pH of the solution after the sorption process did not affect

the sorption result and optical density of investigated solution. The surface area of aerogel changed after sorption process: the gaps between the fibers have decreased, the surface of aerogel became smoother.

S. C.9
(Virtual)

Performance Evaluation of Coagulants for Water Treatment in Emergency

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Natural disasters frequency has increased over the past decades. These disasters lead to substantial loss of life and property and render the affected population homeless many times with little or no resources for survival. The short-term effects of the disasters can last for 1-2 weeks, but the long-term effects can last for months. Water is one of the most important requirements for survival in case of a disaster. For the people to survive, they urgently need food and water. Drinking water and water for general use like washing, cooking and maintaining hygiene are essential for the survival. Under normal circumstances water requirement may be more, but in case of emergency, certain minimum amount of water is required for every individual. Availability of adequate quantity of water is crucial for survival, to maintain adequate hygiene and to avoid ill health. Coagulation is one of the most widely used treatment process for removal of suspended solids. Batch coagulation-based water treatment system like the Oxfam up-flow clarifier has been used by relief organizations on various occasions for emergency treatment. In this study the performance of commercially available chemical coagulants, poly-aluminium chloride (PAC), alum (Aluminum Potassium Sulfate) and natural coagulant, Strychmos Potatorum was studied. These coagulants were studied for their effectiveness in treatment of highly turbid water. The effective optimum dosage of PAC was 10-20 mg/L, alum was 70-80 mg/L and Strychnos Potatorum was 30 mg/L for treatment of water under different turbidity ranges under laboratory conditions. PAC was found to be the best coagulant among the three studied. PAC effectively reduced the turbidity of raw water by 99% and was found to be best suited for use for emergency water treatment.

Session D: Energy in Transport
Time: 15:15 – 17:15
Room Assignment: Oriental Palm I

S. D.1 **Design of Inductive Resonance Coupling-based Wireless Charging Infrastructure for Electric Vehicles**

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Electric vehicles are an alternative to the ICE Engine vehicles to reduce air pollution. Despite this, one of the major impediments to the rapid adoption of EVs is the lack of efficient charging infrastructure on par with contemporary ICE engine refueling stations. Plug-in electric vehicles (PEVs) are the future of environmentally friendly transportation. Due to the increase in PEVs, however, there are drawbacks associated with cost and size, as well as charging cables. To address these challenges, an inductive resonance coupling-based wireless charging system has been proposed in this work. This article focuses on analyzing the electromagnetically coupled resonant wireless technique used for the charging of EVs. In this article, the efficiency of a resonant wireless charging system for EVs is studied by modeling, simulating and examining parameters such as distance, load, coil shape, and inter-turn distance influence the charging process. Charging efficiency can be significantly improved by choosing the right coil dimensions, inter-turn distance, and distance between coils. It is concluded that the efficiency of wireless power transfer increases with a decrease in distance and the same can be increased by increasing the size of the coil and there is also a limitation for the size of the coil after certain turns as the efficiency saturates. In this work, static charging mode is incorporated to eliminate the shock hazard due to wires and the ability to be installed in convenient locations such as home garages or parking lots. It also eliminates the need to constantly plug the charger into the vehicle, as once the vehicle is parked in the parking lot, the charging will automatically begin based on the state of the batteries. Thus, the wireless charging of EVs will promote the quick adoption of EVs and a pollution-free environment.

S. D.2
Student Award Entry
(Virtual)

Quantitative of Real-Driving Emission Factor Based on Vehicle Specific Power from a Selected Diesel Truck in Malaysia

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Recent studies had highlighted that real-driving emission (RDE) testing on diesel trucks are necessary to generate emissions limits. Therefore, current research aims to conduct RDE testing using a Euro IV-compliant diesel truck on pre-designed Malaysian-based test routes. Vehicle specific power (VSP) approach was applied to examine the relationship between RDE and truck's activities. The emission factors (EFs) were divided into 22 different operating mode bins, which were classified according to the calculated VSP and instantaneous vehicle speed. Emission factors of CO, CO_2, HC and particulate matter (specifically $PM_{2.5}$) which quantified under time-specific EFs and distance-based EFs were the main focus in current study. Findings showed that CO_2 and $PM_{2.5}$ were found to react linearly with the VSP and instantaneous vehicle speed, while CO and HC emissions did not exhibit any consistent pattern. Further analysis under specific driving modes indicated that the overall EFs of CO_2 and $PM_{2.5}$ were found to be higher in cruising mode, while the overall EFs of CO and HC were found to be higher in acceleration mode. These findings highlighted the needs of RDE testing in providing accurate quantification of EFs under real-driving condition.

S. D.3

(Virtual)

Decarbonizing Transport Sector in Thailand Towards 2050

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The transport sector is one of the important contributors of increasing GHG emissions in Thailand. The implementation of emissions reduction in this sector, especially in the road transport, is a significant endeavor that can help to prevent increasing the average global surface temperature. However, the questions are how mitigation measures or mitigation policies are appropriate for reducing GHG emissions in the road passenger transport. Therefore, this study aims at formulating decarbonization pathway scenarios of Thailand's

road transport. The studied period for GHG mitigation is 2015-2050. This study assesses the potential of GHG mitigation by the use of renewable energy and energy efficiency in Thailand's NDCs and identifies advance technologies and fuel substitution in the road transport sector in order to achieve the 1.5-degree global climate target. The Asia-Pacific Integrated Model/Enduse (AIM/Enduse) is selected for the analysis. The AIM/Enduse is developed by National Institute for Environmental Studies (NIES), Japan. It is employed to investigate the decarbonization pathways achieving 1.5-degree target during 2015-2050, extended from the Thailand's updated NDC2020. In addition to the BAU scenario, three GHG countermeasure scenarios are formulated for the transport sector in Thailand, namely the extended NDC 2050 (EX_NDC2050), full battery electric vehicle implementation (BEV) and full bio-fuels implementation (BIOF). Results suggests that the emission pathway in the EX_NDC2050 scenario will be higher than the 2-degree target in 2050. The Thailand's updated NDC 2020 in the transport sector are not in-line with the 2-degree and 1.5-degree targets. The emissions pathway of the transport sector will be in-line with the 2-degree target when the battery electric vehicles (BEV) and bio-fuels are fully implemented. The 2-degree target can be achieved when the combined measures in the transport sector are implemented in the proportion of BEV to bio-fuels of 75:25 or 25:75 vice versa. Finally, the policy implication on energy efficiency and CO2 emissions suggests that Thailand should increase the share of electric vehicles and the use of bio-fuels. Moreover, the government should encourage green electricity generation from cleaner technologies and renewable energy including transportation demand management.

S. D.4   **Assessment of Total Cost of Ownership for Electric Two-Wheelers with Point Charging and Battery Swapping in the Indian Scenario**

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To combat the dependency on fossil fuels and their increasing prices, along with concerns over climate change, electric vehicles (EVs) are being considered the future of transportation. However, the adoption of EVs is still at an early stage due to challenges like charging time, ownership cost, range, and many others. Battery swapping (BS) allows swapping a drained battery with a fully charged one in minutes, while point charging (PC) takes hours. Several studies have examined the total cost of ownership (TCO) of EV with PC, however the TCO of EV with BS has not been much investigated. This study aims to evaluate the TCO of electric two-wheeler with two charging

options, PC and BS, for prevalent use cases: private & commercial. The results are compared with the base case of the internal combustion engine for the two-wheeler (I2W). The study predicts that vehicle purchase cost with BS would achieve cost parity with I2W if the Indian government offers a subsidy for 'EV with BS' equal to 50% of that being offered to 'EV with PC'. An EV with PC is most feasible in a private case, whereas an EV with BS is most economical for a commercial case. This study is expected to help policymakers to verify the effectiveness of the current policy.

S. D.5
(Virtual)

Diesel Fuel Quality Assessment from Selected Filling Stations in Kumasi

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Diesel is an essential energy source in the transportation and industrial sectors worldwide, hence, the quality of this commodity is crucial. This study aimed to compare various fuel samples obtained from different fuel stations to understand the quality of the fuels in terms of their sulphur content, density, surface tension, viscosity, and calorific value. Several diesel samples were obtained from Eight (8) fuel filling stations in Kumasi, Ghana. The results revealed that the surface tension, viscosity, densities and the calorific value of almost all the fuels from the various filling stations were in compliance with the Ghana Standard Authority's (GSA) set limit for diesel fuels. The fuels from these filling stations were compliant up to 75% for density, 87.5% for surface tension and viscosity, 50% for calorific values, however, the other 50% were higher than the set limit. However, high caloric value could indicate the addition of fuel enhancers for improvement in specific property. The sulphur, however, showed 37.5% compliance since 3 out of the 8 filling stations had less or equal to 50 ppm of sulphur in the samples. This is a cause for concern and further analyses since it indicates environmental pollution with associated health issues from emissions.

S. D.6 **Analysis of Energy saving between Bleed Air and Bleed less Environmental Control Systems in a typical Aircraft**

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Normally, the required quantity of hot air is drawn from an engine compressor for an Aircraft Environmental Control System (ECS). The present work aims to illustrate the energy saving that can be realized by using a bleed-less aircraft environment control system (ECS) that is powered by an auxiliary ram air compressor: This paper presents a direct comparison between the energy consumption of a conventional bleed air system and a bleed-less ECS. A conventional bleed air ECS system is first modeled using MATLAB and validated with results in the open literature. The system is modeled to match the temperature profile with that of an Airbus 320 during cruise conditions. Then, a bleed less system is modeled by modifying the bleed air system to use a ram-air compressor for the air intake as a bleed less ECS. Finally, the fuel mass penalties associated with each environment control system are calculated. The bleed air system incurs fuel penalties due to bleed air extraction, and additional drag due to the ram air intakes for the large heat exchanger ram-air scoops. Whereas the bleed-less system incurs penalties due to drag from the small ram-air intakes for the heat exchanger and the ram air compressor scoop and a dedicated electrical power system for the ram air compressor. It was found that the total fuel mass penalties calculated for the bleed less system are about 80% lesser compared to a conventional bleed air ECS without a dedicated electrical power system.

S. D.7 **Adoption of Electric Vehicle in Kolkata - Thumbs Up or Down! —A Pilot Study**

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Air pollution is one of the major alarming environmental problems among all the countries irrespective of developed or developing including India. One of the important sectors contributing to air pollution in India is the transport sector. Here in this research, our study is based on vehicular pollution particularly in Kolkata. Owing to geopolitical tension the world is experiencing price hike in the international crude oil market and this has trickled down to its retail price rise in all major cities in the country. "In last 17 days petrol prices were revised upwards 14 times than earlier" (April 7, 2022, https://www.thehindu.com). It has reached to triple digit (INR 115.12) on May 16, 2022 in Kolkata. On the other hand, from the demand side it is observed in

the neo normal state under post pandemic era that the demand for personal vehicles instead of public transport is rising in the country to maintain social distancing and get rid of the fear associated with COVID-19. Under such scenario a steady market for electric automotive industry is developing. Various automobile companies are taking initiative to launch Electric Vehicles. Government of India along with many State Governments are providing subsidies and tax reduction to encourage the countrymen to shift their habit to electronic vehicles. As per the budget document of the Government of India. the subsidy under Faster Adaptation and Manufacturing of Hybrid and Electronic (FAME) vehicles for fiscal 2023 is projected at INR 2908 crores (https://m.economictimes.com). According to Ministry of Power, Government of India is going to expand Public Electric Vehicle Charging Infrastructure across the nation. Thinking in this line the present study, a Bottom up Approach, is an initiative to identify and examine the different factors influencing a consumer's usage of electronic vehicles in Kolkata. The selected respondents (225) are the existing car owners of Kolkata. The study is based on a perfect combination of qualitative and quantitative analysis. Here Structured Equation Modeling (SEM) is used to interpret the data. Respondent's attitude is acting as a strong mediator.

S. D.8　　**Electric Vehicle Conversion Software Safety Study by Mean of Model Based System Design (MBSD) Approach**

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Although electric vehicle conversion option has gained more attention for commercial use, there are questions regard to functional safety aspects. One of them is the software being employed within the system such as, electric propulsion system, battery system, and communication system and others. Thus, this work aim to employ model based design approach to investigate by mean of examination possible safety requirement parameters range and failure scenario. The procedure includes building of systematic models of electric vehicle conversion sub-subsystem, power flow system, traction and vehicle dynamic system, and communication system. Then, the system is simulated based on technical requirement of the particular electric vehicle conversion. Furthermore, in-the-loop test will be used to study the software algorithm within the electric conversion system. The results will be analyzed and evaluated before the algorithm is embedded and tested in actual electric vehicle conversion vehicle lab vehicle before employing in the real field test.

Session E: Solar Energy 2
Time: 10:15 – 12:00 noon
Room Assignment: Marine Ballroom 1

S. E.1

A Lead-Free All-Inorganic Cs_2SnI_6 Based Ultra-Thin Perovskite Solar Cell Optimized using SCAPS-1D Simulator

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In this work, an all-inorganic lead-free Cs_2SnI_6-based perovskite PV cell (structure $FTO/TiO_2/Cs_2SnI_6/SrCu_2O_2$) has been optimized by varying the layer thickness, defect densities, doping profiles using SCAPS 1D simulator. A synergic optimization of the device is also performed by changing materials for Electron-Transport-Layer (ETL) and Hole-Transport-Layer (HTL) to investigate the role of device interface on the carrier dynamics. In our proposed cell structure the light illuminates through the Transparent Conducting Oxide (TCO) layer of Fluorine doped Tin Oxide (Sn_2O:F), which acts as the window layer. The p-type Perovskite (Cs_2SnI_6) is chosen as the key absorber layer for its distinct properties. Finally, before the back-contact, $SrCu_2O_2$ as HTL is included for abrupt separation of hole from absorber owing to its greater hole conductivity with suitable offsets of valance and conduction band distribution. Moreover, $SrCu_2O_2$ based device shows enhanced efficiency than commonly used Spiro-OMeTAD based devices. According to our simulation outcomes, the optimized structure offers an overall power conversion efficiency (PCE) of 32.72%, open-circuit voltage (V_{oc}) of 1.012 V, short-circuit current density (J_{sc}) of 36.7 mA/cm^2 and Fill-Factor (FF) of 88.15%. The entire thickness of our optimized proposed cell is realized only 360 nm, which is extremely thin and would be very cost effective.

S. E.2
(Virtual)

Maximum Power Point Tracking Design Based on Fuzzy Logic Algorithm Under Uncertain Weather Condition

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Electricity is one of the main sources of energy that is very important in everyday life, both for household needs, government agencies, and industry. To strengthen the implementation sustainable development goal by reducing the use of fossil fuel, the utilization of solar energy has great potential, though the efficiency of solar panels or solar energy technology is still relatively low, especially in Indonesia. Located in tropical region, the solar panel module receives solar irradiation that varies due to changes in weather or local environmental conditions, partial shading will occur, making the solar panels partially covered by shadows. This situation will result in a decrease in the output power of solar panels To overcome this issue, a battery is used to store the generated energy. To maximize the potential, the battery needs to be charged optimally which need a control algorithm to provide energy gathered from the solar panel, most of the time. Therefore, a maximum power point tracking (MPPT) is necessary to be associated with an algorithm to optimally control the performance of the solar energy harvesting scheme. In this study, both Mamdani and Sugeno Fuzzy Logic Algorithm are used in the MPPT with a buck converter at a solar panel with a battery. Buck converter is chosen to give safety charging margin to the battery since the converter's output voltage is lower than the input voltage. As for the fuzzy logic algorithm, Mamdani's Fuzzy Logic has the advantage of producing more accurate decision results than Sugeno's type. While, Sugeno's Fuzzy Logic has the advantage of using simple mathematical calculations in its design. In addition, a buck converter was also used to match the voltage generated by the solar panel to match the battery specifications. The system design and testing are carried out using Matlab R2018b Simulink. From the simulation, the Mamdani Fuzzy Logic-based MPPT has the same maximum power point tracking computation time as Sugeno's Fuzzy Logic. In the partial shading test conditions, MPPT based on Fuzzy Logic has a higher efficiency value of 94.50% when compared to MPPT without control which is only 89.56%. Under various conditions of irradiation and temperature, MPPT based on Fuzzy Logic has a higher efficiency value of 94.88% than MPPT without control which is only efficiency of 91.53%.

S. E.3
Student Award Entry
(Virtual)

Optimization and Performance Improvement of CsSnGeI$_3$ All-Inorganic Lead-Free Thin-Film Perovskite Solar Cell through Numerical Simulation

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Among different routes of the generation of electrical power, solar photovoltaic is one of the most promising and trusted technology. Organic, organic-inorganic hybrid lead-based perovskite compounds are becoming commercially appealing as absorber materials in the majority of perovskite solar cells due to high *PCE* (power conversion efficiency), low cost, availability of materials, and ease of production. However, as mentioned above, lead-based organic perovskite solar cells are unstable in open space. Nowadays, Sn-based inorganic perovskites are becoming more popular than lead-based perovskites as Pb-based perovskite solar cells are toxic and not environment-friendly. In this study, the thickness, doping density, defect density, energy bandgap of the absorber, and ETL (electron transport layer) and HTL (hole transport layer) materials of the cell are optimized using SCAPS-1D simulator. The final structure is FTO/ZnO/CsSnGeI$_3$/NiO/Cu$_2$O, where FTO works as TCO (transparent conducting oxide) layer. The optimized structure offered an open-circuit voltage (*V$_{oc}$*) of 1.245V, a short-circuit current (*J$_{sc}$*) of 28.189 mA/cm^2, a Fill Factor (*FF*) of 89.97%, and an overall *PCE* of 31.57%. According to the literature, this is the highest *PCE* for the CsSnGeI$_3$ perovskite solar cell with all-inorganic layers. The proposed optimized structure will pave the path for the fabrication of low-cost, environment friendly and stable perovskite solar cell.

S. E.4
Student Award Entry
(Virtual)

Use of SARIMAX Model for Solar PV Power Output Forecasting in Baguio City, Philippines

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Over the past few decades, there has been a continuous increase in the public interest for solar energy as an alternative and cleaner source of energy. Therefore, it is not surprising that there is a similar interest in developing accurate models to forecast solar photovoltaic (PV) power production. Such models vary depending on the geographical location of PV sites and the seasons considered. The Philippines has yet to have a solar PV output forecasting model adapted to the country's local conditions. This study aims to evaluate the Seasonal Autoregressive Integrated Moving Average with Exogenous Variables (SARIMAX) forecasting model as a tool for forecasting solar PV generation based on the seasonal characteristics of the country and identify which input parameters are significant for each season. This work used solar PV production data as an endogenous variable. Meanwhile, exogenous variables include in-situ solar irradiance data from solar power plants; and cloud cover, wind speed and direction, ambient temperature, precipitation, and relative humidity, which we extracted from ERA5 Reanalysis data. Datasets were divided based on the seasons as defined by the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA), namely, hot dry (HD), rainy (R), and cold dry (CD) seasons. Then, we performed a forecast on each season and one full year to assess the performance of the SARIMAX model. The best model per season was done based on the forecasting accuracy measured using Mean Absolute Error (MAE) and Root Mean Square Error (RMSE). This work analyzed seasonal and year-round SARIMAX models for Baguio City, Philippines. Results show that the cold dry season got the highest accuracy value in terms of 2.26 MAE and 4.06 RMSE. Meanwhile, the rainy season had the lowest accuracy of 12.91 MAE and 16.16 RMSE. We can infer from our findings that seasonal forecasting is better during hot dry and cold dry seasons. We also found that the year-round forecasting model performs better than the rainy season model. From the significant parameters identified in our best models, our analysis showed that wind direction can be removed from all models; irradiation and relative humidity were significant for all seasons.

S. E.5

Systematic Study of the Optimization of Cadmium Telluride (CdTe) Thin-film Solar Cell Performance Using Spherical Plasmonic Metal Nanoparticles

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Cadmium Telluride (CdTe) has gained significant attention as a leading semiconductor absorbing material in thin-film solar cells (TFSCs) due to its high absorption coefficient in the visible to the near-infrared (NIR) region, near-optimum band gap energy, relatively low carbon footprint and production cost. Additionally, CdTe is also a direct band gap material having a direct band gap that has a favorable match with the solar spectrum. Hence, this offers high theoretical efficiencies, which significantly reduces the thickness of the absorbing layer when compared to other materials (e.g., silicon) used in TFSCs. Additionally, Cadmium (Cd) is readily available mainly as a byproduct of the mining industry. Hence, CdTe solar cells now have the lion's share of the TFSC market. However, limited availability of Tellurium (Te) is one of the major challenges hindering the development of CdTe solar cells. Therefore, it is important to design new highly efficient CdTe TFSCs with ultra-thin layers that can significantly reduce the demand on Te. One such method can be coupling plasmonic metal nanoparticles to the absorbing layer of CdTe TFSCs to improve the light absorption and current generation capacity of the solar cells. In this light, this computational study was conducted using the Finite-Difference Time-Domain (FDTD) method that used spherical plasmonic nanoparticles of various metals, e.g., silver, gold, aluminum and titanium, and of different sizes coupled to the absorbing substrate of CdTe TFSCs to investigate their effect on the opto-electronic performance of the solar cells. The results show that the opto-electronic performance of CdTe TFSCs is significantly enhanced by most of the metal nanoparticles mentioned, with silver showing the most significant enhancement. It was observed that 150 nm diameter spherical silver nanoparticles placed on the top surface of CdTe TFSCs, yields greater than 25% enhancement in the short-circuit current density (Jsc) when compared to bare CdTe TFSCs. It was also observed that the other performance parameters of CdTe TFSCs such as open-circuit voltage, fill factor, output power and efficiency also show enhancements with the presence of spherical plasmonic metal nanoparticles. It is hoped that the encouraging results of this study can inspire exciting new research to significantly improve the opto-electronic performance of CdTe TFSCs using different innovative mechanisms.

Session F: Climate Policy
Time: 10:15 – 12:00 noon
Room Assignment: Oriental Palm I

S. F.1 **Thailand Nationally Determined Contributions (NDCs): Analysis of Climate Policy for Enhancing Climate Resilience in Infrastructure Construction Sector**

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The perception of climate change mitigation efforts goes in wider and different phases, from individual incentives to community as a whole. Paris agreement conferences aim to delineate the climate change problem and strengthen the collaboration between the potential countries and developing countries which facing more challenges in terms of financial resource and socioeconomic. The agreement requires each country to implement their domestic climate policy which covers economic, social, and political issues in responding to climate change such as low carbon emission development plans, mitigation and adaptation measures, and climate resilience development. These climate actions are delivered as Nationally Determined Contributions (NDCs) which is a long-term achieving low-emissions plan and reflect the national GHG emission reduction priorities. This research explores the NDC in Thailand context with focus on the development of infrastructure construction sector which is a significant sector contribute to economic growth of the country. Thailand's Nationally Determined Contributions implements 15 climate long-term approaches for year 2021-2030 which covers to 3 categories: Energy and Transportation, Waste Management, and Industrial Manufacture and Product Application. In Thailand, likewise other countries, energy sector is the most contributor to the largest portion of GHG emission as it is interconnected with all activities including the focus area, construction of infrastructure. This research aims to analyze relevant approaches for construction sector indicated in the NDC Roadmap on Mitigation 2021-2030, and the Guidelines for driving and evaluating which includes the mitigation and adaptation measures on climate change. The construction sector by compliance with the NDCs approaches appears to be a potentially significant factor for sustainable development and low carbon future, likewise, building climate resilience through mitigation and adaptation practices, for instance, the application of Ecosystem-Based Adaptation (EbA), the construction rating system as a guideline for measuring sustainability in both building scale and component scale. In addition, to achieve the long-term goal, the participation and collaboration have to be bonded strongly in all phases to support climate action mechanisms in both domestic and international level.

S. F.2
(Virtual)

The Role of Discount Rate and Social Cost of Carbon in Long Term Climate Policy on Renewable Electricity in Thailand

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In economic appraisal of project investment, two important factors that are significantly taken into account are the discount rate and the costs. Discount rate is used to determine the present value of future cash flows of the projects. For climate change projects, the lower discount rates are recommended since benefits will be obtained in the long term. In general, private and external costs are used to evaluate the project investment. Combination of both costs is called "social cost". In this study, only the "social cost of carbon (SCC)", referring to an estimate of the economic costs of one additional ton of carbon dioxide emitting into the atmosphere, is considered. The objective of this paper is to estimate the SCC in term of carbon tax on the subject of three discount rates with the objective of renewable electricity to achieve carbon neutrality by 2050. Firstly, a 6 percent discount is applied from the base year to 2037. Then, a discount of 3 percent is applied until 2050. The results show that renewable electricity can achieve the carbon neutrality target at SCC of higher than 2.0 USD/t-CO_2 and 132.7 USD/t-CO_2 for the periods 2020-2037and 2038-2050, respectively.

S. F.3
(Virtual)

Reducing Coal Overcapacity in China: A New Perspective of Optimizing Local Officials' Promotion System

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Reducing coal overcapacity is still an important task to achieve the goal of carbon peak and carbon neutralization in China. Figuring out coal overcapacity's determinant is a top priority. The existing literature focuses on the macro factor of government intervention behavior. However, the underlying micro factor of local officials' intervention motivation also plays a role; unfortunately less studied. In this paper, we highlight that local officials' promotion pressure is a new perspective on understanding China's coal overcapacity and study whether optimizing GDP-based local officials' promotion system can help reduce coal overcapacity. Using data from 25 coal producing provinces in China, we find that local officials' promotion pressure under the GDP-based promotion system is an important micro factor that

leads to coal overcapacity. Furthermore, we conduct a mediation effect test to reveal its influence mechanism. We find that factor market distortion is one important channel through which local officials' promotion pressure affects overcapacity in the coal sector, and the distortion in the capital market plays a more dominant role than distortion in the labor market. Moreover, to alleviate the negative effect of officials' promotion pressure on capacity utilization rate, we build a diversified promotion system incorporating environmental indicators. Results show that when the environmental pressure index accounts for at least 50% of the weights in the diversified promotion system, the negative effect of promotion pressure disappears. Finally, it is demonstrated that a diversified promotion system helps reduce coal overcapacity. Based on the results, we suggest the policymakers weaken the GDP-based political promotion incentive by adding environmental and ecological evaluation indicators and reducing interventions on factor allocation. This is not only a solution to coal overcapacity in China but also a reference for the resource-dependent countries facing similar overcapacity problems, especially in the context of the open economy and green recovery in the post-COVID-19 period.

S. F.4
Student Award Entry
(Virtual)

Low Carbon Power Generation in Selected GMS Countries to Achieve the Paris Agreement

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This paper adopts different technologies to integrate both the supply and demand-side options in the power sector of the selected GMS countries for restricting the CO_2 emissions under the perspective of the nationally determined contributions (NDCs). This study develops three mitigation scenarios including the Business-as-Usual (BAU). The BAU scenario is established based on the current trend of electricity consumption associated with the socio-economic development of the selected GMS countries. The CO_2 mitigations in the MIT01 scenario are in line with the power development plans (PDP) whilst the MIT02 scenario is formulated by enhancing renewable energy utilization, energy efficiency improvement, carbon capture and storage (CCS), and nuclear power. The Low Emissions Analysis Platform (LEAP) model is employed for the estimation of electricity demand, generation, and GHG emissions between 2015 and 2030. Results show that in 2030 under the MIT01 and MIT02 scenarios, the CO_2 emissions can be reduced by 85.22 $MtCO_2eq$ and 149.24 $MtCO_2eq$, respectively. Additionally, the study is extended to 2050 showing the total CO_2 emission reduction in the MIT01 and MIT02 would be decreased by 26.41% and 68%, respectively compared to the emissions in the BAU. However, the goal of the Paris Agreement required

higher GHG emissions deduction in 2050 than those in the MIT01 and MIT02 scenarios.

S. F.5
Student Award Entry

Assessment of CO_2 Emissions and Costs of Decommissioning of Commercial Onshore Wind Farms in Thailand

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This study presents an assessment of CO_2 emissions associated with decommissioning of 29 commercial onshore wind farms in Thailand. The decommissioning of the onshore wind farms consists of disassembly and transport of wind turbines and demolition and disposal of concrete foundations. Access roads and transmission cables are not included in the assessment due to the conditions of wind farm development in Thailand. Data on 29 wind farms in Thailand were collected from the Energy Regulatory Commission of Thailand (ERC) and the Electricity Generating Authority of Thailand (EGAT). The carbon emission factor of a wind turbine is used to estimate CO_2 emissions from the decommissioning. This study also assesses the reduction of CO_2 emissions from recycling wind turbine materials and concrete foundations. The costs of decommissioning per installed capacity is used to estimate the costs of decommissioning of each wind farm. The results of the study are shown that total carbon emissions from decommissioning are 779,479.3 tCO_2eq. The average carbon intensity of decommissioning is 10.095 gCO_2eq/kWh, and the average costs of decommissioning is 0.0014 USD/kWh. The results are also shown that the CO_2 emissions of decommissioning are minor as compared to other carbon emissions of electricity generation from wind power.

S. F.6

Understanding Community Adaptation for Climate Disaster (Case Study: Landslide Disaster in Balikpapan City, Indonesia)

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Landslides are hydrometeorological disasters that occur frequently in Indonesia, including Balikpapan. During the period 2014-2018, the Central Balikpapan district experienced the most landslides in Balikpapan City, with 62

recorded events. Population density, sex ratio, and population density can all increase social vulnerability to landslides in Balikpapan. People should adapt to their environment in order to reduce social vulnerability. The objective of this research is to better understand the community adaptation strategy to landslides in the Central Balikpapan Sub-district based on social vulnerability. The qualitative method, desk review, and distributing questionnaire using snowball sampling was used in this study. According to the research findings, the adaptation strategy in the low social vulnerability zone is to increase public understanding of the phenomenon of landslides. Meanwhile, increasing understanding of phenomena, reducing expenditure, improving houses, increasing cooperation, providing night patrols, and participating in community groups has been done in the moderate and high social vulnerability zones.

S. F.7
(Virtual)

Climate Governance in India: A Sectoral Approach

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In a world where temperatures are increasing, India is one of the countries with the highest risk of natural disasters. More than 80% of the population lives in places that are most vulnerable to severe hydrological and climatic disasters. Communities are at risk from natural disasters like tropical cyclones, floods, and droughts, which are expected to increase in frequency and severity as Climate Change picks up speed. All countries, including India, must act immediately to reduce their own emissions to reduce risk rises and invest in adaptations to protect their populations from the effects of global warming. According to India's commitments, non-fossil fuel capacity will be increased to 500GW, emissions will be decreased by 1 billion tonnes, carbon intensity will be reduced by more than 45 percent from 2005 levels, and at least 50 percent of the country's energy would come from renewable sources. It has been noted that a number of industries and sectors, including those related to energy, transportation and buildings, contribute to climate change. Keeping that in consideration, the following policy paper assesses the Climate governance and the move of India in these sector's current policies for combating climate change.

Session G: Waste Management and Valorisation
Time: 15:15 – 17:15
Room Assignment: Marine Ballroom 1

S. G.1   **Biodiesel Production from Urban and Suburban Municipal Sewage Sludges in Tokyo, Japan**

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The world`s population, energy demands and waste generation are increasing year by year. In many countries, sewage sludge is disposed of in landfills, but 96.5% of the total sludge produced in Tokyo, Japan, is incinerated. GHG emissions from the Bureau of Sewerage accounted for approximately 37% of the Tokyo Metropolitan Government's activities and more than half of CO_2 emissions are from sludge incineration. Therefore, a process is needed to replace or reduce the incineration of sewage sludge in Tokyo. This study proposes how to mitigate sludge handling, reduce greenhouse gas emissions, and produce sustainable energy based on initial fieldwork. Samples were collected to measure sewage sludge's potential for biodiesel production from urban and suburban wastewater treatment plants in Tokyo. Results showed the average 30 wt. % dry basis organics in sludge with high concentrations of free fatty acids and triglycerides in urban sludge and high ester content in suburban sludge and 97 % - 99% biodiesel yield was achieved through acid/base transesterification. Scale-up of the organic's extraction and biodiesel production from sewage sludge can reduce fossil fuel dependency, and greenhouse gas emissions (approximately 19% from the incineration process) and contribute to achieving carbon neutrality in wastewater treatment.

S. G.2
Student Award Entry

(Virtual)

Effect of Aeration Rate on Wet- refuse-derived Fuel Biodrying Process for Increasing Heating Value and Water Content Reduction

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Mechanical Biological Treatment (MBT) at On-Nuch waste transfer station is used for waste treatment generated from Bangkok and Metropolitan Area. It can separate organic waste, recycle material, and solid waste. This solid waste can be considered for converting into solid recovered fuel because it comprises more than 50% plastic and 20% biomass. However, due to its

higher water content and lower heating value, this material was called wet-refuse-derived fuel (Wet-RDF). Besides, the biodrying process has been used for water removal by activating microorganism's activity. This process encourages heat production and vapor release. However, aerated supply is necessary to determine the optimal biodrying operation. Therefore, this study investigated the aeration rate effect on the Wet-RDF biodrying process. This study was performed on the 0.375 m^3 square-steel lysimeters with 0.5 m wide and 1.5 m high. The continuous negative ventilation has varied the rates to 0.3, 0.5, and 0.6 m^3/kg/day. The operation time was set to 5 days for the experiment. Feedstock's initial moisture content and low heating value were 44.91% and 3,207 kcal/kg, respectively. The measured daily temperature represents the self-heating value in the process for the range of 20-63 °C, and its peak was found during days 2-4. The average inner and exhaust gases as bioactivity produced peaked on day 3 at 4% carbon dioxide and 14-16% oxygen concentrations. The final composition decreased both degradable material and non-degradable material by 2%. The optimum aeration rate was o.6 m^3/kg/day because of higher water content reduction and lower organic loss. In this regard, it provides the optimum biodrying index of 0.171, which raises water reduction while remaining the carbon source in terms of organic reduction. Also, 4,901 kcal/kg of low heating value and 36.6% moisture content were provided for the final product. According to the RDF-3 criteria requirement for local cement production, the optimum aeration rate was accepted only in terms of low heating value.

S. G.3
Student Award Entry

(Virtual)

Biogas Generation from the High-Strength Fresh Leachate using Anaerobic Continuous Stirred-tank Reactor

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Lab-scale anaerobic continuous stirred-tank reactor (CSTR) treating fresh leachate from solid waste transfer station was operated by varying organic loading rate (OLR) from 1 to 20 kg.COD/ m^3. The fresh leachate contains chemical oxygen demand (COD) of 100,184 mg/l, BOD5 of 71,000 mg/l., and pH of 3.00-4.36. During the operation of CSTR, organic (COD) removal efficiency was 75-80%. When OLR increased to 15 kg.COD/m^3, the presence of volatile fatty acid (TVA) became unstable. The organic content in sludge was found varied in the range of 0.45-0.75. Average biogas production in the CSTR was 58.55 L/d with highest methane content of 68 % achieved at an OLR of 10 kg.COD/m^3. This study demonstrates a possibility of treating high-strength fresh leachate in single-stage CSTR for energy recovery.

S. G.4
Student Award Entry

A Bibliometric Analysis of Methane Emission from Waste Management between Developing Countries and Developed Countries

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Waste management is a critical problem in developing countries with limited resources, technological adoption and public awareness. An increasing in consumption also generated the amount of waste that affected greenhouse gas emissions, especially methane in both industrial sector and household sector. This paper systematically analyzed the differences in methane emission control between developing countries and developed countries by using VOSviewer software. A quantitative analysis tool was applied to identify keywords from an article published from 2000 to 2022 in the Scopus database. Those articles relevant to the existing problem presents the challenges in diverse areas related to urban development. Our finding reveals that the most significant gap in waste management between developing countries and developed countries is the policy implementation process. Thus, to follow the gas emission reduction strategy should focus on an integrated data management and the clear stakeholder responsibility to ensure the appropriate decision-making process for sustainable development.

S. G.5
Student Award Entry
(Virtual)

The Situation of RDF Utilization in the Cement Industry in Thailand

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Thailand still faces problems with municipal solid waste (MSW) management. No law enforcement about waste sorting from waste generators affects the contamination of contrary objects in the waste stream. Due to a high proportion of organic waste, mixed waste has high moisture and chloride content, considerable obstacles in the recycling and waste-to-energy businesses. Although refuse-derived fuel (RDF) production to use as a source of fuel for heat and electricity generations is one of the best-available solutions to handle this waste crisis, many factors still disrupt the operation. That is why

landfilling is ordinarily used as a waste disposal method. The total RDF usage volume in the cement industry in Thailand is approximately 0.4 million tons per year. The substitution rate is less than 20%. It is quite a few compared with MSW volume and the substitution rate in other cement plants in foreign countries. This study compiled documents and focus group interviews on reviewing the current situation in the MSW supply chain. The results illustrate the problems which need to be solved through the chain. People, as the waste generator, have to sort the waste. The government should impel a policy about waste-to-energy, primarily supporting the private sector to play a more significant role. Moreover, with cost-effectiveness, RDF production and quality improvement technology must be developed to meet cement plants' RDF quality standards. The new RDF products with higher quality, such as low chloride and small size RDF, should be developed to consume RDF in larger quantities. Finally, cement plants as the user need to invest in supporting technology to increase usage volumes, such as chloride by-pass and mechanical feeding systems. In addition, using RDF at other burning points in cement kilns is one of the most exciting issues that cement plants should not be overlooked.

S. G.6 **Plastic Recycling in Pakistan and Japan – Learning for Leapfrogging**

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Plastic production is continuously increasing worldwide, and so is plastic waste. Therefore, plastic pollution control became a global concern, especially United Nations Environment Assembly (UNEA) Resolution leading to a global instrument involving many countries to revisit their plastic waste management systems and address the leakages across the value chain. Pakistan also joined the initiative of the World Economic Forum to combat plastic pollution and is on the way to developing its first National Plastic Action Plan (NPAP). One of the easiest ways to fight against the plastic waste issue is recycling already existing plastics. Japan is also working to fight against plastic waste issues. This paper evaluates various aspects of plastic generation and its recycling in Pakistan and compares the results with Japan. The data for this research was collected through various sources such as plastic recyclers, solid waste management experts, existing online databases, consultants, engineers, academic experts, etc., through interviews, questionnaires, and field visits. Through this assessment, the paper identifies the potential challenges and drivers in both countries as some of the drivers in one country may help other countries overcome their challenges, improve plastic waste management/recycling situation, and support a circular economy.

S. G.7   **The Reuse Method of Waste Tyre Textile Fibers for Sound Absorption Applications**

Ružickij Robert, Vasarevičius Saulius, Januševičius Tomas , and Grubliauskas Raimondas
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Interest in recycled materials and their use has become very significant in recent years. The tyre recycling process is well known and developed. End-of-life tyre rubber has already been successfully recycled in asphalt, playground surfaces, etc. Waste Tyre Textile Fibre (WTTF) is a byproduct of the tyre recycling process. This paper proposes WTTF applications for sound absorption. In this study, three different types of WTTF samples that are characterized by rubber remains were tested. Rubber particles for acoustics applications are considered impurities due to the negative effect on sound absorption. The first samples used for tests had up to 10% remains (WTTF10), the second had up to 54% remains (WTTF54) and the third had up to 70% remains of total mass. Sound absorption tests were performed according to the ISO 10534-2 standard. The average sound absorption coefficient α of WTTF10 (α avg.in the frequency range 160–5000 Hz) was up to 0.64. With increasing thickness of the sample, the average sound absorption coefficient increases. WTTF54 and WTTF70 showed lower results in smaller thicknesses; however, at 60 mm thickness all samples ranged from 0.61 to 0.64. This study aims to propose new material for sound absorption applications.

S. G.8   **Electricity Generation using Organic Waste as the Feed in Microbial Fuel Cells**

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Microbial Fuel Cells have the potential to simultaneously treat organic waste and produce direct electricity in a renewable form. The key parameters of organic waste including particle size, moisture content, and C/N ratio play a significant role in the power generation of microbial fuel cells (MFCs). In this study, these key parameters were tested by changing their properties with food waste as the organic feed. The activated sludge was collected from UASB at Pathum Thani brewery co. Ltd and the food waste were collected from the AIT campus canteen. The food waste with particle sizes of 3mm, 1mm, and <1mm were studied in an MFC with a membrane whereas in a membrane-less MFC particle sizes of 3mm and 1mm were studied. Similarly, the moisture content of the food waste was tested in the range of 70%, 80%, and 90%. Different C/N ratios such as 30, 45, and 20 were also studied for power generation. the membrane-less MFC with a 1mm particle size showed greater voltage when compared with the membrane-less MFC with a 3mm

particle size. But looking at the overall picture the voltage generation from Membrane-less MFC is less when compared to MFC with a membrane. In MFC with membrane the particle size with <1mm showed the maximum voltage and power density reaching up to 0.72 V and 72.51 W/m3, then followed by 1mm and 3mm particle size with a maximum voltage and power density of 0.69 V and 51.94 W/m3, 0.52 V and 41.74 W/m3 respectively. The moisture content of 70%, 80%, and 90% was studied in an MFC reactor with the membrane in duplications. The feed with 90% of moisture content showed the highest voltage reaching up to 0.92 V, followed by 0.75 V and 0.69 V for 80% and 70% respectively. Likewise, the C/N ratio of 30 showed the highest voltage and power density compared to other C/N ratios.

Session H: Carbon Neutral Society
Time: 15:15 – 17:15
Room Assignment: Oriental Palm I

S. H.1

Student Award Entry

(Virtual)

Transition of Thailand's Power Sector toward Carbon Neutrality 2050

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The Paris Agreement sets out a global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C. To limit global warming to 1.5 degrees Celsius, carbon neutrality becomes a challenge issue worldwide. In 2021, Thailand's Prime Minister pledged at COP26 in Glasgow that Thailand aims at carbon neutrality by 2050, and net zero emissions by 2065. The CO_2 emission reduction in the power sector is a significant issue to develop a decarbonized power system. The objective of this study is to analyze energy system in Thailand's power sector toward carbon neutrality 2050 by using Thailand AIM/Enduse model. This study formulates business-as-usual (BAU) and three different carbon neutrality scenarios (CN2050). These CN2050 scenarios are formulated within Thailand context by considering the global CO_2 emission trajectories obtained from the integrated assessment models (IAMs) under the different Shared Socioeconomic Pathways (SSPs), namely SSP1, SSP2 and SSP4 scenarios for the representative concentration pathway (RCP) of 1.9 watts W/m^2. Most of the CO_2 emissions in the energy sector are contributed by the fossil fuel combustion for electricity generation. The power sector contributed more than 40% of the CO_2 emission in the energy sector. The CO_2 emissions in the power sector are found increasing from 93 MtCO$_2$ in 2010 to 142 MtCO$_2$ in 2030 and 223 MtCO$_2$ in 2050 in the BAU scenario, with AAGR of 2.2% annually. To achieve the carbon neutrality target, the decarbonization in the

power generation are the main pillar to reduce the CO_2 emission. The CO_2 emissions in the power sector are estimated to be reduced by 53%-89% in the power generation are the main pillar to reduce the CO_2 emission. The CO_2 emissions in the power sector are estimated to be reduced by 53%-89% in the CN2050 in 2030 compared to the BAU scenario. In 2050, the CO_2 emissions in the power sector are estimated to be zero in the CN2050 scenario. The improvement of energy efficiency, the penetration of renewable energies, and carbon capture and storage (CCS) deployment including fossil fuel based with both CCS and bioenergy with CCS provide a positive effect on CO_2 emissions reduction over the period 2010-2050.

S. H.2   **Reviewing and Comparing International Best Practices in Carbon Neutral Planning for Thailand Power Sector**

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In the COP26 at Glasgow on 1st November 2021, the Prime Minister of Thailand announced to increase the NDC plan up to 40% from Business-as-Usual (BAU) to reach carbon neutrality by 2050 is an ambitious reduction target for this country. Therefore, this study aims to find the best practice in carbon-neutral planning for Thailand's power sector from international experiences through their communication of long-term strategy submissions. Fifteen countries are selected to be investigated and compared in their planning, specifically in the power sector. As a result, there are four key lessons from the reviewed countries. First, the decarbonization of electricity needs to be targeted by 2035 to support their carbon neutrality goal. Second, Renewable Energy (RE) needs to be set as the main power source in their power generation mix. Third, other sectors (e.g., transport, industrial and building) will be transformed by using electricity instead of fossil fuel. Forth, existing power plants with carbon capture storage (CCS) and other alternative technologies (e.g., energy storage, clean hydrogen, and smart grid) will be integrated to ensure energy security in the power system. Consequently, these key lessons will be adapted using SWOT analysis to propose Thailand's power sector pathway for achieving carbon neutrality by 2050.

S. H.3
(Virtual)

Predicting the Performance of Offshore Wind Farm Using Artificial Intelligence

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As the wind power industry continues to expand, grid presence of wind energy has significantly increased in the recent years. Short-term wind power predictions are becoming increasingly relevant because of the increasing penetration of wind power and the unpredictability in wind-electric generation caused by the fluctuating nature of wind. Physical approach, which combines Numerical Weather Predictions with wind farm performance models, are predominantly used in such forecasting systems. In this paper, the application of Artificial Intelligence in developing simple wind farm performance models, with the case of an offshore wind farm is demonstrated. Machine learning methods based on Artificial Neural Network, Support vector Machine, K-Nearest Neighbor and Random Forest are developed for predicting the power output from 40 turbines in the wind farm. With the minimum required inputs, these simplified models could perform well in estimating the wind farm performance.

S. H.4
(Virtual)

Opportunities of Carbon Capture and Utilization in Thailand's Industries Toward Carbon Neutrality 2050

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The Carbon Capture and Utilization (CCU) is one of the plausible mitigation technologies, expected to support the limiting global warming temperature. Conceptually, carbon is captured from the emission sources, especially from the power plants and industries. A few amounts of captured CO_2 can be recycled or utilized in many industrial processes by converting it into products and services instead of storing. The objective of this paper is to review and propose the opportunities of the implementation of CCU in Thailand's industries. The results indicate that four main industries have high opportunity in CO_2 utilization. For instance, in the chemical industry, the captured CO_2 can be utilized to produce olefin, polymer, and methanol, used as raw materials producing, i.e., fiber, plastic, elastomers, wood enamel, paints, drugs, etc. For the cement industry, the captured CO_2 can be transformed into calcium or magnesium carbonates, which are the raw material used to produce the

construction materials. The captured CO_2 can be used as a solvent instead of water in the dyed fabric or textile industry. Lastly, it could be one of the natural refrigerants in cooling systems, replacing hydrofluorocarbons (HFCs).

S. H.5   **Exploring Different Level of Citizens' Participation on Learning City Building**

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Globally, most of the world's population lives in cities (3.5 billion people) and tend to increase to 5 billion by 2030. With rapid pace of urbanization, it leads our society to face countless challenges, including the impact of quality education for all. Thus, Learning City promotes lifelong learning that offers the foundation for sustainable development and enhances equality of education. One of a key approach for establishment of a learning city was "public participation". Since it can sustain the process of building a learning city which requires enthusiasm, involvement, participation and commitment. Therefore, this research aims to study the relationship between the participation of citizens and activities engagement for building a learning city. Data was employed based on a face-to-face questionnaire survey with 400 sets and was performed from December 2021 to February 2022 by distributing questionnaires among people in Thanyaburi district, Pathum Thani province. Chi-squares analysis was applied to analyze the relationship between citizens' participation and their experience in joining local activities within the study area. The result presented that the importance of promoting the process of public participation. With more participation processes, it can help in promoting social learning among citizens, thereby underlining the creating perception through mutual learning and improve sense of community to a sustainability transformation.

S. H.6
Student Award Entry

Laboratory Testing and Investigation of TEG Cookstoves and Study of its Performance

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In this paper, tests using eucalyptus fuelwood are used to evaluate TEG cookstoves. The WBT 2.2.3 and ISO 19867-1 laboratory testing protocols were used to evaluate the performance of the stove, and CO and CO2 emissions were monitored to obtain the values of modified combustion efficiency. Thermal efficiency, firepower, specific fuel consumption, turndown ratio, and specific

energy consumption were used to examine the results. It was discovered that the WBT experiment produced thermal efficiency in the range of 15 to 24 percent while the ISO procedure testing produced a result of 15.23 percent. The experimental data on fuel burning rate, specific fuel burned, firepower, and total energy consumed revealed that the cold start phase of the trial had the lowest fuel burning rate, efficiency, and firepower due to the time it took to start the TEG fan in the cookstove. While the turndown ratio was between 0.8 and 1.5, the simmering phase lasted roughly 2-3 times longer than the hot-start phase. Thus, it was determined that higher power output, or the inability to "turn down," the stove power, was the cause of lower thermal efficiency and higher specific fuel consumption. When CO2 emissions predominated the study also observed high modified combustion efficiency. Due to smouldering combustion, which decreased combustion efficiency, CO became more dominating. As a result, a considerably superior MCE was discovered during simmering tests than during high power tests since the combustion chamber's air flow was adequate to burn the available gases. In addition, the conduction heat transfer originating from the stove was measured using thermocouples of the k type at three different points: the gap between the cooking pot and the stove, the exterior surface of the stove, and the temperature in the pot when the WBT was being performed. It was clear from the findings that the area of the outer surface wall of the cookstove saw the least amount of heat loss from the stove. On the other hand, the temperature difference between the cooking pot and the stove was observed to be the highest, indicating major areas of heat loss potential at such points.

S. H.7
(Virtual)

Life Cycle Assessment of Concrete Manufacturing for Sustainable Production in India

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Concrete is the most widely used material globally and demand for concrete is increasing in developing countries. The consumption rate is estimated to be 25-30 gigatonnes per year. The present study aims to assess the environmental impacts due to the production of concrete in India. In this study, the reduction in impacts is also calculated considering different scenarios specific to India. The impacts were evaluated for 100 m^3 of concrete production. A total of five impact categories were considered and four scenarios were accounted for estimating the impacts reduction. The scope included material phase, production phase and end-of-life phases while use phase was not considered. Cement contributed the highest (89%) to the overall environmental impacts due to concrete production in India. The study found that the existing baseline scenario (S1) was the second most least preferred and the scenario (S2) considering the dismantling and recycling was the least preferred having the highest environmental impacts. The scenario (S4) considering the use of renewable energy had the least impacts on the environment and offered about 9% of impacts reduction in comparison to existing baseline scenario (S1). This study

will help the decision makers and construction companies to reduce the environmental footprint of concrete production.

S. H.8
(Virtual)

A Review of Market Clearing Mechanisms in Peer-to-Peer Energy Trading Market

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The P2P energy trading concept is very important for incentivizing the household level to install more solar PV systems through the benefits of higher selling prices than the buyback rate or the wholesale rate. Not only the sellers, but the buyers, who participate in the market, can also buy the electricity at cheaper than the retail rate. At the country level, it can also gain benefits from this scenario as higher energy security and a cleaner environment. One of the key factors that directly relate to the benefits of participants is a market clearing mechanism. MCP and MCQ are determined differently in each mechanism. Hence, this paper presents the concept of eight reviewed mechanisms: simple auction- less, auction-less with normalized sorting metric, simple auction, uniform-price auction, double-auction with average, Vickrey auction, pay-as-bid-auction, and generalized second-price auction. Some of these mechanisms can be applied to different market properties leading to different definitions for MCP and MCQ. Finally, the comparative study on different reviewed mechanisms has been discussed for related reasons.

Session I: Energy in Buildings
Time: 09:00 – 10:30 noon
Room Assignment: Marine Ballroom 1

S. I.1

Impact of Sky Terrace Locations on Pedestrian Ventilation and Air Quality in High-Density Areas using CFD Simulation

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Urban ventilation significantly alleviates heat accumulation, removes air pollution, and provides outdoor thermal comfort for pedestrians in cities. Due to urbanization, a high density of building clusters can block wind flows and decrease wind velocity in the city's inner areas, which leads to uncomfortable

conditions and poor air quality. Several urban morphology designs, including increasing open space and reducing the building height and degree of enclosure, could promote natural ventilation for pedestrians in urban areas. However, with the high demand for land and property prices in high-density and compact cities, such design features might not be suitable. Building permeability via sky terraces has been implemented in Hong Kong and Singapore to promote urban ventilation in high-density areas. However, there is little research on how the sky terrace locations and their application in multiple buildings could affect pedestrian wind comfort and air quality. This study investigated the effect of sky terraces of three different heights on improving air ventilation and air pollution dispersion in the central business area of Bangkok, Thailand. The wind environment and age of air were investigated using computational fluid dynamics (CFD) simulation. The results showed that the sky terraces significantly improved the air quality at the pedestrian level, and more areas had higher wind speeds and achieved wind comfort conditions. Lower-level sky terraces impacted the pedestrian wind environment more than upper-level ones. Accelerated wind passage through the bottom-level sky terraces could change local wind patterns, reducing pedestrian wind speed and comfort in some areas. The current study introduces the potential benefits and limited applications of sky terraces in a cluster of high-rise buildings to improve urban ventilation performance in a high-density area.

S. I.2
Student Award Entry

Energy Performance and Thermal Comfort in a Library Building: A Case Study of Dhurakij Pundit University, Thailand

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The building sector represents high potential to address the energy use and occupants' comfort and well-being. This paper aims to proposed a methodological framework to assess energy and thermal comfort performance in buildings. The research framework was applied in an educational building using a library of Dhurakij Pundit University (DPU), Thailand as a case study. A representative building was modeled using SketchUp plugin with OpenStudio platform and EnergyPlus simulation engine for energy simulation. Thermal comfort parameters were measured in each floor of DPU's library and calculation of thermal comfort indices based on the PMV (Predicted Mean Vote) and PPD (Predicted Percentage Dissatisfied) using the CBE Thermal Comfort Tool. It was found that the simulated energy is in line with the measured data with differences between -0.26% to 3.87%, depending on the floor. The energy intensity of DPU's library is 66.53 kWh/m2/year. Based on

the measurements, the PMV and PPD of a reference building are -0.57 and 12%. Ten measures were simulated to assess the energy performance as well as thermal comfort conditions. It was found that seven measures can address both energy performance and thermal comfort in a case study building.

S. I.3
Student Award Entry

Catbalogan, Philippines, Sky City Mega Project Potential Environmental and Operational Challenges

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The need to expand is paramount to an increasing population and improving economy. The said expansion however is challenged with the increasing threat of climate change. Every solution produces another set of issues that contributes to the climate change it ought to respond. A mountain-top development is currently on its way in Catbalogan City, Philippines packaged as a climate-change adaptation project. Using and a narrative literature review and interview of key informants, the case of Catbalogan Sky City Mega Project (CSCMP) was presented. It identifies several issues that must be considered in the designing of the project. At least six operational concerns were identified as well as the environmental issues that it carries. The CSCMP will definitely avoid sea level rise and storm surge but is expected to face water supply production challenges, stronger typhoon winds due to its location, slope instability, and mobility issues and will produce more carbon footprint. On the other hand, the old city is expected to receive more runoff water and excessive soil erosion specifically during development phase increasing flood risk in the old city. The issues identified are interrelated which requires holistic and science-based approaches to address or manage the problems.

S. I.4
Student Award Entry

Methodology for Integrated Building Energy Modeling and Impact Assessment of Urban Energy System Scenarios

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Local governments require new techniques and innovative approaches to assess initiatives to support the transition towards carbon neutrality. This paper presents a methodological approach for integrated building energy modeling and analysis of the impacts of energy conservation measures (ECMs) and energy-related CO_2 emissions in urban areas. To accomplish this goal, the proposed methodology follows four steps: (1) developing a building stock model for urban databases using a geographic information system (GIS)

and QGIS software; (2) creating a detailed archetype-based building stock model using OpenStudio and EnergyPlus; (3) carrying out a scenario analysis of possible ECMs and pathways to achieve carbon neutrality; and (4) analyzing energy savings and energy-related CO_2 emissions. The developed methodology was applied to a tourism urban area, using Pattaya city as a case study. Based on the GIS building model, six archetypes were identified from all residential buildings, including hotels located in the study area. Prototypes of representative building energy models were simulated for a reference case with four ECMs. The results indicated that the building stock in the reference case used 497,669.05 TJ annually and emitted 80,470.32 ktCO2eq. Of the four ECMs, a change to double glazing with low-E coating gave the highest energy savings and reductions in CO_2 emissions. This measure led to energy savings of 9,342.82 TJ and emission reductions of 356.23 ktCO2eq compared to the reference case. Local governments and stakeholders can benefit from the proposed methodological approach for decision making related to energy and carbon neutrality pathways.

S. I.5
(Virtual)

Numerical Detection Method of Faulty Valve Inducing Water Hammer Within Long-Distance District Heating Pipeline

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The district heating (DH) system is an important infrastructure in modern cities and plays an important role in maintaining the temperature of living environment in winter. In recent years, the improvement of air quality and the reduction of carbon emissions have attracted extensive attention. With the advantages of environmental friendliness and strong heating transmission capacity, the long-distance district heating pipeline (LDHP) systems are currently widely used and planned in China, and are extensively concerned in academia and industry. The valve-induced water hammer caused by valve failure or personnel mis-operation will cause large fluctuations of pressure, and even result in the pipeline rupture of the LDHP. Quickly and accurately determining the position and status of the faulty valve is a necessary measure for the efficient repair and adjustment of hydraulic state. In this work, combining the hydraulic transient model based on distributed parameter method with the particle swarm optimization algorithm, a fast and accurate method is proposed to identify the position and opening of faulty valves inducing water hammer within LDHP. The effectiveness of the faulty valve detection algorithm is verified on a 20 km LDHP system, and the effects of the sensor sampling error and period on the robustness of the algorithm are further investigated. The results show that when the sampling period is less than 10 s, the relative errors of the detected position and opening of the faulty

valve are less than 8% and 0.1%, respectively. The faulty valve inducing water hammer on the LDHP can be effectively detected based on the method proposed in this paper. Our research is conducive to timely processing of faulty valves and regulating hydraulic conditions, which is of great significance for ensuring the stability and safety of the heating system.

Session J: Microgrids
Time: 9:30 – 10:30
Room Assignment: Oriental Palm I

S. J.1 **Optimal Costing of Power Generation in Microgrid Using Particle Swarm Optimization**

Ashok Kumar Loganathan, Sampathraja Natarajan, and Veeramanikandan C
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An essential method for assessing the effectiveness of microgrid (MG) operations and sizing is economic analysis. The most cost-effective operation and sizing of an MG necessitate the use of optimization techniques. MGs are optimized using a variety of methodologies, including gradient based and non-gradient-based algorithms. Particle swarm optimization (PSO) is a non-gradient-based evolutionary algorithm used for cost optimization due to its high performance and ease of implementation. Regarding microgrid operations and sizing, the effectiveness of several economic models based on PSO is discussed in this paper. A 10-kW generator system is a part of this system. It is divided into two generation units: one that produces PV power and the other that produces wind power. There are 5 kW in each generation system. These are coupled to the DC micro grid. The cost function and the constraints of the microgrid are described and its performance is analyzed using particle swarm optimization (PSO) algorithm. The convergence graphs for the cost optimization of microgrid using PSO algorithm is presented in this paper. The simulation results of the system shows that the loss of load probability (LSPS) is around 1 % and the cost of energy (COE) is 6.03 $. The computation time required to run the algorithm is 0.30 seconds. An essential method for assessing the effectiveness of microgrid (MG) operations and sizing is economic analysis. The most cost-effective operation and sizing of an MG necessitate the use of optimization techniques. MGs arefor the cost optimization of microgrid using PSO algorithm is presented in this paper. The simulation results of the system shows that the loss of load probability (LSPS) is around 1 % and the cost of energy (COE) is 6.03 $. The computation time required to run the algorithm is 0.30 seconds

S. J.2

(Virtual)

Hybrid Microgrid Optimization for Smart City Planning on Saint Martin's Island in Bangladesh

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The Saint Martin is a popular tourist destination and only the coral island in Bangladesh. A huge number of travelers visit from home and abroad. However, severe electricity shortages are hindering its transformation towards a smart city. The existing ground mounted solar PV and diesel generator is insufficient to meet the rising load demand, causing visitor dissatisfaction. The ocean wave converter can extract a significant portion of energy from the surrounding Bay of Bengal that has not yet been analyzed. This study proposes a grid independent microgrid energy management planning addressing Sustainable Development Goal 7 (SDG7). The energy demand is estimated under smart city context. The HOMER software optimizes four distinct microgrid topologies, comprising of ground PV (GPV), floating PV (FPV), wind turbine generator (WTG), bio-diesel generator (BDG), eco wave power (EWP), bidirectional converter (BDC), first life battery (FLB) and second life battery (SLB). The results shows that the GPV/FPV/WTG/EWP/BDG/BDC/SLB hybrid architecture is most favorable configuration achieving SDG 7. This topology is affordable, reliable and sustainable for the remote area. The sensitivity analysis is also performed. Overall, the work provides policymakers the multidisciplinary expertise needed to transform a small island towards a tourist-intensive smart city using local energy resources while also ensuring decent lifestyle for islanders.

S. J.3

Student Award Entry

Synchrophasor Big Data Architectures, Platforms and Applications: A Review

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The world is moving towards an era of data driven analytics and decision making. Concurrently, the electrical power industry is moving towards a data driven analytical environment from a model driven analytical environment. Electrical power industry utilizes different types of data. Synchrophasor data is one of the main data types associated with many of the power system applications. However, with the expansion of Phasor Measurement Units (PMU) networks, the synchrophasor data is becoming a Big Data (BD) issue. Therefore, many researchers have drawn their attention on synchrophasor big data handling and utilization. This paper briefly discusses power system BD architectures and standard architectures available in real-world applications. The goals of this paper are to make a review of existing BD architectures and commercially available platforms for synchrophasor applications; to do a

comparative analysis of existing BD architectures; and to do a review of the existing applications and the compatibility these applications with the existing BD platforms.

S. J.4 **Fault Detection and Segmentation in Medium Voltage AC Microgrid by Using Differential Protection Principle**

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A microgrid is composed of a variety of energy components: distributed generators (DG), especially renewable energy and energy storage systems. Integration of DGs can significantly improve the power system's reliability, reducing the power outage duration. A distribution medium voltage (MV) system without DGs is essentially a single-point feeding source network, with overcurrent relays frequently employed to detect a fault. Overcurrent relays operate as primary and backup protection with current-graded time in a typical radial distribution network protection method. On the other hand, the protection aspect becomes one of major issues when DGs are integrated into the power system. In a microgrid, the fault current characteristic differs in isolated and grid-connected modes due to differences in power network topology, making the microgrid protection approach more difficult. The protection strategy in the microgrid should be designed to provide optimal protection to the component and the DGs based on the location of the fault occurrence, bidirectional power flow, change in voltage profile, location of DGs, type of DGs such as synchronous or inverter based DGs and uncertainty in the DGs. Therefore, this paper addresses the challenges of microgrid protection by proposing a methodology to detect and segment the fault area based on the differential protection principle. The performance of the proposed method is assessed by DIgSILENT PowerFactory simulation. The simulation results show that the differential protection-based method is able to detect and isolate the fault incident as smallest as possible.

Session K: Environmental Management
Time: 10:45 – 12:15
Room Assignment: Marine Ballroom 1

S. K.1
Student Award Entry

Spatial Multicriteria Evaluation for Future Urban Growth in Bangkok Metropolitan Region: BMR

Apinya Padon[1], Pawinee Iamtrakul[2], Rungroj Jintamethasawat[2], and Jirawan Klaylee[1]
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Urbanization has become a phenomenon that affects numerous significant social and environmental problems in several megacities. The cause of the pain varies according to spatial context, especially in developing countries like Thailand. Many studies have focused on urban growth issues to identify the expansion situation among distinct typologies of the metropolitan area resulting in subsequent problems, e.g., environmental, social and economic problems. This study attempted to apply an Analytical Hierarchy Process (AHP) to perform the geospatial analysis and tackle the growth pattern of the Bangkok Metropolitan Region, BMR, by assessing the city's quality and setting goals to achieve the objectives of future sustainable development. The sustainability assessment of the city is based on three pillars economic, social, and environmental aspects. Finally, the impacts on urban development can be identified to enhance the quality of the city in conjunction with a sustainable plan for future urban development.

S. K.2
Student Award Entry

(Virtual)

Innovareef Concept for Recovery and Rehabilitation of Coral Reef Ecosystems

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Innovareef is an innovative design concept to make the world's marine conservation approach balanced, harmonious, and sustainable. The coral reef degradation problem does not just happen in Thailand but around the world; it is intensified and widespread. If such a situation continues without correction or solution, corals will be depleted from the sea. In the past, several agencies have attempted to fix this problem by restoring coral reefs in different ways. Accordingly, one of the common solutions is to use discontinued materials, such as motorcycles, tanks, tires, PVC pipes, or square cement bars, as artificial corals. However, these materials have become visual pollution and

may contain environmental toxins. With such a problem, design and traditional materials need an innovation to increase their efficiency and have good visuals. Leading to the development of Innovareef, a new model of artificial coral reef and product creation was designed based on new product developments and in-depth interview data collection from specialists. This model aims to guide product developments with natural beauty to fix visual pollution and reduce the burden of coral reefs in marine tourism.

S. K.3
Student Award Entry

The Water-Energy Nexus of Urban Services in a Tourism City: The Case of Pattaya City

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Urban services, such as water and energy resources, are usually consumed more in a tourism city, than in other city types. The water-energy nexus also contributes to the CO_2 emissions from urban areas. The purpose of this research is to investigate the link between water distribution systems, electricity consumption, and energy-related CO_2 emissions from water networks in Pattaya city, Thailand. These networks operate under the Provincial Waterworks Authority (PWA). The water distribution system was modeled in EPANET software, to simulate and examine the water supply capacity in the service pipes, to ensure that it meets the requirement set by PWA. Data were collected from PWA, in terms of the pressure and flow rate of the water supply and the amount of electricity consumption. The current water distribution system consists of 18 junctions, a with flow rate of 1,000 m^3 /hour and pressure at 45 m. The electricity consumption is 720 kWh/day and energy-related CO_2 emissions are 419.11 kgCO2eq/day. The water distribution system was modeled and analyzed to find the optimum flow rate and pressure for the least electricity consumption. The results show that the optimum solution is the flow rate of 1,500 m^3/hour and a pressure at 50 m. Consequently, the electricity consumption is 300 kWh/day, while CO_2 emissions are reduced to 174.63 kgCO2eq/day. The findings from this study would benefit the PWA by reducing the electricity consumption and CO_2 emissions equivalent to 109 MWh/year and 63.73 tCO2eq, respectively.

S. K.4

(Virtual)

Watershed environmental management based on SWAT modeling approach and its application in Jiulong River basin of China

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Water is the origin of life and an important resource of a country. Fujian Province of China has a large total amount of water resources, but with the development of the country and the increase in population, environmental pollution in the river basin has become more and more serious, and the ecosystem and the safety of drinking water for residents are facing serious threats. Jiulong River is the second largest river in Fujian province of China and located in the north semitropical zone. The Jiulong River is one of the most developed areas in Fujian Province and includes livestock breeding and agriculture, making it the major contributor of nutrients to Xiamen Bay. Also the Jiulong River is a significant source of water for drinking, irrigation and industrial use. This study selects the North River basin (Jiulong River) in China as the study area. Establish the SWAT model of the North River basin (Jiulong River) by investigating and collecting relevant data. Calibrate and validate the model by measured data, simulate the migration and transformation process of non-point source pollution loads in the North River basin (Jiulong River). Analyze the transport law of non-point source pollution, identify key pollutants and polluted areas. Combining the simulation results and local development models, it provides a data-supported reference in the future resource planning and protection of the river basin.

S. K.5

Spatial Configuration of Carbon Emission in Suburban Area Based on Trend Analysis: A Case Study of Pathumthani Province

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Sustainable development has become a key challenge for urban analysts and policy planners to achieve sustainable development. Energy and carbon emission issues from urban metabolism could be undermined towards the urban environmental quality which causes an incremental impact on society. Predicting the slow-onset impacts of environmental degradation requires several urban datasets which has been challenging in the practical analytical process due to data availability and analysis methodology. However, the emergence of open data in the current situation can leverage data usersto access, explore the urban situation and apply for multi-scenario analyses.

Therefore, this study aims to estimate carbon emissions in suburban areas (Pathumthani province, Thailand) based on open-source- spatial-related data. There are three objectives of this study which include: (1) to collect and construct a spatial database that is necessitate in calculating carbon emission per capita, (2) to quantify spatial carbon emission based on spatial population database by using trend analysis, and (3) to state future challenges of carbon emission in suburban area. Pathum Thani was selected as an extension area of the Bangkok Metropolitan Area with diverse types of land use planning (e.g., residential, industrial, and educational areas). Toward the data gathering process, this study applies secondary data and satellite data incorporated with a parameter of carbon emission for the determination procedure. Spatial trend analysis based on Geographic Information System (GIS) was applied in this study. After the spatial calculation step, the validation process was performed by checking satellite land-use changes based on the analytical timeframe. The crucial result showed that the quantity of carbon emission in Pathum Thani province is gradually increasing due to demography changes and the varying land classification. The contribution of this study can be represented as an effort to construct an urban database based on the open-data source, which can draw attention among all stakeholders of urban development to propose the proper urban planning to reach the successfulness of sustainable urban development.

S. K.6
(Virtual)

Do Innovation Preferences Affect Wind Energy Perception? A Choice Experiment Approach in Southern Italy

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Wind energy technology is a clean energy innovation within the current energy market and plays an essential role to combat climate change, promote economic competitiveness, and achieve global energy security. The goal of this paper is preferences understanding of public acceptance for wind energy and their incidence on public well-being. It focuses on three aims: recognize public perception of wind energy attributes with Choice Experiments (CEs) application; investigate consumers' attitude to innovate using the innovativeness scales; understand the potential relationship occurring between wind energy perception clusters of innovators. Innovativeness scales are applied for the first time within CEs to identify the potential relationship occurring between the attributes' trade-offs of wind energy perception according to clusters of innovators.

Session L: Renewable Energy
Time: 10:45 – 12:00 noon
Room Assignment: Oriental Palm 1

S. L.1   **Experimental Investigation on the Performance of a Hybrid Hydrokinetic Turbine having Straight-Bladed Darrieus Rotor and Helical-Bladed Savonius Rotor**

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Hydrokinetic turbine is used to harness the kinetic energy of water stream and can be employed for rivers and canals applications. A hybrid hydrokinetic turbine works on the basis of hybrid force (lift force and drag force). It can be Different configurations of hybrid hydrokinetic turbine rotor having straight-bladed Darrieus rotor and helical-bladed Savonius rotor have been modelled under the present study. An experimental study has been carried out to determine the torque developed by different configurations of hybrid hydrokinetic rotors and presented in this paper. The study was carried out for different Reynolds numbers of 1.35×10^5, 2.24×10^5 and 3.14×10^5 corresponding to different water velocities. Based on the experimental study, it is found that the hybrid hydrokinetic turbine rotor having a Savonius helical blade angle of 0^0, performed better in comparison to other configurations. The maximum average torque is observed as 0.36 for a hybrid water turbine rotor having Savonius helical angle of 0^0 corresponding to TSR value of 0.61 and Reynolds number of 1.35×10^5. The results of this study may be useful to develop a prototype for field study.

S. L.2
Student Award Entry

(Virtual)

Vortex Characteristic of The Conical Basin for Gravitational Vortex Water Turbine (GVWT)

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The evolution of hydropower technology towards the development of low head technology. The emergence of the Gravitational Vortex Water Turbine (GVWT) seems to be a promising technology due to its easy operation and maintenance. The energy extraction of GVWT depends on the vortex formation in the basin. This work analyzes the character of the vortex in the GVWT basin through CFD simulation, validated by experimental results. The structure of the vortex, velocity profile, velocity contour, and pressure contour are deeply analyzed to gain information used in GVWT runner design and installation. The simulation of the conical basin without a deflector shows that

the tangential and axial velocities increase with increasing depth. The increase of tangential velocity varies from 8 – 26% for every 10% increase in depth. Meanwhile, the increase of axial velocity is 37 – 83% for every 10% increase in depth. Both velocity components are prominent in the runner torque. The flow rate has a significant role in vortex height, air-core diameter, and velocity. The flow rate increment by approximately 46% can increase the vortex height and potential energy by 17%. Due to more water flowing, the air core tends to be smaller for a higher flow rate, reducing the cavitation risk. Furthermore, the velocity is enhanced by the higher flow rate, especially for radial and tangential components. The conical basin without a deflector has an asymmetric vortex. This characteristic leads to a strong vibration in the runner, causing mechanical problems. Hence, the deflector is utilized since it enhances the structure of the vortex. The deflector angle, known as the notch angle, is varied from 13˚ to 19˚. As it significantly increases the vortex height, the effective head and potential energy arise, followed by the decreasing of kinetic energy. Basin with a deflector produces an axisymmetric vortex and secondary flow. The highest tangential velocity is obtained at a notch angle of 19˚. It causes a smaller loss of kinetic energy, of approximately 30%, which is compensated by the increase in vortex height (approximately 56%). Hence, the use of a basin with a deflector in the GVWT is recommended to improve its performance.

S. L.3
Student Award Entry

(Virtual)

Innovative Process of Amorphous Cellulose – Graphene Oxide Hybrid Structure Bead
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Water contaminants are current urgency issues because they affect human health and water ecosystem. Those contaminants consist of heavy metals, microplastics, pesticides, antibiotics, dyes, bacteria, volatile organic compounds (VOCs) etc. Currently, activated carbon, carbon nanotube and zeolite-based materials are used to be water absorbents, but those adsorbents do not provide satisfied adsorption capacity and become toxic in long term. Nanocelluloses are green materials because they are biocompatible, biodegradable and renewable. Because of their unique properties, they are applicable in various fields such as chromatography, drug delivery system, food packaging, energy, water treatment etc. There are many types of nanocellulose such as cellulose nanofiber (CNF), nanocrystalline cellulose (CNC or NCC), cellulose acetate, bacteria cellulose (BC), regenerated or amorphous cellulose (RC or AC) and microcrystalline cellulose (MC). Among these nanocelluloses, NCC is the most popular for commercialization, but there is still required high cost to produce NCC. In

addition, NCC provides lower yield comparing to AC and these reasons made the researcher encompass to RC production. Once the researcher found the report described RC production methodology resulting to obtain 97% yield so that it triggered the researcher to research about RC production methodology aiming to obtain lean RC production process and a final product. However, RC is not efficiency enough to adsorb water contaminants by itself so that it must be combined with graphene oxide (GO) in which provides high adsorption capacity to enhance the adsorption property. Finally, the final product will be named as "Amorphous Cellulose-Graphene Oxide Hybrid Structure" or "ACGOHS". This research would contribute to both academic and practical contribution. To clarify, the lean methodology to produce ACGOHS will support for future scaling-up process which is process innovation, and the final product (ACGOHS) will be one of the water adsorbent alternatives which is product innovation.

S. L.4
(Virtual)

Assessment of Conventional Acid-Clay Method in Reclaiming Waste Crankcase Lubricating Oil in Ghana

Patrick Opoku-Mensah, James N. Gyamfi, Adjei Domfeh, Emmanuel Awarikabey and Emmanuela Kwao-Boateng
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Crankcase lubricating oil acts as a lubricating medium, reduces engine friction and wear and provides a heat transfer medium in the automobile engine. These functions are achieved through the unique properties of the base oil and additives that constitute the crankcase lubricating oil. Crankcase lubricating oil degrades with time as its additives deplete and become contaminated with engine wear materials. This renders the crankcase lubricating oil ineffective in performing its functions and must be replaced. The drained crankcase lubricating oil pollutes the environment and also depletes the scanty financial resources of a nation as it is imported into the country. The available options for managing waste crankcase lubricating oil includes recycling, energy recovery and disposal. A common Waste Crankcase Lubricating Oil (WCLO) recycling method is the conventional acid-clay method. In this study, an assessment of conventional acid-clay method was done to ascertain its potential to recycle WCLO. The properties of the recycled crankcase lubricating oil, a virgin crankcase lubricating oil and the WCLO were analyzed. The efficacy of the acid-clay process was determined from the analysis. The properties analyzed and compared included density or specific gravity, viscosity and viscosity index, flash point, neutralization number, water content and wear metal particles. The acid-clay method of recycling WCLO was observed to have a yield rate of 60%. The acid-clay method was found to improve density by 98.7%, viscosity at 40 0C by 97.6%, and at 100 0C by99.2%. Viscosity index was improved by 105.4 oC, while the flash point was improved by more than 100.0%. The conventional acid – clay method was able to remove 100% of water and wear metals from the WCLO. From the

results however, the method performed poorly in removing some contaminants as they mimic some of the additives in the oil. The conventional acid-clay method proved effective in recycling waste crankcase lubricating oil. The base oil produced can be fortified with appropriate additives and reused in vehicles. This prevents environmental pollution, reduces the depletion of fossil resources and save the country's foreign exchange used in importing the crude oil.

S. L.5

Single-Walled Carbon Nanotubes (SWCNTs) Nanoparticles for R134a and R152a Refrigerants Evaluating Thermophysical Properties and COP

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The advancement in nanorefrigerants has been remarkably expanded to improve the productivity of refrigeration systems. Nanorefrigerants represent outstanding thermal, rheological, and heat transfer properties. This conference paper describes the theoretical analysis of Single Walled Carbon Nanotubes (SWCNTs) nanoparticles for volume concentrations of 0.5, 1, 2, and 3 vol.% in R134a and R152a refrigerants to determine thermal conductivity, viscosity, Coefficient of Performance (COP), and energy savings. This paper concludes that the Coefficient of Performance is enhanced for both nanorefrigerants due to the remarkable thermal conductivity of nanoparticles. The R152a-based nanorefrigerants have shown a maximum coefficient of performance values than R134a-based nanorefrigerants. The maximum increment in Coefficient of Performance was reported about 1.43% for R152a-based nanorefrigerant as compared to the base refrigerant R152a. The results show an increment in thermal conductivity with increasing volume concentration with the maximum enhancement of 1.94% for 3 vol.%. The viscosity of nanorefrigerants increased with increasing volume concentration. The R152a-based nanorefrigerant reported minimal viscosity values than R134a-nanorefrigerant. The maximum annual energy savings with nanorefrigerants is reported for about 4819.08 kWh/year, which aids in achieving lower global warming emissions. To summarize, R152a-based nanorefrigerants in refrigeration applications are more promising to increase the performance and reduce the energy consumption than R134a due to their higher COP value and environmentally friendly nature

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Bangchak Corporation Public Company Limited, a Thai energy company engaging in business alongside social and environmental stewardship, aims to enhance national energy security with innovation-oriented businesses. This goal is to strengthen business continuity and develop sustainability for organization and Thai society.

Currently, the Company covers 5 main businesses from upstream to downstream, along with Bangchak Initiative and Innovation Center:

1. Natural Resources and Business Development explores and produces petroleum and innovation- oriented business to increase competitiveness for sustainable business growth.

2. Green Power Business produces electricity from eco-friendly energy to respond to the increase in global energy consumption and reduce climate change impacts.

3. Refinery and Trading Business Group - Bangchak is a complex refinery which refines crude oil and standardized finished oil through effective refining units.

4. Marketing Business Group sells standardized oil products which are environmentally friendly. In addition, non-oil businesses are integrated through modern service stations nationwide.

5. Bio-based Product Business vonducts bio-based product business including biodiesel and ethanol. This is to support farmers, preserve the environment and lower fuel imports.

6. Business Development and Innovation Business researches and develops innovative green products to be the leading Asian Greenovative Group.

SILVER SPONSOR

Electricity Generating Authority of Thailand (EGAT)

EGAT is Thailand's leading state-owned power utility under the Ministry of Energy, responsible for electric power generation and transmission for the whole country as well as bulk electric energy sales. We are the largest power producer in Thailand, owning and operating power plants of different types and sizes which are located in 45 sites across the country with a total installed capacity of 15,757.13 MW (as of March 2018). Our power generation facilities consists of 3 thermal power plants, 6 combined cycle power plants, 24 hydropower plants, 9 renewable energy plants, 4 diesel power plants, and Lamtakong Jolabha Vadhana Power Plant. We also own and operate a high voltage transmission network which covers all parts of the country. Under Thailand's electricity supply industry, EGAT purchases bulk electricity from private power producers and neighboring countries and sells wholesale electric energy to two distributing authorities and a small number of direct industrial customers as well as neighboring utilities.

EGAT also engages in energy-related services businesses and expands, through the EGAT Group, our business and investment in electricity and other energy-related businesses at home and abroad.

TECHNICAL TOUR

Chonburi Clean Energy Power Plant

The technical tour is held at the Chonburi Clean Energy (CCE) Power Plant located at WHA Chonburi Industrial Estate 1 in Chonburi province.

The power plant os a non-hazardous industrial waste to energy (incineration) facility with a capacity of 8.63 MW. CCE is a joint investment among Glow Energy, WHA Utilities and Power and SUEZ Group. CCE started its commercial operations on 7 November 2019.

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Attaining the goals of sustainable development is based on three interlinked criteria: economic development, social progress, and environmental protection. Development would be meaningless if it does not ensure a sustainable economic growth that guarantees future generations' ability to thrive and prosper without sacrificing the regenerative capacity of the environment. Economic activities always equate to environmental degradation and pollution, CO_2 and greenhouse gas emissions and consequently global warming and climate change consequences. Thus it is our generation's challenge to aim for a low-carbon based economic growth as it is the only way to help mitigate environmental pollution and subsequent effects of climate change.
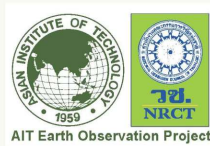
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