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. It is an economic development with social awareness that doesn't sacrifice the environment. Holistic approach to global modernization, urbanization and industrialization must be in place for a sustainable development to exist. If the goal of development is to raise living standards, provide access to modern energy services, use of energy more efficiently, then Green growth must play a key role. Incorporating elements of low-carbon green growth in economic strategies that would include technological, financial and investment aspects, as well as national and regional energy strategy plans towards a sustainable Green future has now become more important. A low-carbon based economic growth is the only way to go to help mitigate environmental pollution and CO2 emissions.

This ICUE 2018 conference will be a venue to exchange research ideas, experiences, technical, social, financial, economic and policy issues covering greening energy utilization. Here, energy professionals, policy makers, researchers, members of the academe, engineers, members of the energy supply sector, etc., 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.

ORGANIZERS

Regional Energy Resources and Information Center (RERIC)

Energy Program, Department of Energy, Environment and Climate Change

Asian Institute of Technology (AIT)

ORGANIZING COMMITTEE

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THE ASIAN INSTITUTE OF TECHNOLOGY (AIT)

The Asian Institute of Technology promotes technological change and sustainable development in the Asia-Pacific region through higher education, research and outreach. Established in Bangkok in 1959, AIT has become a leading regional postgraduate institution and is actively working with public and private sector partners throughout the region and with some of the top universities in the world. Recognized for its multinational, multi- cultural ethos, the Institute operates as a self-contained international community at its campus located 40 km (25 miles) north of Bangkok, Thailand.

Besides the usual labs and academic buildings, the main campus includes housing, sports, and medical facilities, a conference center, and a library with over 230,000 volumes and 830 print and on-line periodicals.

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 7 th DAAM international symposium to celebrate the 1000 th 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) Rating** was awarded to AIT for bagging the most perfect scores (seven scores of '5' each) among all universities in Thailand.

Key Facts and Figures

- 1915 Students from 48 countries
- 22,789 Alumni from 101 countries
- 81 Faculty members from 19 countries
- 134 Adjucnt faculty members from 24 countries
- 30000+ Short-term alumni
- 30 Academic programs
- 450 projects worth $46 million
- 200+ Academic partners
- 3 Schools
- 15 Research and Outreach Centers
- 100+ Research Staff and 500+ Support Staff from about 30 Countries
- 500+ 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 Energy 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 staffs are as follows:

Director:	Prof. Weerakorn Ongsakul
Research/Information Professional:	Maria Kathrina B. Gratuito

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. 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 Energy Program.

VENUE

Phuket Province is located in Southern Thailand. It is the biggest island of Thailand and sits on the Andaman Sea. Phuket, a rainforested, mountainous island, has some of Thailand's most popular beaches, mostly situated along the clear waters of the western shore. The island is home to many seaside resorts, spas and restaurants situated in Rawai, Patong, Karon, Kamala, Kata Yai, Kata Noi, and Mai Khao. Laem Phromthep Viewpoint is said to feature the most beautiful sunsets in Thailand. Phuket City, the capital, has old shophouses and busy markets.

Located on the west coast, between Patong to the north and Kata to the south, **Karon Beach** is the one of the most popular holiday destinations in Phuket and the 3rd longest beach on the island. The beach itself has excellent snorkelling (and even diving) spots at its southern end and is wide enough for beachgoers to never feel crowded. There are three main areas in Karon, each with their own charm: Karon Centre is a lively small city in which visitors can find a good choice of dining, shopping and nightlife entertainment, and a beautiful Buddhist temple hosting a bi-weekly market. Karon Beach Road is ideal for evening strolls and is home to several large resorts, restaurants and shops (including the popular Karon Bazaar). The third main area of Karon is centred around Luang Poh Chuan Road, towards the southern end of the beach, which hosts excellent restaurants and the more raucous nightlife spot of the resort town. **ICUE 2018** will be held at the **Thavorn Palm Beach Resort** which is ideally located right at the center of Karon.

Visiting Phuket is easy as there are now many travel options. Direct and connecting flights are now much more available than ever before. Travel by land is also very much accessible.

Thavorn Palm Beach Resort

The best way to enjoy Phuket is to stay at a beachfront hotel, with Thavorn Palm Beach Resort being among the best choices. Sun lounging would also be ideal as the resort has four (4) amazing pools, each with slightly different features for different kinds of traveler. One has a poolside massage, the other has a large shallow end for families, another has impressive fountains and waterfalls, while the last pool has a fantastic swim-up pool bar. The natural setting of Thavorn Palm Beach Resort is what makes it the best Phuket resort for relaxing holiday. The hotel has an extensive botanical garden filled with endless wildlife, unusual and exotic species of plants, flowers a good collection of orchids as well as rare and valuable specialty trees collected by the owner. The resorts tall trees and carefully manicured gardens are even home to cute animals, including rabbits and tortoises for the kids and young at heart to interact and enjoy.

SUMMARY OF ROOM ASSIGNMENTS

Royal Palm Hall

Venue for:

- Opening Ceremony, Keynote Adresses, Closing Ceromony
- Session 1: Sustainable Development Goals and Green Energy
- Session 5: Green Urban Planning
- Session 9: Energy Efficiency and Rational Use of Energy I
- Session 13: Energy Efficiency and Rational Use of Energy II
- Session 17: Smart Grid and Green Energy Integration I
- Session 20: Smart Grid and Green Energy Integration II

Palm Flower A

Venue for:

- Session 2: Energy Trade for Economic Development
- Session 6: Biomass Technology I
- Session 10: Biofuels and Biogas
- Session 14: Low Carbon Economy and GHG Mitigation
- Session 18: Biomass Technology II
- Session 21: Optimization and Planning Analysis

Palm Flower B

Venue for:

- Session 3: Solar-driven Technologies
- Session 7: Solar Energy Efficiency Enhancement
- Session 11: Green Energy in Transport
- Session 15: Greening Urbanization and Urban Settlements
- Session 19: Wind Operation and Stability
- Session 22: Energy Transition Forecasting

Palm Flower C

Venue for:

- Session 4: Power System Operation I
- Session 8: Promoting Disruptive Technology and Innovation
- Session 12: GHG Mitigation and Climate Change
- Session 16: Power System Operation II

ICUE 2018

PROGRAM a

Day 1: 24 October

Time	Event	
08:00 – 09:00	**REGISTRATION**	
	Opening Sess	
09:00 – 09:15	Opening Remarks –**Prof. Rajendra Shrestha** (Dean, School of Environment, Resou	
09:15 – 09:25	Presentation of tokens of appreciation to sponsors	
09:25 – 09:28	Introduction of Keynote Speaker 1	
09:28 – 10:13	*Keynote Address 1* **Dr. Piyasvasti Amranand** (Chairman, Energy for Environment Fo	
10:13 – 10:15	Presentation of the plaque of appreciation to the Keynote Speaker 1	
10:15 – 10:45	*Coff*	
10:45 – 12:05	Break out Session 1	
	Royal Palm Hall S 1: Sustainable Development Goals and Green Energy	*Palm Flower A* S 2: Energy Trade for Economic Development
12:05 – 13:30	*Lu*	
13:30 – 15:10	Break out Session 2	
	Royal Palm Hall S 5: Green Urban Planning	*Palm Flower A* S 6: Biomass Technology I
15:10 – 15:25	*Coff*	
15:25 – 17:05	Break out Session 3	
	Royal Palm Hall S 9: Energy Efficiency and Rational Use of Energy I	*Palm Flower A* S 10: Biofuels and Biogas
18:00 –	*Welcome cocktails*	

Day 2: 25 Octobe

Time	Event	
08:45 – 08:48	Introduction of Keynote Speaker 2	
08:48 – 09:33	*Keynote Address 2* **Dr. Venkatachalam Anbumozhi** (Economic Research Institute for AS	
09:33 – 09:35	Presentation of the plaque of appreciation to Keynote Speaker 2	
09:35 – 09:50	*Coff*	
09:50 – 11:30	Break out Session 4	
	Royal Palm Hall S 13: Energy Efficiency and Rational Use of Energy II	*Palm Flower A* S 14: Low Carbon Economy and GH Mitigation
11:30 – 12:30	*Lu*	
12:30 – 12:40	*Group*	
12:40 – 16:00		
16:00 – 17:30	*Travel back to Thay*	

Day 3: 26 Octob

Time	Event	
09:20 – 12:00	Break out Session 5	
	Royal Palm Hall S 17: Smart Grid and Green Energy Integration I	*Palm Flower A* S 18: Biomass Techn
	Coffee/Tea	
12:00 – 13:00	*L*	
13:00 – 14:40	Break out Session 6	
	Royal Palm Hall S 20: Smart Grid and Green Energy Integration II	*Palm Flower A* S 21: Optimization a
14:40 – 14:55	*Coff*	
14:55 – 15:25	*Closing Sessi*	
	End of C	

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t a GLANCE

2018 (Wednesday)

(Royal Palm Hall) – 25 minutes
:es and Development, Asian Institute of Technology)

ndation) – *Future of ASEAN Energy Systems*

/Tea Break – 30 minutes
(80 minutes) maximum 4 papers each

	Palm Flower B	*Palm Flower C*
	S 3: Solar Driven Technologies	S 4: Power Systems Operation I

ich Break – 85 minutes
(100 minutes) maximum 5 papers each

	Palm Flower B	*Palm Flower C*
	S 7: Solar Energy Efficiency Enhancement	S 8: Promoting Disruptive Technology and Innovation

/Tea Break – 15 minutes
(100 minutes) maximum 5 papers each

	Palm Flower B	*Palm Flower C*
	S 11: Green Energy in Transport	S 12: GHG Mitigation and Climate Change

eception at Thavorn Palm Beach Resort

2018 (Thursday)

AN and East Asia, ERIA) – *Challenges and Opportunities for a Green ASEAN Energy Grid System*

/Tea Break – 15 minutes
(100 minutes) maximum 5 papers each

	Palm Flower B	*Palm Flower C*
G	S 15: Greening Urbanization and Urban Settlements	S 16: Power Systems Operation II

ich Break – 60 minutes
gathering for the field trip
 FIELD TRIP
in Palm Beach Resort, Karon, Phuket

er 2018 (Friday)

(160 minutes) maximum 8 papers each

	Palm Flower B
logy II	S 19: Wind: Operation and Stability

Break in between – 15 minutes
inch Break 60 minutes
(80 minutes) maximum 5 papers each

	Palm Flower B
d Planning Analysis	S 22: Energy Transition Forecasting

/Tea Break – 15 minutes
m (Royal Palm Hall) – 30 minutes
inference

KEYNOTE SPEAKER 1

Future of ASEAN Energy Systems

Dr. Piyasvasti Amranand
Chairman, Energy for Environment Foundation
Independent Director/Chairman, PTT Global Chemical
Public Co. Ltd.
Former Minister of Energy, Royal Thai Government

Dr. Piyasvasti Amranand spent most of his career in the energy sector. He was Secretary General of the National Energy Policy Council for a number of years, and was Thailand's Energy Minister from 2006 to 2008. His past experience also included a number full time positions both in the public and private sectors, ranging from Director General of the Public Relations Department, Chairman of Kasikorn Asset Management, and Chairman of Panel of Advisors for CEO of Kasikorn Bank. He was also a past President of Thai Airways International during the period October 2009 to June 2012. He was a member of the board of directors of PTT Public Co. Ltd. Dr. Piyasvasti is currently the Chairman of the Energy for Environment Foundation. He also serve in the board of directors of PTT Global Chemical Public Company Limited, Kasikorn Bank, Pruksa Holding Plc., and Kiroro Resort Holding.

During the 1990's, Dr. Piyasvasti played a key role in deregulating and privatizing a number of energy-related state enterprises like PTT and power generation business. During his term as Energy Minister he implemented wide ranging reforms in the energy sector, for instance end of oil price subsidy and repayment of oil fund's massive debt due to the previous government' s subsidy program; implementation of very aggressive policy to promote renewable energy (including biofuels), cogeneration and distributed generation; adoption of Euro 4 fuel qualities and introduction of vapour recovery systems for petrol stations; adoption of a number of standards and incentive programs for energy efficiency; awards of a large number of petroleum concessions; IPP solicitation; conclusion of a number of power purchase agreements for projects in Lao PDR; establishment of nuclear power program; and amendment of a number of energy related laws. The most important law to be passed during his term as Energy Minister was the Energy Industry Act to establish an independent regulatory body for electricity and natural gas industry. The law was also the most important factor which saved PTT Public Co., Ltd. from being nationalized in the court case brought against the government and PTT by the Consumers Association.

He joined Thai Airways in October 2009 when the carrier was in financial trouble. He continued to implement the turnaround plan and introduced a long term strategic plan where the financial position of the company has been substantially strengthened, embarked on the largest aircraft and retrofit program ever implemented in Thai Airways, and formed Thai Smile as an initial step to compete with the low cost airlines.

Dr. Piyasvasti was born in 1953, and graduated from the University of Oxford in 1975 with B.A. (First Class Honours) in Mathematics. He later obtained MSc. in Econometrics and Mathematical Economics, and PhD. in Economics from the London School of Economics and Political Science, University of London, United Kingdom

KEYNOTE SPEAKER 2

Challenges and Opportunities for a Green ASEAN Energy Grid System

Dr. Venkatachalam Anbumozhi
Senior Energy Economist
Economic Research Institute for ASEAN and East Asia
(ERIA), Jakarta, Indonesia

Dr. Venkatachalam Anbumozhi is a Senior Economist at the Economic Research Institute for ASEAN and East Asia (ERIA), Indonesia. His previous positions include Capacity Building Specialist and Senior Fellow at Asian Development Bank Institute, Assistant Professor at the University of Tokyo, Project Manager and Senior Policy Researcher at the Institute for Global Environmental Strategies, Assistant Manager and Senior Engineer in Pacific Consultants International, Tokyo and Research Associate in Asian Institute of Technology, Thailand. A distinguished fellow of Asia Pacific Rim University (APRU) Forum on Development and Environment, he also advised ADB, JICA, JBIC, UNESCAP projects on sustainable development. He has published several books, authored numerous research articles and produced many project reports on natural resource management, climate friendly infrastructure design, and private sector participation in Green Growth. Anbumozhi was invited as a member of the APEC Expert Panel on Green Climate Finance and the ASEAN Panel for promoting climate-resilient growth. He has taught Resource management, International cooperation and Development Finance at the University of Tokyo and has speaking engagements at some of the leading international organizations. He obtained his PhD from the University of Tokyo.

PRESENTATION SCHEDULES

Day 1: 24 October 2018 (Wednesday)

S 01: Sustainable Development Goals and Green Energy
Time: 10:45 – 12:05
Room Assignment: Royal Palm Hall

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 01.1	**Energy Access Scenarios to 2030: Combining Large Scale Questionnaire Survey Results with LEAP Model** *Gabrial Anandarajah[1], Pablo Carvaal[1], Julia Tomei[2], Hector Agudelo[3], and Samir Cordoba[3]* [1]UCL Energy Institute, University College London [2]UCL Institute for Sustainable Resources, University College London [3]Technological University of Choco, Colombia	United Kingdom
S 01.2	**Strategies of German Municipalities to fulfill the Global Climate Change Goals – Critical Review of two Cases: Bottrop and Dinslaken-Lohberg** *Eva Fransemeier* TU Dortmund University, Germany	Germany
S 01.3	**Relationship between Renewable Energy Consumption and Sustainable Economic Growth: the Case of Turkey** *Orhan Çoban, Fatma Nur Yorgancilar, and Ayşe Çoban* Selcuk University, Konya, Turkey	Turkey
S 01.4 **Student Award Entry**	**Energy and Economic Analysis of Eucalyptus Plantation for Woodchips Production in Thailand** *Warakhom Wongchai[1], Woravit Insuan[2] and Anucha Promwungkwa[1]* [1]Chiang Mai University, Thailand [2]Sahacogen Green Com., Ltd., Lamphun, Thailand	Thailand

S 02: Energy Trade for Economic Development
Time: 10:45 – 12:05
Room Assignment: Palm Flower A

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 02.1	**The Impact of Low Electricity Prices on Renewable Energy Production** *Robert Martinez[1] and Patrick Hosein[2]* [1]National Institute of Higher Education, Research, Science and Technology, Trinidad	Trinidad and Tobago

	[2]The University of the West Indies, St. Augustine, Trinidad	
S 02.2	**Day Ahead Tariff Setting for Islanded Microgrids Considering Customers Response**	Colombia
	Juan Carlos Oviedo[1], Javier E. Solano[1], Cesar Duarte[1], David Lupien St-Pierre[2] and Loic Boulon[2]	
	[1]Universidad Industrial de Santander, Bucaramanga, Colombia	
	[2]Universite du Quebec a Trois_Rivieres, Quebec, Canada	
S 02.3	**Assessment of Equity of Feed-in Tariff in Japan**	Japan
	Takahiro Nagata, Yosuke Arino, Yuko Nakano and Keigo Akimoto	
	Research Institute of Innovative Technology for the Earth (RITE), Kyoto	
S 02.4	**Green Consumption to Consumer Social Responsibility (C$_N$SR): A Roadmap towards Sustainable Development**	India
	Mamta Soni and Sunny Dawar	
	Manipal University Jaipur, Rajasthan	

S 03: Solar-driven Technologies
Time: 10:45 – 12:05
Room Assignment: Palm Flower B

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 03.1	**Experimental Analysis of Solar Cabinet Dryer for Fish Processing in Gresik, Indonesia**	Indonesia
	Elita Fidiya Nugrahani, Qurrotin Ayunina M.O. Arifianti, Nimas Ayu Pratiwi, and Kuntum Khoiro Ummatin	
	Universitas Internasional Semen Indonesia	
S 03.2	**Evaluation of Convective Heat Transfer Coefficient of Herbs Dried in a Mixed Mode Solar Dryer**	India
	D.V.N. Lakshmi[1], Apurba Layek[1], and Palanisamy Muthukumar[2]	
	[1]NIT Durgapur, West Bengal, India	
	[2]Indian Institute of Technology Guwahati	
S 03.3	**Performance Analysis of Solar Powered Adsorption Cooling System**	India
	Arun Thakare and Samir J. Deshmukh	
	Prof. Ram Meghe Institute of Technology and Research	
S 03.4	**Experimental Investigation of a Solar Greenhouse Dryer Using Fiber Plastic Cover to Reduce the Moisture Content of Refuse Derived Fuel in an Indonesian Cement Industry**	Indonesia
	Qurrotin A'yunina Maulida Okta Arifianti, M.R. Abidin, E.F. Nugrahani, and K.K. Ummatin	
	Universitas Internasional Semen Indonesia	

S 04: Power System Operation I
Time: 10:45 – 12:05
Room Assignment: Palm Flower C

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 04.1	**Soft-Switched AC Modules for Solar Photovoltaic Applications** *Damrong Amorndechaphon, Korawin Suwannapuk and Teerapol Rittisad* University of Phayao, Phayao	Thailand
S 04.2 **Student Award Entry**	**Effects of Increasing Power Electronics on System Stability: Results from MIGRATE Questionnaire** *Vinay Sewdien[1], M. van der Meijden[1], T. Breithaupt[2], L. Hofmann[2], D. Herwig[2], A. Mertens[2], B.W. Tuinema3, and J.L. Rueda Torres[3]* [1]TenneT TSO B.V., Arnhem [2]Leibniz University of Hannover, Germany [3]Delft University of Technology, The Netherlands	The Netherlands
S 04.3 **Student Award Entry**	**A Review of DSTATCOM used in Solar Photovoltaic System** *Nimita Ashish Gajjar and Tejas N. Zaveri* Gujarat Technological University, Surat	India
S 04.4 **Student Award Entry**	**Small Signal Stability Assessment of Inverter-Based Islanded Microgrids With Universal Droop Controller** *Naresh Kumar Vemula and S.K. Parida* Indian Institute of Technology Patna	India

S 05: Green Urban Planning
Time: 13:30 – 15:10
Room Assignment: Royal Palm Hall

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 05.1	**Bhutan's Urban Towns with Integration of Agricultural Land Use** *Dorji Wangzom[1] and Sangay Zangmo[2]* [1]Ministry of Works and Human Settlement, Thimphu [2]Ministry of Education, Thimphu	Bhutan
S 05.2	**Financial Analysis of Renewal Waste Treatment System with Hydrothermal Technology (a Case Study in Waste to Zero Project in a Cement Industry)** *Kuntum Khoiro Ummatin, D.A. Yakin, Q.A.M.O. Arifianti and E.F. Nugrahani* Universitas Internasional Semen Indonesia, Gresik, Indonesia	Indonesia
S 05.3	**TRNSYS Software Used for the Simulation of the Dynamic Thermal Behavior of a F2-building in Lokossa City in Benin Republic**	Benin

	Comlan Aristide Houngan[1,2], Malahimi Anjorin[1], Obahoundje Salomon[1,2], Dankoro Sadate[1,2], Nepo Ferdinand Morel[1,2], Vianou Antoine[1], and Degan Gérard[1]	
	[1]Laboratoire de Caractérisation Thermo Physique des Matériaux et d'Appropriation Energétique (Albo-CTMAE)/EPAC, Abomey-Calavi, Benin	
	[2]Laboratoire de Rechercher Pluradisciplibaire de l'Enseignement Technique (LaRPET), Lokossa, Benin	
S 05.4	**A Study of the Roofing Tiles Product Properties Manufactured from Agricultural Residues**	Thailand
	Arkom Pasilo and Umphisak Teeboonma	
	Ubonratchathani University, Ubonratchathani	
S 05.5	**Impacts of Rural Electrification on Households' Wellbeing and Productivity: Evidence from Magway region, Myanmar**	Thailand
	Thein Mwe Khin[1], Sylvia Szabo[1,2], Takuji Tsusaka[1], and P. Abdul Salam[1]	
	[1]Asian Institute of Technology, Bangkok, Thailand	
	[2]Centre for Population Change, University of Southampton, Southampton, United Kingdom	

S 06: Biomass Technology I
Time: 13:30 – 15:10
Room Assignment: Palm Flower A

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 06.1	**Practical Application of a Biochar derived Fertilizer for use in Paddy Rice Cultivation - 'One ton per rai' Experiment in Nakhon Ratchasima Province**	Thailand
	Gordon Edward Hirst and Manoj Potapohn	
	Chiang Mai University, Chiang Mai	
S 06.2	**Fuel Biomass Processing in Plasma Reactor**	Kazakhstan
	Vladimir Messerle	
	Combustion Problems Institute, Almaty	
S 06.3	**Modifications of SME Biomass Boiler for High Efficiency Multi-Fuel Input**	Thailand
	Krittipat Piawanich, Pruk Aggarangsi and James Moran	
	Chiang Mai University, Chiang Mai	
S 06.4 **Student Award Entry**	**Hemp Stem Activated Carbon for Fermentative Hydrogen Enhancement**	Thailand
	Tanawat Chaonafai[1], Natthakorn Ruengkitrattanakul[1], Saranya Penpho[1], Rachnarin Nitisoravut[1], Pornthip Wimonsong[2]	
	[1]Sirindhorn International Institute of Technology, Thammasat University	
	[2]Suratthani Rajabhat University, Suratthani	
S 06.5	**Experimental Analysis of a Porous Radiant Pressurized**	India

	Cook Stove by Using a Blend of Waste Cooking Oil (WCO) and Kerosene *Lav Kumar Kaushik and Muthukumar Palanisamy* Indian Institute of Technology Guwahati	

S 07: Solar Energy Efficiency Enhancement
Time: 13:30 – 15:10
Room Assignment: Palm Flower B

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 07.1	**The Use of Plasmonic Metal Nanoparticles to Enhance the Efficiency of Thin-Film Silicon (Si) and Gallium Arsenide (GaAs) Solar Cells – A Comparative Study** *Rashid Ahmed Rifat, Nahid Ibn Ashraf, Saniat Ahmed Chowdhury, and Mustafa Habib Chowdhury* Independent University, Dhaka	Bangladesh
S 07.2	**Automatic Sun Tracking for the Enhancement of Efficiency of Solar Energy System** *Pramod Sahu[1], Nityanand Singh Maurya[2], and Sarita Sahu* Air India Limited, Nagpur NIT Patna, Bihar	India
S 07.3	**Multi-Objective Optimization of Hybrid PVT Solar Panels** *L. Ouhsiane[1,2,3], Monica Siroux[1], M. El Ganaoui[2], and A. Mimet[3]* [1]ICUBE, INSA Strasbourg, Strastbourg [2]Univ Lorraine, Longwy, France [3]Iniversite Abdelmalek Essaadi, Maroc	France
S 07.4 **Student Award Entry**	**Simulation of SVPWM based 3-level H-bridge Inverter used in Grid Connected PV System** *Darshni Maneesh Shukla[1] and Naimish Zaveri[2]* [1]Gujarat Technological University, Surat [2]CK Pithawala College of Engineering and Technology, Surat	India
S 07.5	**Opto-electronic Analysis of $C_{S2}PdCl_2Br_4$ Perovskites Compounds for Photovoltaic Applications** *Amit Soni[1], Jagrati Sahariya[2], K.C. Bhamu[3], and Ushma Ahuja[4]* [1]Manipal University Jaipur, Rajasthan [2]National Institute of Technology Uttarakhand, Srinagar [3]CSIR-National Chemical Laboratory, Pune [4]Mukesh Patel School of Technology Management and Engineering, Mumbai	India

S 08: Promoting Disruptive Technology and Innovation Time: 13:30 – 15:10 Room Assignment: Palm Flower C	

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 08.1	**Blockchain – Revolutionize Green Energy Management** *Pholapatara Ratanasopitkul* Metropolitan Electricity Authority, Thailand	Thailand
S 08.2	**A Blockchain-based Platform for Exchange of Solar Energy: Laboratory-scale Implementation** *Manisa Pipattanasomporn, Murat Kuzlu and Saifur Rahman* Virginia Tech - Advanced Research Institute	USA
S 08.3	**A Low Cost, Open-Source IoT based 2-Axis Active Solar Tracker for Smart Communities** *Annischa Sritoklin, Wiwatthana Malee, Atikom Prugsanantanatorn, Tirasak Sapaklom, Piyasawat Navaratana Na Ayudhya, Ekkachai Mujjalinvimut and Jakkrit Kunthong* King Mongkut's University of Technology Thonburi (KMUTT), Bangkok	Thailand
S 08.4	**A Spark™ based Client for Synchrophasor Data Stream Processing** *Vijay Krishna Menon[1], Sajith Variyar V.[1], Soman K.P.[1], Gopalakrishnan E.A.[1], Sasi K. Kottayil1, Muhammad Shoaib Almas[2] and Lars Nordström[2]* [1]Amrita School of Engineering, Amrita Vishwa Vidyapeetham, Coimbatore [2]KTH-Royal Institute of Technology, Stockholm, Sweden	India
S 08.5	**An Application of IoT for Collection and Analysis of Specific Energy Consumption in Production Line of Ready-to-Drink Juice at the Second Royal Factory Mae Chan** *Worrajak Muangjai[1], Phiched Thanin[2], Wichan Jantee[1], Montri Ngaodet[1], and Narong Nantakusol[1]* [1]Rajamangala University of Technology Lanna, Chiang Mai [2]North-Chiang Mai University, Chiang Mai	Thailand

S 09: Energy Efficiency and Rational Use of Energy I Time: 15:25 – 17:05 Room Assignment: Royal Palm Hall	

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 09.1	**Benchmarking Energy Efficiency in Tropical Data Centres - Metrics and Measurements** *Mahendra Chilukuri[1], Masliza Mohd Dahlan[2] and Chan Chuet Hwye[2]* [1]Vellore Institute of Technology, Vellore, India	India

	[2]Multimedia Development Corporation, Kuala Lumpur, Malaysia	
S 09.2	**Occupant-based HVAC Set Point Interventions for Energy Savings in Buildings**	Indonesia
	Dimas Ardiyanto[1], Manisa Pipattanasomporn[2], Saifur Rahman[2], Nanang Hariyanto[1], and Suwarno[1]	
	[1]Institute Teknologi Bandung, Indonesia	
	[2]Virginia Tech – Advanced Research Institute, Arlington, Virginia, USA	
S 09.3	**Development Control Regulations –Towards Effective Enforcement**	Bhutan
	Dorji Wangzom	
	Ministry of Works and Human Settlement, Thimphu	
S 09.4	**Impacts of Solar PV, Battery Storage and HVAC Set Point Adjustments on Energy Savings and Peak Demand Reduction Potentials in Buildings**	Indonesia
	Dany Pamungkas[1,3], Manisa Pipattanasomporn[2], Saifur Rahman[2], Nanang Hariyanto[3], and Suwarno[3]	
	[1]PT PLN (Persero), Jakarta, Indonesia	
	[2]Virginia Tech – Advanced Research Institute, Arlington, Virginia, USA	
	[3]Institute Teknologi Bandung, Indonesia	
S 09.5	**Achieving Higher Prosumption by Prioritizing Energy Demand Management over Renewable Energy Investment: the Case of an Office Building**	Thailand
	Brahmanand Mohanty	
	Asian Institute of Technology, Pathumthani	

S 10: Biofuels and Biogas
Time: 15:25 – 17:05
Room Assignment: Palm Flower A

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 10.1	**In Vitro Growth of Nyamplung (*Calophyllum inophyllum L.*): the Future Generation Biofuel Plants**	Indonesia
	Asri Insiana Putri and Budi Leksono	
	Ministry of Environment and Forestry	
S 10.2	**Calophyllum inophyllum for Green Energy and Landscape Restoration: Plant Growth, Biofuel Content, Associate Waste Utilization and Agroforestry Prospect**	Indonesia
	Budi Leksono[1], Eritrina Windyarini[1], Trimaria Hasnah[1], Syed Rahman[2], and Himlal Baral[2]	
	[1]Center for Forest Biotechnology and Tree Improvement Research and Development, Yogyakarta	
	[2]Center for International Forestry Research Bogor	
S 10.3	**The Research of Power Supply System Operating Modes with Solid-Oxide Fuel Cells on Biogas**	Russia

	Elena N. Sosnina, Andrey V. Shalukho, and Leonud E. Veselov	
	Nizhny Novgorod State Technical University n.a. R.E. Alekseev	
S 10.4	**Production and Utilization of Biodiesel using Bio-Alcohol as Reactant**	India
	Dilip Kumar Bora	
	Assam Engineering College, Assam	
S 10.5	**Transesterification of Jatropha Seed Oil Naturally Extracted by Distilled Water on Highly Stabilized Structure of Zeolite NaX Impregnated with Potassium Buffer Solution**	Thailand
	Johannex Fefeh Rushman[1,2], Pisit Maneechot[1], Prapita Thanarak[1], Sakda Somkun[1], Saowanee Manadee[3], Surachai Rattanasuk[3], Anukorn Phuruangrat[4], Preecha Sriprapakhan[5], Bongkot Prasit[1], and Surachai Artkla[3]	
	[1]Naresuan University, Pitsanulok, Thailand	
	[2]Kumasi Technical University, Ghana	
	[3]Roi-Et Rajabhat University, Roi-Et, Thailand	
	[4]Prince of Songkhla University, Songkhla, Thailand	
	[5]Maha Sarakham University, Thailand	

S 11: Green Energy in Transport
Time: 15:25 – 17:05
Room Assignment: Palm Flower B

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 11.1	**Electric Vehicle (EV) Transition in Thailand: Is it Beneficial?**	Thailand
	Sujeetha Selvakkumaran[1], Erik O. Ahlgren[1], Pornphimol Winyuchakrit[2], and Bundit Limmeechokchai[2]	
	[1]Chalmers University of Technology, Gothenburg, Sweden	
	[2]SIIT, Thammasat University	
S 11.2	**Numerical Investigation on RCCI Engine Fueled by Methanol and Biodiesel**	Singapore
	Wenming Yang and Zhou Dezhi	
	National University of Singapore	
S 11.3	**Electric Vehicle Charging Station Operation and Management Key Functions for Actual Demonstration Site**	South Korea
	Ha-Lim Lee, Gil-Sung Byeon, Gyeong-Hun Kim, and Kin-Wook Kim	
	Korea Electrotechnology Research Institute	
S 11.4	**A Review on Re-Utilization of Electric Vehicle's Retired Batteries**	Thailand
	Ankit Bhatt, Shubham Tiwari, and Weerakorn Ongsakul	
	Asian Institute of Technology	
S 11.5	**Energy and Environmental Implications of Green House Gas Mitigation Policies in the Transport Sector of Sri Lanka**	Sri Lanka
	Gayashika L. Fernando[1], Migara H. Liyanage[1], and Ganga N.	

Samarasekara[2]

[1]Sri Lanka Institute of Information Technology, Malambe

[2]University of Sri Jayawardenepura, Nugegoda

S 12: GHG Mitigation and Climate Change
Time: 15:25 – 17:05
Room Assignment: Palm Flower C

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 12.1	**A Probabilistic Analysis Approach for Large Power Systems with Renewable Resources** *Van Ky Huynh, Van Duong Ngo, and Dinh Duong Le* The University of Danang-University of Science and Technology Danang	Vietnam
S 12.2	**Trend Detection in CO_2 Emission of Mumbai Metropolitan Region and Cross Comparison with National Emission Database** *Sonam Sahu* Graduate School of Global Environmental Studies, Kyoto University	Japan
S 12.3	**Experimental Verification of Electrostatic Precipitator Stable Operation under Oil and Co-fuel firing Conditions of a Coal-fired Power Plant** *Anh Hoang[1], Tuyen Nguyen[2] and Mao Nguyen[3]* [1]Power Engineering Consulting Joint Stock Company 2 – PECC2, Ho Chi Minh [2]Ho Chi Minh University of Technology, Ho Chi Minh [3]Hanoi University of Science and Technology, Hanoi	Vietnam
S 12.4	**Development of Green Corridor for the Pollution Abatement at Dongri Buzurg Opencast Mine of M/s MOIL Limited, India** Dipankar Shome and Ganesh Manekar MOIL Limited (A Government of India Enterprise), Nagpur	India
S 12.5	**Increasing of Renewables Hosting Capacity in the Czech Republic in terms of European Project InterFlex (Case Study)** *Stanislav Hes, Jan Kula, and Jan Svec* CEZ Distribuce, a.s., Prague, Czech Republic	Czech Republic

Day 2: 25 October 2018 (Thursday)

S 13: Energy Efficiency and Rational Use of Energy II
Time: 09:50 – 11:30
Room Assignment: Royal Palm Hall

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 13.1 **Student Award Entry**	**Scheduling and Energy Management of Smart Homes using Customer Choice Based Algorithm** *Senthil Prabu Ramalingam and Prabhakar Karthikeyan Shanmugam* Vellore Institute of Technology, Tamil Nadu, India	India
S 13.2 **Student Award Entry**	**Energy-Saving Analysis of a Hybrid-power Gas Engine Heat Pump with Continuously Variable Transmission** *Tao Chen and Liang Cai* Southeast University, Nanjing China	China
S 13.3 **Student Award Entry**	**A Hybrid Air Conditioning System Employing Membrane Dehumidification and Dew-Point Cooling** *Jie Lin[1], Duc Thuan Bui[1], Md. Raisul Islam[1], Kian Jon Ernest Chua[1], Ruzhu Wang[2]* [1]National University of Singapore [2]Shanghai Jiaotong University, China	Singapore
S 13.4	**Design and Analysis of A Hammer Mill Machine in High-Efficacy Recycle Process** *Arpha Armatmontree, Wimol San-Um, and Chadaporn Keatmanee* Thai Nichi Institute of Technology, Bangkok	Thailand
S 13.5	**Impact of Relative Advantage, Perceived Behavioural Control and Perceived Ease of Use on Intention to adopt with Solar Energy Technology in Sri Lanka** *Udari Bandara[1] and T.S.M. Amarasena[2]* [1]Ceylon Electricity Board [2]University of Sri Jayewardenepura	Sri Lanka

S 14: Low Carbon Economy and GHG Mitigation
Time: 09:50 – 11:30
Room Assignment: Palm Flower A

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 14.1	**Low Carbon Economy and Society** *Rajendra Prasad Adhikari* Tribhuvan University, Kathmandu	Nepal
S 14.2	**Factors, Problems and Obstacles in Developing Hatyai City Municipality into a Low Carbon City of Thailand**	Thailand

	Thitichaya Boonsom and Chanisada Choosuk	
	Prince of Songkla University	
S 14.3 **Student Award Entry**	**The Role of Renewable Energy in CO$_2$ Mitigation from Power Sector in Cambodia**	Thailand
	Chhay Lyheang and Bundit Limmeechokchai	
	Sirindhorn International Institute of Technology, Thammasat University	
S 14.4	**Robust Methane Reduction Campaigns for Strengthened Greenhouse Gas Management**	Thailand
	Phitchaya Suwagul	
	PTT Exploration and Production Public Company Limited, Bangkok	

S 15: Greening Urbanization and Urban Settlements
Time: 09:50 – 11:30
Room Assignment: Palm Flower B

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 15.1	**Educational Building's Operational Performance Evaluation through Green Building Assessment - Case of a Philippine State University**	Philippines
	Tristan Magallones Jr., Rocelito A. Duropan and Angela Grace Toledo-Bruno	
	Central Mindanao University, Bukidnon	
S 15.2	**Development of Cabinet Maker RDF Prototype with Biodry Technology for Small Community**	Thailand
	Prapita Thanarak, Pisit Maneechot, Bongkot Prasit, and Chusak Raksanau	
	Naresuan University, Phitsanulok	
S 15.3	**Design of District Sewage Heat Supply with Geographic Information System**	Japan
	Toshiaki Ichinose	
	National Institute for Environmental Studies, Nagoya University	
S 15.4	**Greening Uranium-Containing Solid Fuels**	Kazakhstan
	Vladimir E. Messerle[1,3] and Alexandr B. Ustimenko[2]	
	[1]Combustion Problems Institute, Almaty, Kazakhstan	
	[2]Kazakh National University, Almaty, Kazakhstan	
	[3]Institute of Thermophysics , SB RAS, Novosibirsk, Russia	
S 15.5	**Performance Assessment of Building by Virtual Energy Audit**	India
	Atharav Joshi, Akash Mundada,Yash Suryavanshi, Maya Kurulekar, Mrunmai Ranade, Nilesh Jadhav, Siddarth Jabade, Kailash Patil, and Yogesh Despande	
	Vishwakarma University, Pune	

S 16: Power System Operation II
Time: 09:50 – 11:30
Room Assignment: Palm Flower A

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 16.1	**Real-time Implementation of Synchrophasor Based Linear State Estimator in OPAL-RT HYPERSIM** *Anamika Dubey[1], Saikat Chakrabarti[1], A. Sharma[1] and Nigamananda Panigraphy[2]* Indian Institute of Technology Kanpur, Kanpur OPAL-RT Technologies, India	India
S 16.2	**Transient Analysis of Single-Line-to-Ground Faults in Three-Phase Circuits Using Clarke Transformation** *Diego Bellan* Politecnico di Milano, Milan	Italy
S 16.3	**A Data-driven Approach for Estimating Power System Frequency and Amplitude Using Dynamic Mode Decomposition** *Neethu Mohan, Soman K.P., and Sachin Kumar S.* Amrita School of Engineering, Coimbatore, Amrita Vishwa Vidyapeetham	India
S 16.4	**Rate Dependent Transitions in Power Systems** *K.S. Suchithra and E.A. Gopalakrishnan* Amrita School of Engineering, Coimbatore, Amrita Vishwa Vidyapeetham	India
S 16.5	**Identification of Weak Nodes in Power System Using Conditional Number of Power Flow Jacobian Matrix** *Hemanthkumar Chappa and Tripta Thakur* MANIT Bhopal	India

Day 3: 26 October 2018 (Friday)

S 17: Smart Grid and Green Energy Integration I
Time: 09:20 – 12:00
Room Assignment: Royal Palm Hall

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 17.1	**A Framework for Developing VPP Conceptual Models: From Multiple Dimensions and Stakeholders, Towards a Unified Perspective** *Edwin Lerch[1], Mubashir Bokhari[2] and Fin Jennrich[2]* [1]Seimens Ltd., Thailand	Thailand

Ref. No.	Title, Authors, Affiliation	Country
	[2]Seimens AG, Erlangen, Germany	
S 17.2	**A Comprehensive Analysis of Renewable Energy Representations in Power System Generation Expansion Planning** *Xiangyu Zhang, Manisa Pippatanasomporn, and Saifur Rahman* Virginia Tech, Arlington	USA
S 17.3 **Student Award Entry**	**A Game Theoretic Approach for Demand-side Management considering Generation, Storage and the Combinatorial Nature of Load Scheduling** *Mrityunjay Kumar Mishra and S.K. Parida* Indian Institute of Technology Patna	India
S 17.4	**Implementation Methodology of Integrated Renewable Energy System Modeling for Off-grid Rural Electrification: A review** *Alpesh M. Patel and Sunil Kumar Singal* Alternate Hydro Energy Centre, Indian Institute of Technology, Roorkee	India
S 17.5	**Grid Integrated Solar Photovoltaic Array Power Plant Modeling and Simulation** *Kishan Bhushan Sahay and Mihir Goel* Madan Mohan Malaviya University of Technology, Gorakhpur	India
S 17.6	**Modeling and Simulation of Grid Connected 1 MW Solar PV Power Plant** *Kishan Bhushan Sahay, Prabuddha Anand, and Vishal Yadav* Madan Mohan Malaviya University of Technology, Gorakhpur	India
S 17.7	**Economic Load Dispatch Using Genetic Algorithm Optimization Technique** *Kishan Bhushan Sahay, Anurag Sonkar, and Abhishek Kumar* Madan Mohan Malaviya University of Technology, Gorakhpur,	India
S 17.8	**Multi-Objective Optimization for Enhancing System Coordination Restoration by Placement of Fault Current Limiters on an Active Distribution System with System Reliability Considerations** *Rachawadee Puangsukra[1], Jai Govind Singh[2], Weerakorn Ongsakul[2] and Francisco Gonzalez-Longatt[3]* [1]Provincial Electricity Authority (PEA), Thailand [2]Asian Institute of Technology, Pathumthani, Thailand [3]Loughborough University, United Kingdom	Thailand

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S 18: Biomass Technology II
Time: 09:20 – 12:00
Room Assignment: Palm Flower A

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 18.1	**Hydroprocessed *Calophyllum Inophyllum* Oil for Linear Bio-Alkane Fuel Production** *Dieni Mansur[1], Ruliana, and Cecep E. Rustana* [1]Indonesia Institute of Sciences, Banten	Indonesia

	[2]State University of Jakarta, Jakarta	
S 18.2 **Student Award Entry**	**The Use of Inclined Tuyer and its Effect on the Compatibility of Downdraft Gasifier Fed by Rice Husk and Wood Sawdust** *Anak Agung Susastriawan[1], Harwin Saptoadi[2], and Purnomo[2]* [1]Institut Sains & Teknologi AKPRIND, Yogyakarta [2]Universitas Gadjah Mada, Yogyakarta	Indonesia
S 18.3	**Co-Firing Cassava Rhizome and Eucalyptus Bark in a Fluidized-Bed Combustor Using Reburning: Combustor Performance and Time-Related Bed Behavior** *Chhaina Se[1], Vladimir I. Kuprianov[1], and Pichet Ningduangdee[2]* [1]Sirindhorn International Institute of Technology, Thammasat University [2]Phetchaburi Rajabhat University, Phetchaburi	Thailand
S 18.4	**Mixotrophic Cultivation of *Nannochloropsis* sp. BR2 in Sugarcane Bagasse for Biodiesel Production** *Maleeha Manzoor[1,2,3], Skye Thomas-Hall[1], Faiza Jabeen, Peter Schenk[1], and Javed Iqbal Qazi[2]* [1]Government College University, Faisalabad, Pakistan [2]Department of Zoology, University of Punjab, Lahore [3]School of Agriculture & Food Sciences, University of Queensland, Brisbane, Australia	Pakistan
S 18.5	**Synergistic Treatment Strategy for Efficient Release of Reducing Sugar from Orange Peel during Acid and Enzymatic Treatment Process** *Ria Majumdar, Umesh Mishra, and Biswanath Bhunia* National Institute of Technology Agartala, Tripura	India
S 18.6	**Preparation of Fuel Pellets and Extraction of Natural Dyes from Falling Leaves to be Used as Sensitizer in Dye Sensitized Solar Cell** *Adarsh Kumar Pandey[1], Muhammad Shakeel Ahmad[2], Sahar Tariq[3], Nasrudin Abd Rahim[2], and R. Saidur[1, 4]* [1]Sunway University, Selangor, Malaysia [2]University of Malaya, Kuala Lumpur, Malaysia [3]University of Punjab, Lahore, Pakistan [4]Lancaster University, Lancaster, United Kingdom	Malaysia
S 18.7	**The Effects of Nanoenhanced Calcium Chloride Hexahydrate based Phase Change Materials on Microstructural and Thermal Properties for Thermal Energy Storage** *Jesbains Kaur[1], Saidur Rahman[1], Fitwi Yohaness[2], Noriyuki Kuwano[3], Nor Azwadi Che Sidik[3]* [1]Sunway University, Selangor [2]Universiti Malaysia Pahang [3]Malaysia-Japan International Institute of Technology, University Teknologi Malaysia Kuala Lumpur	Malaysia
S 18.8	**Metal Oxide Nanoparticles doped Polyaniline based Nanocomposite as Stable Electrode Material for Supercapacitors**	Malaysia

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Syed Shahabuddin[1], Nurul Aquilla Mazlan[1,2], Siti Nor Atika Baharin[2], and R. Saidur[1]

[1]Sunway University, Selangor

[2]University Technology MARA, Kuala Pilah, Negeri Sembilan

S 19: Wind: Operation and Stability
Time: 09:20 – 12:00
Room Assignment: Palm Flower B

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 19.1	**Control of Doubly Fed Induction Generator of Variable Speed Wind Turbine System using Neural Network** *Nanami Gana Lantewa and Nurraddeen Magaji* Bayero University, Kano	Nigeria
S 19.2	**Evaluation and Mapping of Wind Energy Potential over Southern Part of India using ANN and GIS Approach** *Khalid Anwar and Sandip Deshmukh* BITS Pilani, Hyderabad Campus	India
S 19.3	**An Evaluation of Potential Rise in a Wind Turbine Generator Earthing System during a Direct Lightning Strike** *Raghavender Goud Deshagoni[1], Ramesh Rayudu[1], Ciaran P. Moore[1], and Tony Auditorey[2]* [1]Victoria University of Wellington [2]Line Tech Consulting Ltd.	New Zealand
S 19.4	**A Proposed Method for Calculating Earth Electrode Length for a Wind Turbine Generator Grounding System** *Raghavender Goud Deshagoni[1], Tony Auditorey[2], Ramesh Rayudu[1], and Ciaran P. Moore[1]* [1]Victoria University of Wellington [2]Electrical Specialist Services (EES)	New Zealand
S 19.5	**Optimal Placement and Sizing of DG Based on Single Phase Wind Turbine Generator in Distribution System** *Panaya Sudta, Nathakornphong Veerachayapornkul, Weerakorn Ongsakul, Nikhil Sasidharan, and Jai Govind Singh* Asian Institute of Technology	Thailand
S 19.6	**Modeling and Comparative Performance Analysis of Different Bladed Vertical Axis Wind Turbine (VAWT)** *Hafeez Khoharo, Laveet Kumar, and Muhammad Sharif Jamali* Mehran University of Engineering and Technology, Jamshoro, Pakistan	Pakistan
S 19.7	**An Optimized ANN Measure-Correlate-Predict Method for Long-term Wind Prediction in Malaysia** *Yong Kim Hwang[1], Mohd Zamri Ibrahim[1], Ali Najah Ahmed[1,2], and Aliashim Albani[1]* [1]School of Ocean Engineering, Universiti Malaysia Terengganu	Malaysia

	[2]Universiti Tenaga Nasional, Selangor	
S 19.8	**Computational Fluid Dynamics Studies on the Wind Speed Characteristics of an Improved Diffuser Design**	Indonesia
	Fajril Mardiansah, Aditya Dwi Putranto, and Hilda Rasnia Hapsari	
	Universitas Gadjah Mada, Yogyakarta	

S 20: Smart Grid and Green Energy Integration II
Time: 13:00 – 14:40
Room Assignment: Royal Palm Hall

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 20.1	**Optimization of Virtual Power Plant Topology with Distributed Generation Sources**	Russia
	Andrey V. Shalukho, Elena N. Sosnina, Ivan A. Lipuzhin, Alexander Yu Kechkin, Alexander A. Voroshilov	
	Nizhny Novgorod State Technical University n.a. R.E. Alekseev	
S 20.2	**Optimal Planning and Operation of Battery Energy Storage Systems in Smart Grids Using Improved Genetic Algorithm Based Intelligent Optimization Tool**	Thailand
	Kannathat Mansuwan[1,2], Peerapol Jirapong[1], Sattawat Burana[1] and Panida Thararak[1]	
	[1]Chiang Mai University, Chiang Mai	
	[2]Provincial Electricity Authority, Bangkok	
S 20.3	**Using Experts' Opinions and Multi-Criteria Decision Analysis to Determine the Weighing of Criteria Employed in Planning Remote Area Microgrids**	Australia
	Taskin Jamal, Tania Urmee, G.M. Shafiullah, and Farhad Shahnia	
	Murdoch University, Perth	
S 20.4	**The Development of Wave Energy Converter System Using Hydraulic Power Take Off at Terengganu Shoreline**	Malaysia
	Nur Hafizah Tul Huda, Mohd Zamri Ibrahim, Siti Juwairiyah A. Rahman, Aliashim Albani, and Safina Mohad	
	School of Ocean Engineering, Universiti Malaysia Terengganu, Kuala Nerus	
S 20.5	**Performance Analysis of LTE in Rich Multipath and Rural Environments for Wireless Communication in Smart Grid**	Thailand
	Md. Ariful Islam, Israt Jahan, Md. Jakaria Rahimi, and Jai Govind Singh	
	Asian Institute of Technology, Pathumthani	

S 21: Optimization and Planning Analysis
Time: 13:00 – 14:40
Room Assignment: Palm Flower A

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 21.1	**Optimizing Generation Mix using Markovitz mean-Variance Theory** *Arjun C. Unni, Weerakorn Ongsakul, Rajanivedha Ramakrishnan, Shubham Tiwari* Asian Institute of Technology, Pathumthani	Thailand
S 21.2	**PSO based Unit Commitment of a Hybrid Microgrid System** *Rajanivedha Ramakrishnan, Jai Govind Singh, and Weerakorn Ongsakul* Asian Institute of Technology, Pathumthani	Thailand
S 21.3	**Maintenance Record Reported Form Computerized using a Personal Computer** *Ming-Jong Lin* Jia-Nan Power Supply Branch, Taiwan Power Company	Taiwan
S 21.4	**Control of DC Motor using Genetic Algorithm based PID Controller** *Shubham Tiwari, Ankit Bhatt, Arjun C. Unni, Jai Govind Singh, and Weerakorn Ongsakul* Asian Institute of Technology, Pathumthani	Thailand
S 21.5	**A Probabilistic Approach for Power Loss Minimization in Distribution Systems** S.M.G. Mostafa[1] and Jai Govind Singh[2] [1]EEE Department, IIUC, Chittagong, Bangladesh [2]Asian Institute of Technology, Pathumthani	Bangladesh

S 22: Energy Transition Forecasting
Time: 13:00 – 14:40
Room Assignment: Palm Flower B

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 22.1	**One Step Ahead, Two Steps Backwards: Energy Transitions and Coal in Developing Countries** *Rafia Zaman[1], Christian Hofer[2] and Thomas Brudermann[2]* [1]Khulna University, Khulna, Bangladesh [2]University of Graz, Austria	Austria
S 22.2	**Natural Gas as a Transition Fuel for Indian Power Supply Sector: Emissions and Energy Security – the Trade Off** *Nandini Das[1], Shyamasree Dasgupta[1,2], Oluf Langhelle[3], Joyashree Roy[1], and Mohsen Assadi[3]*	India

	[1]Jadavpur University, India [2]Indian Institute of Technology Mandi, India [3]University of Stavanger, Norway	
S 22.3	**Solar – Grid Hybrid System – A Cost Effective and Improved Renewable Energy Utilization Approach** *M.S. Muhit and Asif Karim* American International University	Bangladesh
S 22.4	**Hour-Ahead Solar Forecasting Program Using Back Propagation Artificial Neural Network** *Tanawat Laopaiboon[1], Weerakorn Ongsakul[1], Pradya Panyainkaew[2], and Nikhil Sasidharan[3]* [1]Asian Institute of Technology, Thailand [2]Provincial Electricity Authority, Bangkok [3]National Institute of Technology, Calicut, India	Thailand
S 22.5	**One hour Ahead Short-Term Electricity Price Forecasting Using ANN Algorithms** *Ayushi Yadav[1], Ayush Sahay[2], Mukh Raj Yadav[1], Somiya Bhadari[1], Abha Yadav[1], and Kishan Bhushan Sahay[3]* *[1]Madan Mohan Malaviya University of Technology, Gorakhpur* *[2]Lucknow University, Lucknow* *[3]Delhi Technological University, Delhi*	India
S 22.6	**Confidential Interval Formation of Time-of-Use Customers based on Behavior Analytic by using Gaussian Mixture Model and K-mean Clustering: a Case Study of PEA, Thailand** *Pornchai Chaweewat, Jai Govind Singh, and Weerakorn Ongsakul* Asian Institute of Technology	Thailand

DETAILED ABSTRACTS

S 01.1   **Energy Access Scenarios to 2030: Combining Large Scale Questionnaire Survey Results with LEAP Model**

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This paper develops energy access scenarios to 2030 based on the 7th Sustainable Development Goal's agenda to Choco department, which is one of the least developed region in Colombia, using a newly developed LEAP model for the region. The demand for various energy services are given exogenously to the model based on surveys gathered by the Project for Rural Sustainable Energy (PERS) in 2015. On the energy supply side, several conversion processes are represented for electricity generation in rural mini-grids. Transmission and distribution include these mini-grids and the national grid which provides most of the departments electricity supply. It develops four scenarios based on different level of energy access to different energy services. We derive 4 demand use scenarios: REF (Reference): consider only energy demand increase due to growth of household rate. SDG (Sustainable Development Goals): This scenario considers that ALL households have access to lighting by 2030. In 2030 50% of households are served by a grid, 45% by a mini-grid and the remaining 5% remains non-electrified but have solar home systems for lights. (An exception are San Juan households, where grid connected households are over 93%. It also considers that at least 90% households by 2030 will use LPG to cook and 5% of household's electricity, therefore reducing the amount of firewood for cooking. SAT (Saturation increase): This scenario builds on top of the SDG, but considers that saturation levels in households with mini-grids increases to the level of saturation in households with grid access by 2030.INT (Intensity increase): This scenario builds on top of the SAT, but increases the energy intensity of all electric appliances (lights, refrigeration, cooling, etc.). This considers that increase access to better electricity services (grid and mini-grid) induces households to consume more electricity. By 2030, intensity of appliances that are operating with a mini-grid will increase to be the same as the intensity of appliances operating with grid. This assumes that mini-grids are robust enough to supply energy as well as the national grid. The analysis shows that future supply for residential sector electricity from mini-grid increases rapidly. By 2025, in Choco, under the assumptions of 100% energy access by 2030, mini-grid supplies electricity to more households than that of centralised system. Further, more than two third of the mini-grid supply in 2030 is generated by renewable sources such as hydro, biomass and solar. The remaining generation comes from diesel generators which also serves as peak load plants.

S 01.2 **Strategies of German Municipalities to fulfill the Global Climate Change Goals – Critical Review of two Cases: Bottrop and Dinslaken-Lohberg**

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In the last years, changes in climate have caused impacts on human and natural systems all over the world. In the future, there must be effective measures and strategies to reduce the climate change. Because of this development the role of cities in the energy efficiency debate has gained importance over the last years. The local level is supposed to be the most promising option to implement energy efficiency measures. For achieving the goals (Reduction of the CO_2 emission of 40 % by the year 2020) set by the EU and the national government many German cities have developed an energy efficiency and climate change strategy. Municipalities in Europe are supported by the EU through a funding scheme from the EU down to the federal state government. In future there must be more effective strategies and measures to reduce the climate change, otherwise it will be difficult to limit the increase of the global temperature to 1.5°C. For achieving these goals municipalities can apply for different funding programs. The structure of the funding system is very complex as the subsidies can be offered by the EU and the federal and state governmental level. Especially in the disadvantaged Ruhr Area, municipalities apply for different funding programs because of their precarious budgetary situation. In most cases, this is perceived as an ultima ratio in order to come up with energy efficiency goals and to initiate local development projects. Due to the structure of this funding system, the funding organizations seem to have a direct influence on the investment behavior of the municipalities. The uncertain precarious budgetary situation of German municipalities causes a veritable dependency on subsidies. The focus of our research is on the structurally weak region Western Germany where the municipalities are dependent on financial fundings. We analysed that our two-case studies Bottrop and Dinslaken followed over the past years an energy efficiency path. This allows to apply for different funding programs and through this manner they developed subconscious a holistic strategy over the past years to implement successful energy efficiency projects. This success pushes the cities in an energy efficiency path which can hardly be changed. But the success is obvious: they show a significant decrease in CO_2 emissions. Methodological, we conducted in-depth interviews with 12 stakeholders from two different municipalities who successfully received funding from different programs. Moreover, we spoke to 5 stakeholders from federal state ministries to gain an inside of the development of funding programs. The analysis is based on inductive coding and qualitative content analysis. The results were analyzed and transferred to the theory of PATH DEPENDENCIES. It can be observed that both municipalities seem to be locked-in financially at an early stage. This lock-in on the energy efficiency path determines not just the energy efficiency planning of the municipality but also the prospective city development in general. As a preliminary result both municipalities followed an energy efficiency path with a holistic strategy which includes important topic.

S 01.3 **Relationship between Renewable Energy Consumption and Sustainable Economic Growth: The Case of Turkey**

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Energy is a fundamental factor in increasing individual and social well-being. The

sustainability of growth depends on the diversification of energy resources. Dependence on foreign energy, such as Turkey's national income in countries with high employment, investment opportunities, environmental factors, and the importance of security of energy supply in areas such as renewable energy resource diversification is increasing with each passing day. In this study, by considering Turkey's renewable energy potential, it aimed to analyze the relationship of economic growth-renewable energy consumption. According to the results of the analysis, all the variables except for GDP-GEO variables have reached to the result that they act together in the long run. In addition, a one-way causality relationship between GDP, WIND, SOLAR and HYDRO was established and it was determined that BIOMASS and HYDRO variables are positive and GEO variable has negative effect on GDP.

| S 01.4 Student Award Entry | **Energy and Economic Analysis of Eucalyptus Plantation for Woodchips Production in Thailand** |

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This article presents energy and economic analysis of Eucalyptus plantation for woodchips production as energy crop in North Thailand. The selected site was Sahacogen Green Co., Ltd. plantation area covering Lamphun and Lampang province. The investigated data of energy and economy were based on the data from experimental plantation and recorded data from the company, which included seedling, soil preparation and conditioning, cultivation, stump removal and soil recovery, harvesting and transportation. Eucalyptus plantation has been established since 2008 with a 2.0×3.0 m^2 spacing. It was managed as a Short Rotation Coppice (SRC) which was first harvested at the 4th year following by 3 rotations of every 3 years. Stumps were removed and soil recovery was counted at the end of 13th years. For biomass harvesting, saw cutting machine, tractor and Vermeer BC1000XL were used for woodchips production in the field at the end of each rotation period. Woodchips were transferred by truck to the steam power plant warehouse. The results of evaluation showed that woodchips production was characteristics of a highly efficient energy system with Cumulative Energy Demand (CED) 22.34 MJ/GJ of biomass and Net Energy Ratio (NER) of 44.76. The monetary values refer to cash inflows/outflow accomplished at the end of the cultivation period (2021) when assuming the woodchips price of 31.25 USD/t 40 wt% moisture, discount rate of 5.0% and inflation rate of 0.0% for 13 years on average indicating 1828.40 USD/ha which is equivalent to 2.46 USD/GJ. The economy of woodchips production project in terms of Net Present Values (NPV) and Internal Rates of Return (IRR) was -159.18 USD/ha and 3.94%, respectively.

S 02: Energy Trade for Economic Development
Time: 10:45 – 12:05
Room Assignment: Palm Flower A

S 02.1   **The Impact of Low Electricity Prices on Renewable Energy Production**

Robert Martinez[1] and Patrick Hosein[2]
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Many countries are actively developing plans to increase renewable energy production with some countries even targeting a goal of 100% renewable energy within the next few years. The reasons are twofold, reduced carbon emissions and reduced dependence on fossil fuels with the associated fluctuations in oil and natural gas prices. However, several other countries have not been taking the required actions to increase their production of renewable energy. In some cases this occurs in energy-rich countries where electricity prices are heavily subsidized and hence residential and commercial consumers have no incentive to invest in renewable energy because the time taken to offset the investment is far too long. We use Machine Learning techniques to quantify this conjecture by showing the relationship between renewable energy production and electric prices for various countries. The data used for this exercise (namely electricity costs and renewable energy production per country) is taken from various online datasets. We conclude that, in order for a country to seriously increase its renewable energy production so that it is a significant percentage of total energy production, it must first reduce the heavy subsidies provided to its citizens. Using our model we can determine, for a given country, what reduction in subsidies is required to achieve a certain renewable energy production target. Countries can then use this information to plan future renewable energy targets and electricity subsidy reductions. We use our home country as a use case for this exercise.

S 02.2   **Day Ahead Tariff Setting for Islanded Microgrids Considering Customers Response**

Juan Carlos Oviedo[1], Javier E. Solano[1], Cesar Duarte[1], David Lupien St-Pierre[2] and Loic Boulon[2]
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This paper considers the problem of day ahead pricing in an islanded microgrid. In order to find cost reflective tariffs, an optimization problem is formulated to estimate the hourly day ahead prices. The optimization problem maximizes the profit of the owner of the microgrid in one hand and reduces the payment of the customers for their needed energy on the other hand. The proposed load forecasting method is achieved using a generative hierarchical model. The estimation of the marginal costs of the generated electrical energy has been established using the levelized cost of energy theory as a basis. The forecasted energy generation and consumption and the marginal costs of producing the energy are the inputs of the optimization problem. The optimization problem is used to simulate the behavior of the customers in a microgrid with 25 residential homes. The obtained results reflect the effectiveness of the proposed model reducing the electrical consume during peak hours.

S 02.3

Assessment of Equity of Feed-in Tariff in Japan

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The diffusion of renewable energy such as solar photovoltaics (PV) is effective for global warming countermeasures. When focusing on residential PV, however, it is thought that PV installation is difficult for households without a sufficient income, as PV is still expensive. In addition, Feed-in Tariff (FIT) requires the surcharge of electricity consumers. Its burden is larger for a lower-income class than for a high-income class because the ratio of energy cost among the total expenditures is higher, and it is recognized as a problem from the viewpoint of "Equity". In this study, we conducted quantitative analyses of influences of FIT on households by income class and evaluated its equity, based on the actual data regarding a proportion of PV installation, surplus electricity purchase price for PV, surcharge cost, etc. under FIT in Japan. As a result, we find that the ratio of electricity cost among the total consumption expenditure (E/C) increases due to FIT for all income classes, but this impact is greater for low-income class. The index of E/C increasing point due to FIT for low-income class is three times more than that for high-income class. The difference by the income hierarchy becomes bigger due to FIT introduction.

S 02.4

Green Consumption to Consumer Social Responsibility (C$_N$SR): A Roadmap towards Sustainable Development

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Green consumption aims to safeguard the environmental resources like electricity, water, fuel, etc. as these resources are important for human survival and have to be preserved for future generations. Recently, many researchers have focused on environmental health improvement with the introduction of advanced and improved production processes. This approach will work more effectively when consumers' understanding about their social responsibility is developed in parallel. In this paper, efforts are being made to incorporate consumers' social responsibility in the frame to address and resolve environmental health issues. Relationship between sustainable development and consumers' consumption pattern has been discussed with the help of Consumer Social Responsibility (CnSR) Model for improved survival.

S 03: Solar-driven Technologies
Time: 10:45 – 12:05
Room Assignment: Palm Flower B

S 03.1

Experimental Analysis of Solar Cabinet Dryer for Fish Processing in Gresik, Indonesia

Elita Fidiya Nugrahani, Qurrotin Ayunina M.O. Arifianti, Nimas Ayu Pratiwi, and Kuntum Khoiro Ummatin
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Most fishermen in Gresik, East Java, Indonesia used open air bamboo wicker as a

conventional solar fish dryer. However, the dryer has weakness such as need long time to dry and cleanliness issue. The condition raises the idea of designing and manufacturing solar cabinet dryer to improve efficiency and overcome the weaknesses in a conventional fish dryer. The solar cabinet dryer contains 3 kg fish and designed in 3 shelf collectors which are equipped with mirror to maximize solar radiation. The fish dried to below 40% of moisture content based on Indonesian National Standard. Dryer performance is measured from drying rate and efficiency. It found that the drying rate per hour was 18.93%, 20.81%, 20.92% mass/hour for 30o, 45o and 60o mirror angle respectively. Highest efficiency performance of solar cabinet dryer was 34.94%. In cleanliness issue showed a decrease of 25.1 x 106 bacteria colonies/gr on conventional drying to 19.5x106 bacteria colonies/gr on designed solar fish dryer.

S 03.2 **Evaluation of Convective Heat Transfer Coefficient of Herbs Dried in a Mixed Mode Solar Dryer**

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A mixed mode forced convection solar dryer (MFSCD) integrated with double pass counterflow solar air heaters was developed in-house for drying of high valued Moringa Oleifera and Stevia rebaudiana leaves. Experiments were carried out to evaluate the convective heat transfer coefficient of the samples in the developed solar dryer and under open sun drying (OSD). From the analysis, the average convective heat transfer coefficient of the leaves in the MFSCD are found to be 4.93 and 4.22 W/m2-K for Moringa and Stevia leaves and in OSD the average values are 1.31 and 1.25 W/m2-K, respectively. The efficiency of the mixed mode solar dryer was found to be 26.4 %. The proximate analysis for the protein and fiber content of the experimental samples concludes that the crude protein and crude fiber of solar dried samples are better than the sun-dried ones.

S 03.3 **Performance Analysis of Solar Powered Adsorption Cooling System**

Arun Thakare and Samir J. Deshmukh
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The use of solar energy for environmental control is receiving much more attention as a result of the projected world energy shortage. Cooling is particularly attractive as a solar energy application because of the near coincidence of peak cooling loads with available solar power. This paper describes the performance analysis of intermittent solar adsorption cooling system with composite adsorbent and water as a refrigerant. The composite adsorbent used in the system is 25 % activated carbon and 75 % silica gel. The system consists of adsorption container integrated with solar flat plate collector with absorber area of 0.9 m^2 and contains a porous adsorbent medium. The other components of the system are condenser, evaporator, cooling cabinet and valves. The system works on the thermodynamic adsorption cycle. The cooling load of 10 liters of water at a temperature of 35 degree Celsius was introduced in the cooling cabinet before the start of cycle. At the beginning of each test the adsorbent was heated with the help of solar energy. The chilled water with temperature reduction of 77 % is produced. The solar coefficient of performance of 0.088 and the cooling coefficient of performance is 0.83 is obtained for 10 liters of water load.

S 03.4   Experimental Investigation of a Solar Greenhouse Dryer Using Fiber Plastic Cover to Reduce the Moisture Content of Refuse Derived Fuel in an Indonesian Cement Industry

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Refuse Derived Fuel (RDF) is a potential alternative energy made from municipal solid waste (MSW). RDF could partially substitute coal in industries that use combustion equipment, for example in cement manufacturing industries. The optimal moisture content for solid fuel is around 10-20%. However, RDF that supplied in one of Indonesian cement industries reached moisture content almost 30%. A solar dryer has been built and tested to reduce the moisture content of RDF. Its parts were a greenhouse type tunnel drying unit with fiber plastic cover and electrical axial fans. In this experiment, the effects of three fan modes on the thermal efficiency were also investigated. The modes were operating one fan, two fans, and without fan. The solar dryer had dimensions of 2 m x 1.5 m x 0.8 m (length x width x height). The mass of RDF was 20 kg. The efficiency was calculated using the measured experimental data, i.e. environment temperature, room temperature, air velocity, solar irradiation, and relative humidity. The result revealed that the lowest moisture content produced by the dryer reached to 14.75%. Furthermore, the thermal efficiency could increase up to about 17.07% by using two fans mode.

S 04: Power System Operation I
Time: 10:45 – 12:05
Room Assignment: Palm Flower C

S 04.1   Soft-Switched AC Modules for Solar Photovoltaic Applications

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The passive lossless snubber network is proposed to improve the overall efficiency of AC modules for photovoltaic (PV) inverter. The proposed network consists of an inductor, two capacitors, and three diodes. No additional control for snubber network is required and circuit structure is simple while system efficiency is high as compared with hard-switching inverter. Operation principles, theoretical analysis, relevant equations, and simulation results of the soft-switched grid-connected AC module with the proposed passive lossless snubber network are presented in detail.

S 04.2
Student Award Entry

Effects of Increasing Power Electronics on System Stability: Results from MIGRATE Questionnaire

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Power systems throughout the world are experiencing increasing levels of power electronics interfaced generation in their generation portfolio. As these devices have a significantly different dynamic behavior than conventional synchronous generators, it is expected that this trend will pose power system stability related challenges. This paper presents the results of a questionnaire conducted within the MIGRATE project. The aim of this questionnaire, to which more than 20 European transmission system operators (TSOs) responded, was to identify and prioritize these challenges. The TSOs identified challenges related to rotor angle stability (two), frequency stability (three), voltage stability (five), and power electronics interactions and resonances (two). In a follow-up survey, the TSOs were asked to rank the challenges based on their severity, probability of occurrence, and time of manifestation. The decrease of inertia was ranked the highest among the 11 issues. Additionally, the TSOs gave insight into current practices with regards to system monitoring and analysis. Based on the ranking, mitigation measures are currently being designed in order to facilitate an even higher amount of power electronics interfaced renewable energy sources in the power system.

S 04.3
Student Award Entry

A Review of DSTATCOM used in Solar Photovoltaic System

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This paper aims to present a comprehensive review of the distribution static compensator connected with solar photovoltaic (SPV) system employed for voltage regulation, power factor correction, and load balancing in the distribution network. The inverter employed with SPV system for supplying active power to the grid/load can be made multifunctional i.e. it also serves as DSTATCOM when SPV power is not available (The arrangement is called PV-DSTATCOM). For such an arrangement the need for the actually installed DSTATCOM for voltage regulation and temporary over voltage control can be either minimized or altogether eliminated, bringing a significant savings for the utility. The intention of this review is to provide a broad view on configuration, topologies, and control techniques to the researchers and engineers working on power quality improvement. More than 100 research publications on the topologies, configuration, control techniques and applications of distribution static compensator have been thoroughly reviewed and classified for quick reference.

S 04.4
**Student
Award
Entry**

Small Signal Stability Assessment of Inverter-Based Islanded Microgrids With Universal Droop Controller

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The microgrid is an integrated form of distributed energy resources (DERs), which are typically interfaced with load and utility grid by power electronic converters. Stability analysis plays an important role in planning the microgrid system. In this paper, the analysis of stability and power sharing is carried out for an islanded microgrid with a universal droop controller. For a small signal stability assessment, state space model is developed for the microgrid system considering the linearized model of inverters and its associated feedback controllers. The different frequency modes of the complete model are identified and a eigen value analysis is done to determine the critical values of the controller gains. The system stability is tested on a microgrid framework with three inverters functioning as DERs. The effectiveness of the model is validated and verified with time domain simulations.

S 05: Green Urban Planning
Time: 13:30 – 15:10
Room Assignment: Royal Palm Hall

S 05.1

Bhutan's Urban Towns with Integration of Agricultural Land Use

Dorji Wangzom[1] and Sangay Zangmo[2]
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Bhutan's sustainable strategies strive for food self-sufficiency. Since the rapid development in the last few decades, there has been allocation of agricultural land (especially paddy fields area) for town development. Thimphu way back was a beautiful valley with paddy fields and clusters of traditional houses and now it is a city with concrete structures. The problem is aggravated as there is only very minimal arable land in the mountainous country. The agricultural lands are being converted to towns and the country import food from other countries. The food is the first step to self-sufficiency. Urbanization is inevitable but is there a way for a balanced approach of maintaining the agricultural land and urbanizing at the same time. Planning policies and approaches to create or maintain agricultural land in urban centers of the country for green urbanization will be discussed. The paper will present recommendations and suggestions for a balanced approach.

S 05.2 **Financial Analysis of Renewal Waste Treatment System with Hydrothermal Technology (a Case Study in Waste to Zero Project in a Cement Industry)**

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To decrease the amount of solid waste in Gresik city, a solid waste processing machine was installed in final disposal sites. One of the machine products, Refuse Derived Fuel (RDF), a kind of biomass that can be used as coal substitute in cement plants. This program will be implemented successfully if RDF is produced continually and also has lower moisture. The initial design of the machine yielded 3.3 tonnes of RDF per hour with 10% moisture content and caloric value more than 4800 kcal/ kg. Nonetheless, for subsequent process, the machine could produce only 3 tonnes of RDF per day with a significant increase of moisture content (around 30%) and caloric value less than 4800 kcal/ kg. This problem might appear due to the existence of impurity (sand, gravel) in RDF and waste in the wet condition. According to this issue, an alternative technology that could be applied to fix the problems is hydrothermal technology. To execute this idea, a feasibility study should be assessed, especially related to the financial aspect. The assessment would be analyzed by using calculation how much opportunity cost generated from substitution of coal with RDF, Net Present Value (NPV), Payback Period (PBP), and Internal Rate of Return (IRR) against Weighted Average Cost of Capital (WACC). The financial analysis shows that a renewal waste treatment system with hydrothermal technology could improve RDF production capacity and maximize the profit.

S 05.3 **TRNSYS Software Used for the Simulation of the Dynamic Thermal Behavior of a F2-building in Lokossa City in Benin Republic**

Comlan Aristide Houngan[1,2], Malahimi Anjorin[1], Obahoundje Salomon[1,2], Dankoro Sadate[1,2], Nepo Ferdinand Morel[1,2], Vianou Antoine[1], and Degan Gérard[1]
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The present study was based on the use of TRNSYS software for the simulation of the dynamic thermal behavior of a F2 building in Lokossa, Benin Republic. The results showed that between 00 AM and 07AM, the temperature of the indoor air is approximately 20°C and increases gradually until 02 PM when the temperature reaches its peak 30°C. However, the total incident solar radiation receives varies from a face to another and the roof received the largest due to its horizontal orientation. The heat received by a face reaches its peaks dependently on its orientation. There is a phase shift in the heat transfer received by the envelope. This is possible due to the thermal inertia of the envelope's constituent materials, property that allows the building envelope to dampen the heat received and to phase out the transmission time to ensure thermal comfort in the home.

S 05.4   **A Study of the Roofing Tiles Product Properties Manufactured from Agricultural Residues**

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The main objective of this work was to study the roofing tiles products are manufactured from agricultural residues. The agricultural residues in this work are kenaf fiber, corn cob fiber and water hyacinth fiber. Urea formaldehyde resin adhesive was selected as the binder. The properties of study were physical based on JIS A 5908-2003, mechanical based on TIS 535-2540 and ASTM D 256-2006a, thermal conductivity based on ASTM C 117-2010 and SEM technique was used to investigate the microstructural characteristics. Consequently, Also, this work shows a compared to the properties of commercial roofing tiles in Thailand. The study results revealed that physical, mechanical, thermal conductivity and microstructural characteristics of the roofing tiles product are accordance with the standard test requirements. Finally, it was found that the roofing tiles product properties manufactured from agricultural residues in this work are similar to commercial roofing tiles in Thailand.

S 05.5   **Impacts of Rural Electrification on Households' Wellbeing and Productivity: Evidence from Magway region, Myanmar**

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Access to electricity is one of the critical drivers of sustainable development and constitutes a basic requirement to improve quality of life. In Myanmar, the current electrification rate is around 30 per cent and the electricity consumption is approximately 140 KWh per capita per year, with numbers considerably lower in rural areas. While some literature has studied the roles of electrification in development, formulation of effective electrification strategies would require accumulation of empirical evidence from rural households coupled with solid analysis. Using new survey data of 400 households from Inn Kone and Yone Sate village in Aunglan Township, Magway region in Myanmar, we analyze the effects of electrification on households' wellbeing and agricultural and non-agricultural productivity. In addition to qualitative and descriptive analysis, the study applies regression modelling and propensity score matching and tests the differences in the living conditions, wellbeing and productivity of households with similar characteristics with and without access to electricity grids. Preliminary results suggest that access to electricity is a significant determinant of individual and household level wealth, better health and nutritional status as well as school performance for children. The results further indicate important gender effects and highlight the need for an integrated policy planning and program design to prioritize rural electrification and universal access to electricity in the Magway region and elsewhere.

S 06: Biomass Technology I
Time: 13:30 – 15:10
Room Assignment: Palm Flower A

S 06.1   **Practical Application of a Biochar derived Fertilizer for use in Paddy Rice Cultivation - 'One ton per rai' Experiment in Nakhon Ratchasima Province**

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Biochar is produced by direct thermal decomposition of biomass in the absence or restriction of oxygen (preventing combustion), a process known as pyrolysis. This produces high-carbon, fine-grained charcoal like substance. Biochar is promoted primarily as a soil amendment, which has the potential to dramatically increase crop yields. In addition it offers numerous environmental benefits including:
• GHG reduction in both from the supply (production) and demand (application), through carbon sequestration
• Adsorption of soil toxins
• Improved soil health by increasing organic matter
• Resolving localized biomass waste issues
With the potential of increased crop yields and multitude of environmental benefits, biochar application would appear to be an obvious agricultural practice, however, it has still to create traction as a viable agricultural system. This is due, in part, to the large dosage rates required and consequently higher application costs when compared with the use of synthetic fertilizers. A plausible resolution to this is through technology adaption, specifically the development of 'low dose, high-efficiency biochar fertilizers', based on nano-structures and soluble components. The rationale behind of these biochar based fertilizers is to increase the redox potential (Eh), by reducing from a mineral into a biochar substrate. The concept is that Eh and pH are respectively and jointly major drivers of soil/plant/microorganism systems. The practical application of this treatment is being trailed in a paddy rice field experiment, 'One Ton per Ria': (farm size 10.4 Rai (1.66 ha) in Nakhon Ratchasima province. The aim of the trial is to produce 1000 kg/ria (6.25 t/ha) whereas the Thai average is 480 kg/rai (3.01 t/ha (2014)). It is proposed that the experiment runs for five years, with only one harvest per year due to the availability of water. The report will show a breakdown of the input costs, output yields, details of the biochar derived fertilizer and direct pro rata cost comparisons of the new system with the control (business as usual). With only one harvest to report, the experiment is still in the early stages, but results so far are encouraging. In addition, the benefits of using biochar as an agricultural system must be considered to mitigate the wider environmental issues presently facing Thailand.

S 06.2   **Fuel Biomass Processing in Plasma Reactor**

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The aim of the work was to conduct complex thermodyn amic and experimental studies of fuel biomass (FBM) plasma processing, comparison of the calculated and experimental data and the development of technological process recommendations. The organic part of FBM is represented by carbon, oxygen and hydrogen with a total

concentration of 99.7%, whereas the mineral part is only 0.3%. The results of thermodynamic analysis of high-calorific fuel gas production by gasification of FBM in air are discussing. Also experimental installation is presented and the results of experiments on gasification of FBM in air plasma compare with the computation.

The aim of thermodynamic calculations was to determine the integral parameters of the gasification process: equilibrium composition of the gas phase of the gasification products, the degree of carbon gasification and specific power consumption for the process. The calculations showed that the maximum yield of the synthesis gas at plasma air gasification of FBM is achieved at a temperature of 1600K. Synthesis gas with a concentration of 71.6% (CO – 41.9, H2 – 29.7) can be obtained.

Experimental studies of FBM gasification were performed on the installation, main elements of which are a plasma chemical reactor with productivity by FBM up to 50 kg/h and long live DC plasmatron of 70 kW nominal power having nanocarbon recoverable electrodes. Gas analysis showed the following composition of the gas at the exit of plasma installation, vol.%: CO – 42.0, H2 – 25.1, N2–32.9. Specific heat of combustion of the synthesis gas produced by air gasification amounts to 9450 kJ/kg. The total concentration of the synthesis gas was 67.1%, which agreed well with the calculations. Carbon content of the slag in the sample was 1.13 wt.%, which corresponded to the degree of FBM carbon gasification 96.6%. Specific power consumption for FBM gasification in the plasma reactor according to the results of experiments amounted to 1.53 kWh/kg of working substance. In the experiments, as well as in calculations, no harmful impurities were found in the products of FBM plasma gasification.

S 06.3   Modifications of SME Biomass Boiler for High Efficiency Multi-Fuel Input

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This research focuses on modifications of a conventional biomass burner for a vertical fire-tube boiler to accept multiple fuel with increased efficiency. The selected boiler for this work has thermal power output of 90 kWth using firewood as primary fuel. The main objective is to design and develop multi-fuel feeding system to accept other available biomass applicable to existing burner with minimal modifications of the main structure. After the burner was refitted with the feeding system, the optimum surplus combustion air was studied for three types of solid fuels; corn cob, wood chips and biomass pellets. A breakpoint analysis was conducted for each biomass fuel. It was found that before burner modification, the highest values of thermal efficiency of fire wood burner were 40.52%. After the change of burner feeding in accordance with air input improvements, the thermal efficiency of the burner for corn cob, wood chip and pellets were 54.18 %, 50.46 % and 69.41 % respectively. The semiautomatic fuel feed can be readily utilized for all three fuel types and feed rate could be reduced by 58.1.1%, 58.2% and 70.63% by weight respectively compared with firewood. It is also found that biomass pellets are the most suitable alternative fuel for roasting of parchment coffee with the lowest processing cost in comparison with other biomasses.

S 06.4

Student Award Entry

Hemp Stem Activated Carbon for Fermentative Hydrogen Enhancement

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Hemp stem was used as a raw material to make available activated carbon as it contains high carbon and adsorption capacity. It was synthesized by a chemical activation using H_3PO_4. The effect of activation temperature within a range of 350-500°C was explored. The obtained hemp stem activated carbons (H-ACs) were used for biohydrogen enhancement. Treated activated carbon (TAC) from the National Nanotechnology Center, Thailand was used for a comparative study. The results showed that H-AC with activation temperature of 500°C obtained the maximum hydrogen yield of 2.64 ± 1.16 mol of H_2/mol of sucrose. Determination of specific surface area based on the Brunauer-Emmet-Teller (BET) theory, showed that H-AC (500°C) possessed the highest mesopore volume of 0.3650 cm^3/g with specific surface area of 1,219.24 m^2/g. A greater porosity of H-AC (500°C) as compared to TAC and other H-ACs led to a greater adsorption ability, particularly for volatile fatty acids, thus enhanced fermentative hydrogen production.

S 6.5

Experimental Analysis of a Porous Radiant Pressurized Cook Stove by Using a Blend of Waste Cooking Oil (WCO) and Kerosene

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A large number of populations in developing countries still continue to use various forms of solid fuels as the primary energy source for cooking. Maintaining uninterrupted availability of fuel at an affordable price demands them to achieve Sustainable Development Goals (SDGs). In this paper, a comparative thermal performance assessment of Porous Kerosene Pressure Cookstove (PKPs) and Conventional Kerosene Pressure Cookstove (CKPs) are presented. The experiments are conducted by using two different, Waste Cooking Oil (WCO) and kerosene blends (BS1, 10/90: WCO/Kerosene by % volume) and BS2 (50/50)). Also, the impact of firing power (1.5-3 kW) on burner characteristics are established and compared for both the stoves. With fuel sample BS1, the measured thermal efficiency is found in the range of 51.2-44.8% and 43-33.3% for PKPs and CKPs, respectively. Whereas, the same is in the range of 45.3-37.8% and 36.2-28.6%, respectively, in case of BS2. Due to improved combustion in case of porous media burner (i.e. PKPs), a large reduction is found for CO and NOx emissions. The overall performance of PKPs shows WCO as a potential alternative source for cooking.

S 07: Solar Energy Efficiency Enhancement
Time: 13:30 – 15:10
Room Assignment: Palm Flower B

S 07.1 **The Use of Plasmonic Metal Nanoparticles to Enhance the Efficiency of Thin-Film Silicon (Si) and Gallium Arsenide (GaAs) Solar Cells – A Comparative Study**

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This study compares the response of thin-film silicon and gallium arsenide solar cells to the use of plasmonic metal nanoparticles for modifying their respective opto-electronic behavior. Square arrays of silver nanoparticles were placed at different inter-particle distances on top of a thin film of Silicon and gallium-arsenide substrate, respectively. The absorption of incident sunlight within each solar cell type is analyzed, and compared to the short circuit current density, open circuit voltage and the output power generated from each solar cell type due to the effect of the plasmonic nanoparticles. It is found that gallium-arsenide shows larger values than Silicon of the short circuit current generated, open circuit voltage, the fill-factor and the output power generated. These results show the effect of plasmonic metal nanoparticles to increase the opto-electronic efficiency of thin-film solar cells is not limited to only Silicon substrates but extends to other commonly used semiconductor substrates.

S 07.2 **Automatic Sun Tracking for the Enhancement of Efficiency of Solar Energy System**

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Energy is the prime component for the development of a nation. Enormous amount of fossil fuels, viz. coal, gas, oil, etc. are extracted, converted, distributed and consumed by the society on daily basis for various activities. The limited stock of fossil fuels and its end result as global warming forced scientists to harness energy from nonconventional resources. Renewable energy, such as solar, wind, geothermal, ocean tidal waves are the best proven sources of energy. Solar energy is one of the most abundant and cheap resources among these. Solar energy is converted into electrical energy with the help of photovoltaic solar panels. Solar energy is maximized when the sunrays fall perpendicular on the panel. The rigid fixed type conventional solar panels have restriction to receive maximum sunrays because of changing angle of incidence. Automatic sun tracking system is the solution to harness maximum solar energy by facing the sun whole day.

S 07.3   **Multi-Objective Optimization of Hybrid PVT Solar Panels**

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Hybrid photovoltaic/thermal PV/T solar systems are used to convert solar energy into electricity and heat power. The integration of photovoltaic modules with thermals collectors can produce higher temperatures in the photovoltaic module and decrease the efficiency of PVT collectors. Thus, the optimization of hybrid PV / T panels is necessary to improve the overall efficiency of the system. In this work, a mathematical model, describing the thermal, electrical and mechanical flow is developed to predict the variables of the system. Then a multi-objective optimization based on a genetic algorithm (NSGA-II) is applied for an air-based hybrid PV/T panel to improve the efficiency of the system.

S 07.4
Student Award Entry

Simulation of SVPWM based 3-level H-bridge Inverter used in Grid Connected PV System

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In this paper, a photovoltaic (PV) array based three-level cascaded H-bridge multilevel inverter (CHBMLI) incorporated with shunt active filter (SAPF) is proposed. Inverter is modulated by space vector modulation technique. The entire system is used for power conditioning application to improve the power quality in the distribution network. The photovoltaic based CHBMLIs are very attractive solution for the distributed generation nowadays. Because this inverter has isolated dc source on the dc side of the each H-bridge. The compensation strategy proposed is based on the PQ theory. The simulation results presented in this paper proves the compensation capabilities of the proposed system. The simulation studies are carried out under MATLAB Simulink environment.

S 07.5   **Opto-electronic Analysis of $C_{S2}PdCl_2Br_4$ Perovskites Compounds for Photovoltaic Applications**

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In this paper, electronic and optical properties of $C_{S2}PdCl_2Br_4$ perovskite compound are presented using full potential linearized augmented plane wave (FP-LAPW) method. All computations are performed using most accurate modified Becke Johnson (mBJ) potential within density functional theory. Energy band computations are performed over here to elaborate relationship between energy and wave vector (k). Pattern of occurrence observed for energy bands are analyzed in terms of plotted total and partial density of states. For investigating optical behavior of Cs2PdCl2Br4, we have computed dielectric tensor, absorption spectra, reflectivity and refraction spectra using mBJ potential. Different peaks recorded in the imaginary components of dielectric tensor are interpreted in terms of interband transitions for better understanding. Significant absorption intensity available in desired energy range and suitable band gap indicates

effective utilization of this compound in photovoltaic applications.

S 08: Promoting Disruptive Technology and Innovation
Time: 13:30 – 15:10
Room Assignment: Palm Flower C

S 08.1   **Blockchain – Revolutionize Green Energy Management**

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In 2008 Blockchain became known by whitepaper by Satoshi Nakamoto, author of the article "Bitcoin: A Peer-to-Peer Electronic Cash System." Blockchain technology facilitates peer-to-peer transactions without the intermediary, which is safe and trust. Blockchain is a data structure that makes it possible to create a digital ledger of transactions and share it among a distributed network of computers, continuously updated simultaneously and secure with encryption. Furthermore, blockchain uses cryptography to allow each participant on the network to manipulate the ledger in a secure way without the need for a centralized trusted party. Since the Bitcoin protocol is open source. This concept has led to the idea develop of smart contract. Blockchain technology can apply in non-Financial Uses which have application examples in many industries include energy sector. Energy Sector can apply this technology from grid management to retail & customer experience that will transformation to new business model.

S 08.2   **A Blockchain-based Platform for Exchange of Solar Energy: Laboratory-scale Implementation**

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Over the last decade, the increasing uptake of rooftop solar photovoltaics (PV) at the grid edge transforms residential houses into complex energy "prosumers". A house with rooftop solar PV can both consume and export electricity. Hence, it can participate in a "Transactive Energy" network involving peer-to-peer (P2P) exchange of excess electricity. The challenge is to keep track of these transactions and compensate buyers and sellers accordingly. Recently, blockchain has emerged as a distributed ledger technology which allows exchanges among participants without the need for a central market entity. There are several blockchain pilots in the energy sector, which focus on the business, legal and financial aspects, but without much details about how to implement a blockchain-based P2P trading platform. This paper addresses this issue by presenting laboratory-scale implementation of a blockchain network for exchange of solar electricity among participants using Hyperledger – an open-source collaborative effort. Participants, assets and transactions necessary to establish the blockchain-based network for keeping track of solar PV output exchanges are described, together with the smart contract, use cases and their implementation.

S 08.3 **A Low Cost, Open-Source IoT based 2-Axis Active Solar Tracker for Smart Communities**

Annischa Sritoklin, Wiwatthana Malee, Atikom Prugsanantanatorn, Tirasak Sapaklom, Piyasawat Navaratana Na Ayudhya, Ekkachai Mujjalinvimut and Jakkrit Kunthong
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The need for green and sustainable energy source is greater than ever and solar cell is undoubtedly one energy source that gains more popularity as the technology become less expensive and more accessible by anyone. In this paper, we are presenting an active 2-axis solar tracker system combine with the Internet of Things (IoT) technology for an affordable, easy to construct, small foot-print, low maintenance, intelligent and the system able to generate as much as 30% more power than traditional static installation commonly available today. The active 2-axis solar tracker system design is to be simple to construct, require little and cost effective so every house hold in a community can effort and able to take advantage of an open-source technology available. The system consists of sensors, micro controller the ESP8266, cloud server, Node-RED software, grid-tie inverter, and solar panels. There are no specialize components in the system, so every component is locally available, low cost and easy to replace. The result of the system is presented, and it reveal that the system performed as expected as it able to provide energy up to 30% more than static installation while require extremely small foot print 1 m2 for 1.2kw system and 4 m2 for a 6kw system, and little maintenance. The tracker is able to withstand high wind thanks to Node-Red smart algorithm and ESP8266 IoT enable microcontroller working hand in hand to quickly move the solar panel to flat position in the event of high wind conditions. Since this is an open-source research project, the system has potential to be applied to many other communities around the country and perhaps around the world. As the system will not only save the house's owner money, but also reduce the electricity grid's load. Most importantly, this project is enabling people in community to do his or her part as responsible citizens in helping to promote awareness for alternative green and sustainable energy in their community.

S 08.4 **A Spark™ based Client for Synchrophasor Data Stream Processing**

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The SCADA based monitoring systems, having a very low sampling of one reading per 2-4 seconds is known to produce roughly 4.3 Tera Bytes (TiBs) of data annually. With synchrophasor technology, this will go up at least 100 times more as the rate of streaming is as high as 50/100 (60/120) Hz. Phasor data concentrators (PDCs) transmit byte streams encapsulating a comprehensive list of power system parameter including multiple phasor measurements, instantaneous frequency estimates, rate of change of frequency and several analog and digital quantities; this high volume and velocity of data makes it truly 'Big Data'. This helps in making the power grid a lot more observable, enabling real-time monitoring of crucial grid events such as voltage stability, grid stress and transient oscillations. Synchrophasor technology uses the IEEE C37.118.2-2011™Phasor Measurement Unit (PMU) / PDC communication protocol for data exchange which has no direct interface with any contemporary big data stream APIs or protocols. In this paper we propose a streaming interface in Apache Spark™, a

popular big data platform, using Scala programming language, implementing a complete IEEE C37.118.2-2011™ client inside a stream receiver so that we can effortlessly receive synchrophasor data directly to Spark™ applications for real-time processing and archiving.

S 08.5   **An Application of IoT for Collection and Analysis of Specific Energy Consumption in Production Line of Ready-to-Drink Juice at the Second Royal Factory Mae Chan**

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This paper presents an Internet of Things (IoT) communication to energy meter via Modbus protocol for analysis of specific energy consumption (SEC) parameters of ready-to-drink fruit juice production lines in The Second Royal Factory Mae Chan. SEC is a measure of energy efficiency at the output level by measuring the amount of energy used relative to the weight of the unit of physical output. So, use index values specific energy consumption it reflects the efficiency and cost of energy. The part of the production line represents the energy consumption per product. In order to introduce this principle into energy management in the production line of ready-to-drink fruit juice production lines with high power consumption, the analysis starts with indexing the electricity consumption of the plant according to the power consumption in the production line significant to the power consumption in the form of energy consumption indexes on the weight of the product obtained using IoT and the weight of the product. Based on the data analysis, the energy consumption index of the ready-to-drink fruit juice line was similar, and the trend was higher than that of other product lines. It shows that the ready-to-drink fruit juice line has higher electricity costs than other production lines. Based on index usage data, the energy can be used to manage energy costs and improve efficiency the energy of Ready-to-Drink Juice Line of The Second Royal Factory Mae Chan.

S 09: Energy Efficiency and Rational Use of Energy I
Time: 15:25 – 17:05
Room Assignment: Royal Palm Hall

S 09.1   **Benchmarking Energy Efficiency in Tropical Data Centres - Metrics and Measurements**

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The 21st century is driven by the digital economy through the vast use of "Information and Communication Technologies". This has created the "Data Centre Business and Industry" which will continue to grow with e-commerce, mobile users, social media, internet of things, smart grid and smart cities. Data Centre's energy consumption and energy prices (cost) are increasing due to growing demand for Information and Communication Technology and Services. Thus, it has become increasingly important to focus on energy efficiency and sustainability to stay competitive and provide better

services for Data Centre operators. Energy efficiency also reduces the carbon footprint by three times as one unit (energy) saved at consumer will save 3 units (energy) at the source. In addition, Energy Efficiency supersedes the benefit of using renewable energy in reducing carbon emissions. This has led to Green ICT initiatives to enhance energy efficiency in ICT devices as well as using ICT devices. Several countries conducted Benchmarking Energy Efficiency of Data Centres, namely US (2007), EU(2010), Japan (2011), Singapore (2012), India (2012 & 2014) and Malaysia (2015) This paper presents Benchmarking Energy Efficiency in Tropical Data Centres and proposes recommendations for Data Centre Industry to stay sustainable and competitive and reduce emission.

S 09.2   Occupant-based HVAC Set Point Interventions for Energy Savings in Buildings

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Energy savings and occupant thermal comfort are the two most important factors in controlling heating ventilation and air conditioning (HVAC) operation in buildings. Typically, it is found that thermal comfort is not always met in buildings. Hence, there is still an opportunity to improve indoor thermal comfort, and at the same time save energy by controlling HVAC set points. The objective of this paper is to propose a method to obtain energy savings by adjusting HVAC set points based on occupant comfort measured using Predicted Mean Vote (PMV) and occupancy information. The idea is to calculate hourly PMV values based on real-time occupancy information, indoor temperature set points and humidity in a building. Then, a new set of temperature set points that can maintain occupant comfort, i.e., PMV = 0, is derived. To evaluate the effectiveness of the proposed method, a building model is developed in eQUEST using the information from a real-world building located in Alexandria, VA. Research findings indicate that HVAC electrical consumption savings of 14.58% is achieved when the proposed set point adjustment method is implemented as compared to that of the base case. To study the impact of adding occupancy information on HVAC energy savings, another scenario is simulated where HVAC set point is increased when the building is unoccupied, e.g., during lunchtime or holidays. Research findings indicate that additional HVAC electrical consumption savings of 8.79% is achieved when taking into account occupancy information in HVAC control.

S 09.3   Development Control Regulations –Towards Effective Enforcement

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Bhutan is facing challenges at different levels of urban development process. The trend of urbanization is grossly skewed towards the western regions .The urban centers are ever expanding and the primary concerns faced by the sector are uncontrolled growth of the towns and the need to improve and sustain urban amenities and services. Most of the urban centers do not have properly planned green open spaces, parks or children's play areas, which are amenities required to improve the living environment of the urban

centers. The areas where there are urban plans, the development has deviated from the plan and Development Control Regulations (DCR) is not followed. This paper will focus on the existing urban development situation in Bhutan followed by case studies and way forward for effective implementation of the DCR.

S 09.4   **Impacts of Solar PV, Battery Storage and HVAC Set Point Adjustments on Energy Savings and Peak Demand Reduction Potentials in Buildings**

Dany Pamungkas[1,3], Manisa Pipattanasomporn[2], Saifur Rahman[2], Nanang Hariyanto[3], and Suwarno[3]
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This paper discusses and compares three alternatives to reduce electrical energy consumption (kWh) and peak demand (kW) in buildings, namely deployment of rooftop solar PV, battery energy storage and HVAC set point adjustments. The building model of a warehouse located in Alexandria, VA, was developed in eQUEST, and its electrical consumption was validated with metered data. To perform the overall analysis, adjustment of HVAC set points was conducted in eQUEST, while Solar PV and battery models were developed and deployed on top of the developed eQUEST building model. Overall, the method presented here can serve as a guideline for building owners to analyze energy savings/peak demand reduction alternatives, of which benefits are varied from buildings to buildings based on building sizes, electricity tariffs, climate zones and building operation.

S 09.5   **Achieving Higher Prosumption by Prioritizing Energy Demand Management over Renewable Energy Investment: the Case of an Office Building**

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This paper highlights the efforts made by an office building to minimize its dependence on fossil-fuel based electricity by allocating a fixed capital for the purpose. The primary intent was to install a grid-interactive solar power plant that would help offset the electricity imported from the power grid. Consultations were held with the building occupants to propose an alternative which would allow them to achieve higher energy prosumption by prioritizing energy demand management over renewable energy investment. The logic presented to assist in the decision making in favor of this suggestion was based upon the following facts. First, a quick calculation showed that the office building did not have sufficient rooftop space for installing a solar power plant that could even offset half of the purchased electricity. Next, many of the electrical appliances in the building were old and inefficient and it made perfect sense to replace the "low-hanging fruits"; the investment made on these retrofits would be recovered in a shorter time span as compared to the investment made on renewable energy generation. Finally, the capital remaining after the investment made on energy-efficiency retrofits would be used for installing a solar power plant that can be accommodated on the roof of the building.
To start with, a detailed energy audit was conducted to establish a base line of electricity consumption of the building and identify the best strategy to lower the dependence on

fossil-fuel based electricity. An analysis of the energy consumption pattern showed that air conditioning had the largest share of electricity use (67%) followed by lighting (14%). Hence, it was decided to replace majority of the old and inefficient air conditioners by state-of-the art multi-split variable refrigerant flow (VRF) units that would provide high energy performance throughout the year. A capital investment of US$53,225 was made on these air conditioners and calculations showed a simple payback period of less than 5 years. It was then decided to go ahead with a 45 kWp solar power plant with an investment of US$49,200 that would be recovered within 7 years. A full year of monitoring of the energy performance of the building after the adoption of the energy efficiency and solar power plant shows that thanks to sequencing of energy demand management followed by renewable energy generation, the building has been able to achieve a higher energy prosumption within the allocated budget. Moreover, the payback period on the investments would be faster than if all the capital was mobilized for renewable energy generation.

S 10: Biofuels and Biogas
Time: 15:25 – 17:05
Room Assignment: Palm Flower A

S 10.1   **In Vitro Growth of Nyamplung (*Calophyllum inophyllum L.*): the Future Generation Biofuel Plants**

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Nyamplung (*Calophyllum inophyllum* L.) is a potential tree for renewable world energy resources, producing future generation biofuel plants. Propagation technique is required for large scale plantation with highest oil yield of nyamplung. In this study, tissue culture techniques were used for evaluated the optimized nyamplung growth hormone. Shoots rejuvenation were used as explant in MS media enriched with NAA 0.5 mgL-1, 1 mgL-1; 1.5 mgL-1; BAP 1 mgL-1, 2 mgL-1 and 3 mgL-1 and Kinetin 0.15 mgL-1. Shoot and root were induced on the all media used after 10 months incubation. The highest shoot elongation was MS media enriched with 0.5 mgL-1 NAA, 1 mgL-1 BAP and 0.15 mgL-1 Kinetin (10.54 ± 1.98 cm) and the highest root elongation was also in this media (4.65 ± 0.68 cm). Although all the explants rooted after 3 months, in this same media induced a faster root differentiation than the other treatments. NAA concentration higher than 0.5 mgL-1 had no effect on the sprouting process. BAP concentration higher than 3 mgL-1 inhibited callus inductions. The low rates of mortality of rooted plantlets were observed in acclimatization (98 % plants live and grow well up to 6 months of observation). The best hormone concentration of nyamplung media regeneration was expected the highest multiplication for mass micro propagation.

S 10.2

Calophyllum inophyllum for Green Energy and Landscape Restoration: Plant Growth, Biofuel Content, Associate Waste Utilization and Agroforestry Prospect

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Indonesia has approximately 16.8 Mha of degraded lands. These lands have the potential to grow biofuel species to meet the need for energy security, income generation and land restoration. As a promising species *Calophyllum inophyllum* is suitable to grow in 5.7 Mha of degraded land in Indonesia and could contribute to green energy production and restoration of these degraded lands. During the growing stage, this species can grow up to 1 m in height per year and tolerates to harsh environmental conditions. Its seed provides high levels of non-edible oil, thus making it ideal for biodiesel production. In addition, during the biodiesel production process, its waste and by-products can be used as a raw material in pharmaceuticals and cosmetic industries, and as a compost for soil enrichment. Growing various cash crops with *Calophyllum inophyllum* as agroforestry can provide extra income to farmers, thus create added value of *Calophyllum inophyllum* cultivation.

S 10.3

The Research of Power Supply System Operating Modes with Solid-Oxide Fuel Cells on Biogas

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The article is devoted to the construction of the Virtual Power Plant (VPP) distribution network (DN), which unites sources of distributed generation and a centralized electrical network. Graph theory and structural-topological analysis are used to determining the optimal VPP DN topology. The main idea is to assess the reliability and efficiency of VPP DN on the basis of structural-topological characteristics of its graphs. The results of calculations for a low-voltage VPP DN with a wind power plant and a gas piston unit are presented. The PSCAD model of VPP DN is described, which explores the dependencies of VPP DN parameters on its topologies and operating modes. A physical model VPP DN has been developed: it consists of simulators of wind and solar power plants, power storage devices, loads and power lines. On the basis of the physical model, a study of the quality of electricity in VPP DN depending on the ratio of the power of the centralized electrical network and the distributed generation sources has been carried out. Based on the results of the study, an algorithm for determining the optimal VPP DN topology has been developed.

S 10.4

Production and Utilization of Biodiesel using Bio-Alcohol as Reactant

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The production of biodiesel was attempted using seed oil of niger (Guizotia abyssinica) and bioethanol reactant was attempted. The bioethanol reactant was obtained from

vegetative sources viz. water hyacinth. The biodiesel after separation from the glycerol was tested for important properties and compared with ASTM standard as well as with those of conventional diesel (HSD). Almost all the properties of biodiesel were within the range of ASTM standard and also were nearer to the properties of conventional diesel. The engine testing was undertaken using different blends of biodiesel and diesel. Out of these blends, B20 i.e. 20% biodiesel was found to be most suitable from the viewpoints of higher brake thermal efficiency, lower brake specific fuel consumption and lower emission of UBHC. Present study also validates the viability and feasibility of a biorefinery for large scale production of bioethanol employing water hyacinth as feedstock.

S 10.5   **Transesterification of Jatropha Seed Oil Naturally Extracted by Distilled Water on Highly Stabilized Structure of Zeolite NaX Impregnated with Potassium Buffer Solution**

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This research aimed at establishing species of active potassium onto 3D-framework of Zeolite NaX that was prepared with a molar ratio of $1Al_2O_3:1.65K_2O:2.2SiO_2:5.5Na_2O:122H_2O$ by hydrothermal synthesis. The potassium acetate/acetic acid buffer solution impregnated catalysts produced the desired K loadings of xKa/NaXs (x values were 9, 10, 11 and 12 wt%). Characterization of catalysts were carried out with FTIR, N_2 adsorption-desorption, XRD and CO_2-TPD to analyse the respective parameters of the reagents (catalysts) and the product. The 3D-framework of NaX was not destroyed but the surface area and the volume of its micropore were found to have slightly decreased when number of loadings of K was increased. All preppared xKa/NaXs were used to conduct transesterification of Jatropha Curcas *Lineaus* (JCL) seed oil and methanol at the molar ratio of 1:16. 12K/NaX emerged as the best catalyst which produced 78.39 wt% yield of biodiesel and found to be the highest yield at a reaction time of 3.5 hours. The basicity increased with K loadings and facilitated a better catalytic performance for biodiesel sunthesis from this source.

S 11: Green Energy in Transport
Time: 15:25 – 17:05
Room Assignment: Palm Flower B

S 11.1   **Electric Vehicle (EV) Transition in Thailand: Is it Beneficial?**

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The adoption of electric vehicles (EV) is effectively a problem of socio-technical

transitions and comes with its complexities. The Thai Energy Efficiency Development Plan includes the adoption of EV as a voluntary measure to increase the energy effectiveness of its transport sector and to mitigate GHG emissions. But, there are other important social, technological, economic and policy factors which need to be thoroughly investigated before the EV transition is attempted in Thailand, since the environmental cost may outweigh the benefits of the EV transition. The methodology used is based on systems thinking and called Causal Loop Diagrams (CLD). In CLD, the factors underpinning the benefits accruing from the EV transition in Thailand are characterized as causal relationships and feedback loops. Preliminary CLD investigation into the factors for EVs show the technological factor EV efficiency levels and their cost (economic factor) are important in determining the GHG reduction benefit, along with the grid emission factor.

S 11.2   **Numerical Investigation on RCCI Engine Fueled by Methanol and Biodiesel**

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RCCI (Reactivity Controlled Compression Ignition) technology is recognized as one of the most promising low combustion technologies for achieving simultaneous high efficiency and low soot and NO_x emissions. In this work, a 3-dimensional numerical platform coupled with skeletal chemical reaction mechanism has been employed to investigate the impact of various operating conditions on the performance and emissions of a RCCI engine fueled with biodiesel and methanol. For the first time, a φ-T map was employed to investigate the methanol percentage on the performance of the engine. The results indicated that the groups of cells distributed at high ER decrease as methanol percentage increases. Generally, soot emissions drops significantly with the increase of methanol percentage as a result of better mixing between the fuel and air and more homogeneous combustion process. While NO_x increases slightly when the methanol percentage increases from 20% to 60%.

S 11.3   **Electric Vehicle Charging Station Operation and Management Key Functions for Actual Demonstration Site**

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The penetration of electric vehicle charging station will increase as the electric vehicle is a great issue of several industries. For a successive penetration, research is necessary for operating the charging station effectively. In this paper, photo voltaic device generation prediction, electric vehicle charging station usage prediction and peak demand reduce function is proposed for an electric vehicle charging station energy management system. The proposed energy management system will be installed in the demonstration site main control room of Gwang-ju metropolitan city hall at July 2018, and be tested.

S 11.4   **A Review on Re-Utilization of Electric Vehicle's Retired Batteries**

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The utilization of batteries as a primary source for energy recovery and energy storage applications such as solar energy, wind energy, hybrid system and electric vehicles has been increasing rapidly now days. This paper reviews about the utilization methods of retired batteries from transportation sectors. It also describes the classification of chemical storage batteries, their characteristics, benefits and challenges while utilizing retired batteries, and some of the application aspects. The importance of retired batteries along with an integration of building block system is presented in this paper.

S 11.5   **Energy and Environmental Implications of Green House Gas Mitigation Policies in the Transport Sector of Sri Lanka**

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This study analyzes the greenhouse gas mitigation policy options for the transport sector in Sri Lanka. It was carried out through the Asia—Pacific Integrated Assessment Model (AIM/Enduse), which is a bottom up type least cost optimization framework. A business as usual scenario and four alternative mitigation policy options were considered in this study. These policy options include two scenarios with 100 $/tonCO$_2$, 500 $/tonCO$_2$ carbon tax, a subsidy scenario with tax rebates for electric, hybrid vehicles and a scenario which promotes public transport. The results show that the transport sector energy consumption is expected to increase from 5 Mtoe in 2015 to 19.5 Mtoe in 2045. The CO$_2$ emissions are expected to increase from 15 Mton in 2015 to 58 Mton in 2045. Out of the four scenarios, promoting public transport was most effective as it could reduce energy consumption by 52% and reduce CO$_2$ emissions by almost 36% in 2045. At current electricity prices and other costs, electric vehicles are not found to be economical in the analysis.

S 12: GHG Mitigation and Climate Change
Time: 15:25 – 17:05
Room Assignment: Palm Flower C

S 12.1   **A Probabilistic Analysis Approach for Large Power Systems with Renewable Resources**

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Probabilistic power flow has been widely used to manage uncertainties of demand, renewable energy sources and so on in power systems. Among many methods developed for probabilistic power flow, Monte Carlo simulation can give highly accurate results; however, it is usually computationally very intensive and this makes it impractical for calculation and analysis of large power systems in practice. In this paper,

we make use of data clustering techniques to group the input data to reduce the computation time, while maintaining an appropriate level of accuracy. The proposed approach is carried out on the modified IEEE-118 bus test system to demonstrate the performance of the proposed method in comparison with the result obtained by the traditional Monte Carlo simulation.

S 12.2   Trend Detection in CO_2 Emission of Mumbai Metropolitan Region and Cross Comparison with National Emission Database

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With greenhouse gas emissions amounting to 2909.1 $MtCO_2$ eq., currently, India is being viewed as the next emission superpower in the world. Pertaining to an overwhelming surge in the urban population, the economically developed regions of the country are transforming from rural to urban at an unimaginable pace. The atmospheric emissions from land use change, human activities etc. become a cause of concern for the planners and policy makers. Mumbai Metropolitan Region (MMR) located in the western coast of India is one such potential part of the country having a strikingly high economic performance. But the economic development comes with the consequence of making it an effectual GHG emitter too. Empathising with the perturbed situation where development is inevitable but climate change issues are vital too, the present paper aims to study the emission trend in MMR and examine its emission growth. The changing patterns in CO_2 emissions of MMR have been compared with the national emission database. The purpose is to find out the role of such key players in the overall emission growth of the country. The paper presents the trend in CO_2 emission and discovers the annual change along with average annual growth rate in MMR. 1971 has been taken as the static baseline year for the scope of this paper. The change in emission profile of MMR compared with the change in emission profile of India shows that the percentage change in emission is similar in sufficient extent but a huge difference in the annual growth rates noticeably exists. There is an obvious leap in the trendline in both the cases, but an interesting and somewhat synchronized change is observed in the emission profiles. The emission growth rate of MMR is observed to be exceedingly slow as compared to the annual growth rate of the country. The comparison of the change in emissions over time closely links the emission intensity of MMR with that of India's emission intensity. And thus this cross comparison manifests MMR as a key player in the national emission profile. In the end, the paper concludes with emphasizing the implication of emissions of a metropolitan region like MMR in determining the climate change protocols for the country.

S 12.3   Experimental Verification of Electrostatic Precipitator Stable Operation under Oil and Co-fuel firing Conditions of a Coal-fired Power Plant

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Electrostatic Precipitators are usually put into service after a complete shut-off of oil supply to the boiler burners of the furnace of a coal-fired power plant. However, such

practice may lead to enormous dust concentration in the flue gas (design value is 37.9 g/Nm³ at 50%RO load) and heavy black smoke appearing at the stack outlet during the oil and/or co-fuel firing condition of boiler. To minimize such problem, an experimental study on charging and electrostatic precipitator operation during unit start-up and shut-down was carried out to verify de-dusting performance. It requires the manual control of the secondary voltages to be lower than sparking voltage of 10~15kV in case of oil and/or co-fuel firing condition of boiler. The study results prove that the electrostatic precipitator runs normally with good de-dusting performance (about 56.4 mg/Nm3 at unit start-up and within 31 mg/Nm3 at unit shut-down) and meets the Vietnamese environmental emission requirements as per proposed specified rules. From the study results, it can be predicted that Electrostatic Precipitators (ESP) & Sea-Flue Gas Desulphurization System (FGD) may be kept running during house load operation and run-back modes. Also, with the ESP and FGD running, the coal-fired power plant may not be limited to the loading dispatch at stable loads under co-firing condition below the minimum load of anthracite coal firing as required from power system.

S 12.4 Development of Green Corridor for the Pollution Abatement at Dongri Buzurg Opencast Mine of M/s MOIL Limited, India

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Environment is the sum of substances forces and conditions external to an organism that influence its various components and constitutes a multi-dimensional system of complex relationships in a continuing state of change. Manganese is one of the major mineral deposits occurring in the Indian sub-continent. It has played a great role in development of civilization and industrialization. The occurrence of Manganese ore in Dongri Buzurg Mine is proved by the way of exploration and its production has important role in the steel industries. Mining has its vary base, destruction of the part of environment, and mineral processing, which deals with the recovering with the small parts of mined material that is of use to mankind and discharging rest as waste, both the process has have an impact on the environment. MOIL Limited has been using technologies for sustainable development since its inception. The sustainable development framework (SDF) is addressing on various issues begins with grant of mining lease to final mine closure plan stages of mining life cycle. The SDF is also refers on economics, environment and social impacts of mining. It is also causes the environment degradations that lead to destruction of wildlife habitat. To achieve the integration of socio-environmental-economic factors it is essential to develop and implement SDF. By recent amendment of Mines and Minerals (Development and Regulation) Act, 1957, implementation and evaluation of SDF have become mandatory. SDF is modeled by international agencies International Union for the Conservation of Nature and Natural Resources (IUCN) and International Council of Mining and Metal (ICMM) and tailored for Indian conditions. Some of the aspects of SDF are covered in a case study for development of green corridor for the pollution abatement at Dongri Buzurg Opencast Mine.

S 12.5 Increasing of Renewables Hosting Capacity in the Czech Republic in terms of European Project InterFlex (Case Study)

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The paper describes proposed, implemented, tested and verified technical solutions

supporting distributed energy resources (DER) and electrical vehicles (EV) integration in the distribution grids. The solutions are implemented by CEZ Distribuce, the largest Distribution System Operator (DSO) in the Czech Republic, in terms of Horizon 2020 InterFlex project. New approaches for PV inverters control are introduced in a way that DER integration is less limited by voltage constraints or other grid issues. Different approaches for LV and MV grids are explained. Smart solutions including autonomous functions of PV inverters, remote control or energy storage are presented to show the future potential for successful DER grid integration. Further an idea how to control EV charging power is introduced to integrate EVs smoothly.

S 13: Energy Efficiency and Rational Use of Energy II
Time: 09:50 – 11:30
Room Assignment: Royal Palm Hall

S 13.1
Student Award Entry

Scheduling and Energy Management of Smart Homes using Customer Choice Based Algorithm

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In developing countries, reduction of energy consumption cost, load forecasting, scheduling and control on the utility side are the major concern towards energy management. In this paper, a solution to this problem is addressed using PERT (Program Evaluation and Review Technique) combined with CPM (Critical Path Method). It is a technique to obtain the best solutions for optimized scheduling of household appliances for Home Energy Management System (HEMS). The optimization is carried out with various constraints in the selected home environment. The state of this condition is considered as a Mixed Integer Linear Programming (MILP) problem with more complexity. To reduce the complexity of this problem, it is solved in two stages namely, a grouping of appliances and selection of optimized group. The simulation of scheduling the appliances with all necessary inter dependencies is carried out using the proposed technique which is named as Customer Choice Based Algorithm (CCBA). The input data for simulation are considered from the existing methods and its results and performance are compared with the proposed algorithm. The proposed technique has effectively managed the peak demand and reduces the cost of energy consumption.

S 13.2
Student Award Entry

Energy-Saving Analysis of a Hybrid-power Gas Engine Heat Pump with Continuously Variable Transmission

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Hybrid-power gas engine heat pump (HPGHP) could achieve the efficient operation of the engine and improve the partial load performance of the air conditioning system through the cooperation of the gas engine and the dual-use motor. In the paper, the continuously variable transmission is applied to a coaxial parallel HPGHP system to analyze the influence of transmission mechanism on the operating characteristics, and an instantaneous optimal control strategy aiming at minimizing the equivalent energy consumption is proposed to complete the torque distribution of the engine and the motor. The results show that the compressor speed of 1350 rpm and 1800 rpm are the

switching point of three operating modes under the specified heating conditions, and the engine torque and gas consumption rate maintained at relatively stable values of 29.5 N·m and 284 g·(kW·h)-1 by means of the motor with high efficiency in the wide torque range, showing the good energy saving effect.

S 13.3

Student Award Entry

A Hybrid Air Conditioning System Employing Membrane Dehumidification and Dew-Point Cooling

Jie Lin[1], Duc Thuan Bui[1], Md. Raisul Islam[1], Kian Jon Ernest Chua[1], Ruzhu Wang[2]
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The hybrid vacuum membrane dehumidification (VMD) and dew point evaporative cooling (DPEC) system decouples the air latent and sensible heat loads. Experiments are conducted on both VMD and DPEC to individually investigate their capabilities of achieving sufficient humidity and temperature reductions. The dehumidification and cooling performance of the hybrid VMD and DPEC system are studied under hot and humid weather conditions. A theoretical analysis is also carried out to evaluate the energy efficiency limit of the hybrid system. Key findings from this study included: (1) the dehumidifier and cooler are capable of achieving respective humidity and temperature reductions of 4 to 14 g/kg and 4 to 9°C; (2) the hybrid system is able to dehumidify the ambient air humidity from 18.5 to 9 g/kg, while cooling the air from 32.8 to 19°C; and (3) the maximum realizable COP is greater than 16 under the ambient conditions of 32oC and 20.0g/kg.

S 13.4

Design and Analysis of A Hammer Mill Machine in High-Efficacy Recycle Process

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This paper proposes a three-dimensional model of the hammer mill for high-efficacy recycle process. It has been established with a modeling software (SolidWorks) to solve the inconvenience of the testing with a real machine by imported into Simulink. According to various types of wastes creating in huge amounts by every consumption around the word, an effective hammer mill machine is strongly required. The machine should be able to mill all types of wastes including soft (food waste) and hard materials (construction and demolition waste). The significant factors of the modeling of a hammer mill machine are relied on its blades. Therefore, we introduce the calculation of force applying to the blades, as well as, the evaluation of materials are used for making the blades (Stainless steel and Titanium). The evaluation of the force according to the blade materials are conducted by the simulation of the hammer mill model used for corn and brisk. The experimental results show that the proposed force applying to the blades made of Titanium are able to mill both of corn and brisk more efficiently than stainless steel blades do considering to the following parameters: normal stress, static stain, static displacement, and factor of safety (FOS).

S 13.5   **Impact of Relative Advantage, Perceived Behavioural Control and Perceived Ease of Use on Intention to adopt with Solar Energy Technology in Sri Lanka**

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The acceptance and slow growth of solar energy is a major barrier in Sri Lanka. The aim of this study is to identify the impact of relative advantage, perceived behavioural control and perceived ease of use over intention to adopt with solar energy technology in Sri Lanka. Technology acceptance model (TAM), Diffusion of innovation (DOI) and Theory of planned behavior (TPB) are the theories that used to develop the research foundation. A self-administrated questionnaire was conducted to collect data from a sample of 384 respondent households. Structural Equation Modeling (SEM) was used to test the hypothesis. The result of the study indicates that relative advantage, perceived behavioural control and perceived ease of use have a positive impact with Solar Energy adoption. Providing financial support, obtaining continuous feedback and free technical advisory schemes will uplift the solar usage. Strategic planning to determine effective marketing activities to change customer's intention will ensure sustainable business growth.

S 14: Low Carbon Economy and GHG Mitigation
Time: 09:50 – 11:30
Room Assignment: Palm Flower A

S 14.1   **Low Carbon Economy and Society**

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The main challenge of developed countries is to maintain their economic expansion, which is mainly based on the energy from fossil fuels, with significant greenhouse gas emissions. Likewise, the least developed countries have high risks of climate-change induced disasters, as they can neither set the policy for mitigation nor invest much amount money on clean technologies because of their fragile nature of socio-economic-environmental conditions and weak political guidelines. It is thus essential to provide sufficient financial and technical supports to move toward clean energy path by developed countries through World Bank, UNDP, International Monetary Fund, Asian Development Bank etc. This work systematically reviews the emerging concepts of low carbon economy and society, and the transition towards a sustainable economy, with particular focus on developing countries. By analyzing poverty, clean energy technologies and job opportunities, income distribution and carbon pricing, economic aspects of carbon emission, restoration of lost biodiversity; the present and future trends, new perspectives have been presented on each of the above topics.

S 14.2   **Factors, Problems and Obstacles in Developing Hatyai City Municipality into a Low Carbon City of Thailand**

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This research is a study about the city development of Hatyai City Municipality using 4 ways to develop a low-carbon city, namely: 1) city of trees 2) city of waste minimization 3) city of energy efficiency and 4) city of sustainable consumption. Qualitative research is used to find answers in developing the city through policy, participation and suggestions, in order to be a low-carbon city according to the fixed guidelines. In-depth interview and participatory observation are used for research techniques with 3 groups of stakeholders; administrator and officers of Hatyai City Municipality, other local authorities, private representatives and civil society. Data is analyzed using grounded theory. The study found that an important influence that affects policy setting is an outer organization network which works as a volunteer and takes part in pushing for policy and affects development trends in the future. Factors, problems and obstacles were found that show there are limitations in setting national and local policy, lack of environmental knowledge, lack of participation to achieve a low-carbon city. A policy suggestion to set a goal for a low-carbon city that people is to unanimously participate in, reducing the emissions of greenhouse gas and for an operation to set a policy and work plan for people to acknowledge the benefit of being a low-carbon city and the positive impact on life quality, the economy, society and environment.

S 14.3
Student Award Entry   **The Role of Renewable Energy in CO_2 Mitigation from Power Sector in Cambodia**

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The power generation in Cambodia is dominated by hydropower and coal. In 2015, the shares of electricity generation generated from coal, hydro, oil and biomass were 48.1%, 47.40%, 3.65% and 0.85% respectively. The government of Cambodia has set up the Power Development Plan (PDP) 2020 which mainly emphasizes on the development of renewable energy and coal-based power. The drastically increasing share of coal-based electricity generation in the recent years is providing an alarming signal in terms of the increasing greenhouse gas (GHG) emissions from the power sector in Cambodia. Recently, renewable energy and efficient technologies have played an important role in GHG emission's reduction. The aim of this paper is to quantify the potentials of renewable energy and carbon dioxide (CO_2) mitigation options in the power sector of Cambodia. In this study, the Long-range Energy Planning (LEAP) model is used to analyze the electricity generation mix and CO_2 mitigation during 2015 to 2050. The BAU scenario is constructed in this study following the power development targets of PDP2020, and the share of renewable energy-based power generation is assumed to reach 44% by 2050. Three countermeasure (CM) scenarios of CO2 mitigation (namely, CM1, CM2, and CM3) are modeled along with the Business as Usual (BAU) scenario. Two countermeasure scenarios, namely CM1 and CM2 considering an additional 5% of power generation based on solar PV and biomass-based technologies have been constructed in this study respectively. In the CM3 scenario, the CO_2 mitigation effects of replacing 50% of conventional coal-fired power plants with the efficient carbon capture storage (CCS) technology in coal power plants have been analyzed. The results demonstrate that in BAU scenario, electricity supply and CO2 emissions from power sector will increase to 65.9 TWh and 14683.5 kt-CO_2 eq respectively in 2050. In

countermeasures scenarios, CO_2 emissions in 2050 would be reduced by 45% in CM3, 15% in CM1 and 12.47% in a CM2 scenario when compared to the BAU scenario.

S 14.4 Robust Methane Reduction Campaigns for Strengthened Greenhouse Gas Management

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Methane is one of the E&P products with a Global Warming Potential about 25 times greater than carbon dioxide, any company that is able to reduce the methane emissions will gain environmental benefits and strengthen its reputation. For PTTEP, it has annually disclosed its greenhouse gas (GHG) emission performances to relevant parties. In 2016 the direct emissions disclosed were 4.6 million tonnesCO2e, of which about 5% were contributed by methane. PTTEP had initiated the methane survey campaigns for emphasizing the emission reduction. The campaign used an infrared camera and a high volume sampler for effectively identifying and quantifying the emission volumes, which in 2016 about 11,000 tonnesCO$_2$e per year were detected. PTTEP has adopted the results for improving the GHG performance reporting. Normally, the methane emissions were obtained from a calculation; thus, with the survey results PTTEP was able to improve the methane emission performances by 60%.

S 15: Greening Urbanization and Urban Settlements
Time: 09:50 – 11:30
Room Assignment: Palm Flower B

S 15.1 Educational Building's Operational Performance Evaluation through Green Building Assessment - Case of a Philippine State University

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"Greening" an existing building is not an easy task. However, this has been a major concern worldwide in the recent years to address the growing threat of climate change. This study aims to assess the College of Engineering Building of Central Mindanao University through green building assessment and the effect of occupant behavior in its sustainability and determine the potential sustainability measures and policies to be implemented. In this study, two (2) green building rating tools are used to assess the target educational building in a Philippine State University. These tools are the Building for Ecologically Responsive Design Excellence (BERDE) and Green Building Index (GBI). Additionally, a survey which includes the users' (students, faculty & staff) perception of ventilation (POV), perception of design (POD), perception of noise (PON) and perception of energy efficiency (PEE) was conducted by the researchers as a secondary tool to provide support in formulating policy notes. This research concludes that the even though the building is unable to get a certain acceptable rating as a green building in both green building rating tools, the occupants energy efficiency awareness is a strong and promising aspect wherein future innovations can anchor upon and contribute to the sustainability of College of Engineering. In the end, policy recommendations are formulated to improve the buildings performance.

S 15.2 **Development of Cabinet Maker RDF Prototype with Biodry Technology for Small Community**

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The concept of adopting biodry system is to improve the quality of MBT waste. In Thailand, the waste is not separated, resulting in mixed waste of dry waste, wet waste and plastic waste. As a result, the accumulated MBT waste before use in RDF production has low heating value and high humidity. As a result, it took 9 months for the Thai industry. Buy a waste to go to power. Considering the heat and humidity that affect the price of garbage. The use of biodry technology for waste after MBT process will increase the heat and humidity of the waste. Development of a prototype RDF cabinet using biodry technology with a power supply to the air pump for air supply using solar cells for community waste management. Community waste is transformed into RDF and can be used as alternative fuels in the form of electricity or heat. This will help reduce the environmental management problem of garbage. The prototype system. Will perform that installation at Tamanao Subdistrict Administrative Organization Chaibadan District Lopburi Province. The results of the study showed that the Biodry system was developed as a aerator. Potential to be used in wet waste. Higher heat and humidity are reduced. As a result of the oxygen degradation process. The heat, which when tested with wet garbage is heated to $49^{O}C$ by this heat will help to drain moisture. Excess of garbage and add heat to the pile of Biodry until the dry inside. When the garbage is dry, the contaminated surface of the soil or plaster coating can cause the heat to rise in the 30 day period for a short time. And using solar panels as a source of energy to the air system. The garbage can have a heating value of more than 5,000 kcal / kg and a moisture content of less than 30%. The waste is a good quality fuel for use in the heating industry or the general industry.

S 15.3 **Design of District Sewage Heat Supply with Geographic Information System**

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In relation to established plans of district heat supply facilities that make effective reuse of heat obtained from sewage, we developed GIS software to perform analyses of the spatial congruence between heat demand and the use of waste heat in heat supply operations. Based on an analysis using this GIS, we also explored plans for determining locations of heat-recovery facilities in Tokyo. Additionally, we assessed the suitability of heat-supply operations for individual geographical areas by evaluating their heat supply/demand relationships. It is possible to install heat recovery facilities in four locations in the Ochiai treatment district (252 GJ/h) and three in the Mikawashima treatment district (194 GJ/h). Up to five facilities can be installed in the Nakagawa treatment district, for a total usable heat of 205 GJ/h, which corresponds to 70.3% of the recoverable heat at the sewage treatment plant influent point. In the areas with a large amount of usable heat (the Ochiai and Mikawashima treatment districts), there are generally long sewerage lines and many possible heat recovery locations. Owing to the many possible recovery locations, each with large heat demand in areas such as business districts, the amount of usable heat per heat pump is large. There were also a few cases in which the flow rate was a limiting condition. When sewerage lines run mainly through residential areas (e.g., the Nakagawa treatment district), heat demand

along the sewerage lines is small.We therefore chose indicators that represent the characteristics of the heat supply/demand relationship for each line. Taking into account the way sewerage line groups were formed, the representative indicators chosen were the values of the utilization factor and the amount of usable heat per heat pump when pumps were installed in three locations on a sewerage line. A large usable heat amount per pump is an advantage in establishing district heat supply operations. In that sense, the Shibaura treatment district is already highly suited to establishing heat supply operations.

S 15.4

Greening Uranium-Containing Solid Fuels

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The results of thermodynamic and experimental investigation of plasma processing of uranium-containing Nizhneilli brown coal (NBC) and Estonian dictyonema shale (EDS) are presented. The essence of plasma processing of the uranium-containing solid fuels (SF) is in the conversion of the organic mass of SF into synthesis gas, with the simultaneous release of uranium-containing compounds into the gas phase, followed by the production of uranium-free ash. Thermodynamic analysis showed that the gaseous phase of the SF plasma steam gasification products consists, basically, of synthesis gas with a concentration of up to 95.2 vol.% at 1,800 K. At this temperature, uranium-containing compounds completely pass into the gas phase in the form of uranium oxides. Experiments on plasma steam gasification of EDS were performed in entrained-flow plasma reactor. The results of the research testify to the insensitivity of the plasma processing technology to the quality of the SF used.

S 15.5

Performance Assessment of Building by Virtual Energy Audit

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Every region, country and city is witnessing unprecedented growth in infrastructure that includes predominantly building structures. Global Construction 2030 – forecasts the volume of construction. Global Construction Perspectives and Oxford Economics - shows average global construction growth of 3.9% pa to 2030, outpacing that of global GDP by over one percentage point, driven by developed countries recovering from economic instability and emerging countries continuing to industrialize output will grow by 85% to $15.5 trillion worldwide by 2030. This astounding growth in building structures reflects obviously in energy consumption and in turn carbon footprint. There is a need to assess energy efficiency status of the buildings that would enable taking up appropriate energy conservation measures throughout the lifecycle of a building. In this regard, the traditional on-site physical audit suffers with limitations in terms of deployment, installation, human resource and scalability in overall execution, making it techno-economically less attractive and time consuming.

The present paper provides practical application and validation of an innovative tool that enables performance assessment of buildings to uncover energy efficiency improvements in buildings and facilities remotely. This tool uses multi-physics principles wherein entire building is analyzed based on fundamental energy and work transfer principles using laws of thermodynamics, heat transfer and mass transfer. This

innovative tool enables cost efficient energy savings through a virtual energy audit conducted remotely.

In the present work, the case study from India, in particular academic building, industrial building and commercial building are considered as a candidate for virtual energy audit. The results depict that virtual energy audit is holistic and accurate evaluation and analysis of candidate's current energy use. The results enable take informed and educated decisions for prioritizing energy conservation measures to improve energy efficiency

S 16: Power System Operation II
Time: 09:50 – 11:30
Room Assignment: Palm Flower A

S 16.1   **Real-time Implementation of Synchrophasor Based Linear State Estimator in OPAL-RT HYPERSIM**

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Real-time monitoring of system behavior is an integral part of modern power system operation and control. With the increasing demand, it is becoming critical and very essential to monitor system states for quick decisions to prevent the cascading blackout. Availability of phasor measurement units (PMUs) has been proven a cornerstone for real-time monitoring of the system at some of the specific locations, where these devices are placed. However, higher cost and required communication infrastructure limit the placement of PMUs at some optimal places only. Although many research works have been done for PMU based linear state estimator (LSE), online implementation and validation of various estimation algorithms at control centers are yet to be fully established. This paper presents the systematic procedure of digital simulation in the OPAL-RT HYPERSIM, generation of the IEEE C.37-118 protocol compliant synchronized measurements, and validation of state estimation algorithms in the real-time environment.

S 16.2   **Transient Analysis of Single-Line-to-Ground Faults in Three-Phase Circuits Using Clarke Transformation**

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This work deals with the analytical solution of transients in single-line-to-ground faults in three-phase power systems through the Clarke transformation. The proposed approach is based on the Thevenin representation of the alpha, beta, and zero component circuits in the Laplace domain. The fault results in a mutual coupling of such circuits. For the single-line-to-ground fault the circuit coupling can be represented by an ideal transformer connected between the alpha and the zero component circuits. The proposed systematic methodology, however, can be readily extended to other kinds of faults. The analytical solution derived in the paper is validated through Matlab simulations in the time domain.

S 16.3   **A Data-driven Approach for Estimating Power System Frequency and Amplitude Using Dynamic Mode Decomposition**

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To ensure power system stability, control and quality supply of power, it is essential to monitor power system parameters such as frequency and amplitude. This paper proposes a data-driven approach based on dynamic mode decomposition (DMD) algorithm for the accurate estimation of frequency and amplitude in smart grid. In the proposed approach, to extract the multiple frequency components, including harmonics, inter-harmonics and subharmonics, a stacked measurement matrix is created by appending multiple time-shifted versions of power signals. An optimal hard-thresholding is performed on the singular values of the measurement matrix to deal with the uncertainties and high-level noises. Further, the frequency and amplitude are computed based on the extracted dynamic modes. The performance of the proposed approach is confirmed through various experiments conducted on different power system scenarios under noisy and noiseless conditions. The effectiveness of the DMD based method is verified by comparing the results with several state-of-the-art methods. The promising results suggest that the proposed approach can be used as an efficient candidate for estimating the power system frequency and amplitude.

S 16.4   **Rate Dependent Transitions in Power Systems**

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Bifurcations are the sudden qualitative transitions occurring in dynamical systems due to infinitesimal changes in the control parameters. These abrupt qualitative transitions are crucial in deciding the stable operating regime in the case of a power system. However, in the actual power system, the control parameters such as the electrical power demand, the inertia of the system, damping of the system etc. are found to vary with respect to time. In this paper, bifurcations in an electrical power system for the quasi-static and rate dependent variation of the control parameters are investigated. The canonical power system is represented by assuming a single machine connected to an infinite bus (SMIB). The mathematical modeling of the canonical system is carried out by a second order swing equation model of the generator. We observe a delay in the point of transition for rate-dependent variation of the control parameter, mechanical power, P_m. We also investigate the influence of noise and sensitivity to initial conditions in rate-dependent variations of the control parameter. Our study is highly relevant as the stability regimes for the quasi-static and rate dependent variations of control parameters are different.

S 16.5   **Identification of Weak Nodes in Power System Using Conditional Number of Power Flow Jacobian Matrix**

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In power system an important feature is the ability to anticipate Voltage instability, as it helps in splitting the network into islands and system will be in extremis state. Identification of weak nodes in power system may be useful for system operators for

actuating suitable controls to prevent voltage instability. Time series evolution of the conditional number of power flow Jacobian matrix is utilized in this paper to identify the weak nodes in the system. If the conditional number value goes beyond the threshold value, then the generators with minimum reactive power margin and loads with maximum change in nodal reactive power loss within the zone are identified. All these generators and nodes within the zone are ranked, the generator with minimum reactive power margin and the node with highest change in nodal reactive power loss in the minimum reactive power margin zone is the weakest node. This methodology is validated in New England 39 bus test system and the simulation results shows that this methodology is effective in identification of weak nodes in the power system.

S 17: Smart Grid and Green Energy Integration I
Time: 09:20 – 12:00
Room Assignment: Royal Palm Hall

S 17.1   **A Framework for Developing VPP Conceptual Models: From Multiple Dimensions and Stakeholders, Towards a Unified Perspective**

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Virtual Power Plants (VPP) are one of the most important concepts today for offering flexible control and management of distributed generation and load resources for supporting grid operation. By virtue of aggregating flexible negative and positive generation resources, or 'flex', into a single portfolio and offering it to entities who are customers of 'flex', the VPP needs to offer different value propositions to different customers. For utilities, cities, residential communities, industry parks, or clusters of small & medium enterprises, a VPP not only offers grid stability, new revenue sources, and a more sustainable and greener future, it also raises the question: How can different entities come together to foster the VPP concept and realize a common value creation network. This paper proposes a structured and methodical framework for evaluating the frame conditions, designing multiple VPP conceptual models for different value chain segments, and finally, creating integrated VPP conceptual models that can be used as starting points for detailed financial and operational planning.

S 17.2   **A Comprehensive Analysis of Renewable Energy Representations in Power System Generation Expansion Planning**

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Due to the stochastic nature of renewable generation, power system planning with high penetration of renewables is challenging. Analyzing the influence of renewable energy variability on system reliability is of crucial importance in power system planning. There are two well-known approaches in incorporating renewable generation: the negative load approach and the multi-state generation approach. The objective of this study is to review the performance of these two methods in quantifying system reliability. Both pros

and cons of each method are discussed based on experiments conducted using public data for both wind and solar power generation. Reliability indices are quantified using these two representations of renewable generation. In addition, this paper analyzes how representative a single-year renewable generation profile is, by comparing the reliability indices using multiple-year renewable energy data.

S 17.3
Student Award Entry

A Game Theoretic Approach for Demand-side Management considering Generation, Storage and the Combinatorial Nature of Load Scheduling

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In this paper an energy consumption scheduling for residential area considering generation, storage and the combinatorial nature of shiftable device scheduling has been proposed. The smart grid consists of the traditional users as well as users with smart meter who participate in the day ahead optimization process to reduce their energy bill by storing, generating and shifting their device to non-peak hours. These entities by participating in optimization process reduce the per unit energy cost of the grid for all users. It is assumed that all of the participating users own a storing, generating or both devices having same characteristic. A billing scheme has been adopted to encourage the user to shift their load to non-peak hour. The users will compete to shift their load as well as to charge their storage device to low load period, therefore the resulting day ahead optimization problem has been formulated as non-cooperative game between the users. The iterative distributed algorithm can be run on user's smart meters to solve the formulated problem. The strategy set for the scheduling of time shiftable devices are discrete and combinatorial in nature, hence particle swarm algorithm for optimizing the individual users pay off function has been used. The obtained results demonstrated the effectiveness of the proposed method in terms of reduced energy price and system peak while considering the user's privacy and comfortability.

S 17.4

Implementation Methodology of Integrated Renewable Energy System Modeling for Off-grid Rural Electrification: A review

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The various needs of human domiciled in the isolated rural areas can be fulfilled using locally available renewable energy (RE) sources especially when a grid extension becomes economically unviable. The off-grid rural electrification using single RE source may not be economical and reliable due to the intermittent operating characteristics of the major RE sources. The integrated system designed using two or more indigenous RE sources along with the energy storage device can overcome the demerits of single RE source based system. This paper aims to present a review on implementation methodology of the integrated renewable energy system (IRES) modeling for off-grid rural electrification. In this context, a review on the earlier studies conducted on the IRES for off-grid rural electrification has been carried out, and the discussion on the various configurations, design approach, and the steps involved in modeling methodology of the off-grid IRES has been presented, which can be useful for planning the off-grid IRES to electrify the remote rural areas. This study will be useful to the researchers working on RE sources based stand-alone power generation for remote rural areas.

S 17.5   **Grid Integrated Solar Photovoltaic Array Power Plant Modeling and Simulation**

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In this paper we discuss the simulation model and modeling of a 3MW PV based solar power plant connected to the grid on MATLAB Simulink R2014a. The motive behind this is to meet with the ever changing demand of energy in this today's world while keeping our planet free from pollution. For this purpose, one such idea is to employ the use of solar energy by harvesting it with the help of proper techniques. The requirement of MPPT controller is to ensure that at maximum power output possible, the PV power generation system gives an output. This system comprises of a solar arrays, Insulated Gate Bipolar Transistor based inverters and transformers to couple it to the grid. A graphical description of plant's performance has also been done.

S 17.6   **Modeling and Simulation of Grid Connected 1 MW Solar PV Power Plant**

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For a generation like ours where pollution a also a major matter of concern along with the depletion of the fossil fuel , we need to find different methods of energy generation where the pollution is at its minimum and the power generated is sufficient enough to fulfill the crisis. The modeling model as well as simulation of a 1 MW solar power plant based on PV when connected to a grid is done on MATLAB simulink R2014a. If the extraction of energy coming from the sun is done in proper ways then we can cope with the growing demands of the electricity without harming the environment. The development of PV array model with their integration and the implementation of simulink are described in this paper. IGBT, Inverter, solar array and transformer are some of the components used in this system. Power plant performance is also shown with the help of a graph.

S 17.7   **Economic Load Dispatch Using Genetic Algorithm Optimization Technique**

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In the power system, "Economic load dispatch" means the generation of electricity is low of cost and the power system constraints such as Real power and Reactive power vary within the specified limits while fulfill the load demand of the power system. Main objective of the ELD problem is to minimize the total fuel cost. The total cost of operation includes the cost of fuel, transmission cost, labour cost and cost of maintenance. The two major factors to be considered while dispatching power to generating units are the cost of generation and the quantity of power supplied. The relation between the cost of generation and quantity of power supplied is expressed in a polynomial equation and it is solved by applying of mathematical technique. The suggested optimization techniques have a merit in finding an optimal solution. In this research paper we apply basically genetic algorithm and simulated algorithm. We have tested the applied algorithm on IEEE 30 bus system and 20 unit generator system.

S 17.8   **Multi-Objective Optimization for Enhancing System Coordination Restoration by Placement of Fault Current Limiters on an Active Distribution System with System Reliability Considerations**

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Nowadays, customer satisfaction relies on not only the power delivery, but also in the system reliability. It results a number of measures adopted by utility for reliability improvement. Moreover, distributed generators (DGs) are also enhanced to integrate to distribution system because DGs improve system reliability and capability. However, DGs can lead to mis-operation of protective devices and wider outage areas in power system due to increase in fault level. Moreover, system outage is the vital cause which decreases the system reliability. To mitigate escalation of fault level, fault current limiters (FCLs) are installed to limit incremental fault generated by DGs and improve system reliability. However, to enhance effectiveness of FCLs installation, non-dominated sorting particles swarm optimization (NSPSO) is adopted to find the optimal placement of FCLs. Moreover, novel binary particle swarm optimization and continuous particle swarm optimization are performed optimization simultaneously for selecting installed locations. Therefore, three objectives are considered in optimization process consist of to minimize total cost of fault current limiters installed, to minimize total different of margin operating time of main and backup relay pairs and to maximize system reliability. The optimal results are the set of various solutions conform with multi-objective placed in pareto optimal front, and the result show effectiveness of combined continuous-binary NSPSO. The optimization process is carried out on IEEE 33-bus and IEEE-69 bus radial system.

S 18: Biomass Technology II
Time: 09:20 – 12:00
Room Assignment: Palm Flower A

S 18.1   **Hydroprocessed *Calophyllum Inophyllum* Oil for Linear Bio-Alkane Fuel Production**

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The use of vegetable oils in transesterified form is a common technological product for biofuel especially biodiesel. In order to develop a specification of biofuel, vegetable oils were converted into bio-alkane fuel by hydroprocessing technology. Selective bio-alkane fuel formation and higher heating value (HHV) of the product were investigated. Hydroprocessing of *Calophyllum inophyllum* oil as one of vegetable oil was carried out at ranges of parameter process (T = 320-350°C, PH2 = 1-4 MPa, t = 60-240 min, commercial NiMo/Al$_2$O$_3$ catalyst loading = 0-2.5 % mass of feed). Liquid product after hydroprocessed was analyzed to determine the formation of bio-alkane fuel composition and its calorific value. During hydroprocessing the fatty acids in *Calophyllum inophyllum*

oil (mainly palmitic acid (C_{16}), stearic acid (C_{18}:0), oleic acid (C_{18}:1), and linoleic acid (C_{18}:2) were mainly converted into pentadecane ($C_{15}H_{32}$) and heptadecane ($C_{17}H36$). Increase in temperature, hydrogen pressure, and amount of catalyst, the total percentage area of the bio-alkane fuel as well as HHV in the liquid product also increased. Finally, hydroprocessed *Calophyllum inophyllum* oil selectively produced pentadecane ($C_{15}H_{32}$) and heptadecane ($C_{17}H_{36}$) with small amount of nonane (C_9H_{20}), decane ($C_{10}H_{22}$), undecane ($C_{11}H_{24}$), dodecane ($C_{12}H_{26}$), tridecane ($C_{13}H_{28}$), tetradecane ($C_{14}H_{30}$), hexadecane ($C_{16}H_{34}$), octadecane ($C_{18}H_{38}$), nonadecane ($C_{19}H_{40}$), eicosane ($C_{20}H_{42}$), heneicosane ($C_{21}H_{44}$), docosane ($C_{22}H_{46}$), and tetracosane ($C_{24}H_{50}$).

S 18.2
Student Award Entry

The Use of Inclined Tuyer and its Effect on the Compatibility of Downdraft Gasifier Fed by Rice Husk and Wood Sawdust

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The recent work investigates effect of tuyer inclination angle of 300 and 600 on the compatibility of small-scale downdraft gasifier on feedstocks of rice husk and wood sawdust. The compatibility in terms of cold gas efficiency of the gasifier are compared for both feedstocks. The results are also compared with the result for the use of horizontal tuyer. The result indicates that inclined tuyer effects temperature profile, fuel consumption rate, higher heating value gas, and cold gas efficiency. The use of inclined tuyer decreases cold gas efficiency of the gasifier. The compatibility of the gasifier on the feedstocks in terms of cold gas efficiency using inclined tuyer is lower than using horizontal tuyer. The cold gas efficiency with horizontal tuyer 00, and inclined tuyer 300, and 600 are 78.39%, 51.73%, and 55.30% for rice husk gasification. Meanwhile for sawdust gasification, the values are 66.36%, 42.25%, and 35.40%, respectively.

S 18.3

Co-Firing Cassava Rhizome and Eucalyptus Bark in a Fluidized-Bed Combustor Using Reburning: Combustor Performance and Time-Related Bed Behavior

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Pelletized cassava rhizome (base fuel) and eucalyptus bark (reburn fuel) with elevated potassium content were co-fired in a conical fluidized-bed combustor using reburning to reduce NOx emissions. Long-term co-firing tests were performed with two alternative bed materials, pure alumina sand and a mixture of alumina sand and silica sand (in equal wt.%), to mitigate bed agglomeration. All experiments were performed with constant operating parameters (total heat input to the reactor, energy share of the reburn fuel, excess air, and secondary-to-total air ratio). Physical and chemical characteristics of the bed materials and particulate matter were quantified at different time instants. The study showed weak effects of the bed material type on combustion and emission performance of the combustor. When co-firing the selected biomass fuels, high (over 99%) combustion efficiency can be achieved at about 45% NO emission reduction, as compared to firing the base fuel alone. Using the selected bed materials, bed agglomeration can be prevented in the combustor for a relatively long operating time. However, the bed materials showed time-domain changes in physiochemical

characteristics and a diminishing capability to resist bed agglomeration, particularly when using a mixture of alumina and silica sand.

S 18.4   **Mixotrophic Cultivation of Nannochloropsis sp. BR2 in Sugarcane Bagasse for Biodiesel Production**

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Modern day civilization is dependent on energy from fossil fuels. But the major drawback of using fossil fuels is environmental pollution. Biodiesel is extensively used biofuel, used for transportation purpose throughout the world. Biodiesel can be generated by various types of renewable lignocellulosic biomass alongwith many other value-added products. The present study resulted into comparison of mixotrophic and autotrophic cultivations of three oil producing/accumulating microalgae including two freshwater and one marine inhabitant. Protein productivities and carbohydrate contents were analyzed. Maximum protein productivity for *Nannochloropsis* sp. BR2 was 2229 mg/L/d in sugarcane bagasse. Biodiesel via in situ transesterification was also investigated. Total fatty acid and saturated fatty acid methyl esters were increased in case of *Nannochloropsis* sp. BR2 upto 170 mg/g and 72 mg/g respectively, than its photoautotrophic cultivation. Thus, cultivating oleaginous microalgae mixotrophically on sugarcane bagasse and other food industrial wastes is promising for the provision of value added products and bring new jobs for the workers.

S 18.5   **Synergistic Treatment Strategy for Efficient Release of Reducing Sugar from Orange Peel during Acid and Enzymatic Treatment Process**

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In the present study, the orange peels were hydrolyzed at $121^{o}C$, 15 psi for 15 mins, 30mins and 45 mins using sulphuric acid (H_2SO_4) at concentration ranging from 2.5 to 15 %(v/v). Furthermore enzymatic treatment process was carried out by using equal amount of xylanase enzyme to acid hydrolysates after neutralization with sodium hydroxide (NaOH) at a concentration of 5% (w/v). The enzymatic process was carried out at $37^{o}C$ at 180rpm and reducing sugar was measured after 1, 2 and 3 hr of enzymatic treatment. It was found that the maximum reducing sugar per gram of orange peel was found to be 315.54 mg/g in presence of 2.5% (v/v) H_2SO_4 at 15 psi for 30 min reaction time which was considered to be optimum. The maximum reducing sugar found during enzymatic treatment was 616.81mg/g at 3rd hour, 310.19mg/g at 2nd hour and 274.50 mg/g at 1st hour respectively from the sample which was hydrolyzed by 2.5% (v/v) sulphuric acid. Since enzymatic conversion rate for production of reducing sugar from acid hydrolysates was found to be higher after one hour enzyme treatment process, therefore, it was considered to be optimum. The reducing sugar production rate was found to be decreasing at various incubation times may be due to inhibition of enzyme. Therefore, the maximum reducing sugar (582.48 mg/gm of orange peel) can be produced by optimization of acid hydrolysis and enzymatic treatment.

S 18.6 **Preparation of Fuel Pellets and Extraction of Natural Dyes from Falling Leaves to be Used as Sensitizer in Dye Sensitized Solar Cell**

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Natural dye sensitized solar cells due to their ease in fabrication and non-toxicity are of great interest in the field of energy conversion. In this study, three plants (a) Eugenia oleina (b) Muntingia calabura (c) Buxus sinica var (boxwood) have been selected due to their abundance in University of Malaya, Malaysia. Isopropyle alcohol has been utilized to extract the natural dye pigments from the falling leaves of these plants. Cocktail of these natural extract has also been investigated which displayed highest efficiency due to high light absorption ability. Another objective of this study is to use the spent leaves after extraction of dye as fuel for heating purposes. The gross calorific value (GCV) has been measured using bomb calorimeter. The GCV values of individual and combined spent leaves were almost the same with very little difference. The maximum GCV value displayed by pellets prepared by spent leaves of Muntingia calabura was 16.84KJ/g.

S 18.7 **The Effects of Nanoenhanced Calcium Chloride Hexahydrate based Phase Change Materials on Microstructural and Thermal Properties for Thermal Energy Storage**

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Phase change materials store and release thermal energy during the process of melting and freezing. PCMs exhibit a high enthalpy of fusion with the ability, in a relatively small volume, to store or release large amounts of energy as latent heat during melting and solidification. However PCMs has drawbacks such as low thermal conductivity, low thermal stability, super cooling and high corrosivity. Therefore the current research is to improve the thermos-physical properties of nano-enhanced PCM, calcium chloride hexahydrate ($CaCl_2.6H_2O$) by incorporating multiwall carbon nanotube (MWCNT), graphene, strontium titanate and titanium dioxide with nucleating agents, surfactants as well as additives for advanced nanocomposites for the application of photovoltaic thermal(PV/T) system to generate electricity, heat and PV cooling for sustainable energy. The advanced nanocomposite was synthesized by two step method and further characterized using thermal conductivity meter, Differential scanning calorimeter (DSC), thermal gravimetric analysis (TGA). Scanning electron microscope (SEM) and Transmission electron microscope (TEM). Conclusively by adding nanoparticles acts as a nucleating agent and improved the thermal conductivity in PCM enhances it's thermos physical properties for thermal energy storage. The thermal conductivity and latent heat increased rapidly.

S 18.8

Metal Oxide Nanoparticles doped Polyaniline based Nanocomposite as Stable Electrode Material for Supercapacitors

Syed Shahabuddin[1], Nurul Aquilla Mazlan[1,2], Siti Nor Atika Baharin[2], and R. Saidur[1]

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The present study displays the simple approach for the synthesis of nanoparticle doped polyaniline (PANI) nanocomposites by in-situ oxidative polymerization methodology for devising electrode material for high performance supercapacitors for energy storage. There are many existing methods for charge storage which includes, electric double layer capacitor (EDLC), Pseudo capacitor, and hybrid super capacitor. In EDLC there is no chemical reaction and the charge is stored by electric double layer effect by forming double layers of charges at electrode-electrolyte interface whereas chemical reactions for storing charges is utilised in pseudo capacitor. However, to cope up with the ever growing demand of energy storage, a hybrid super capacitor is lately most explored by researchers. A hybrid supercapacitor is a combination of EDLC, pseudo capacitor and battery grade material. We have devised a simple, facile technique to designed novel and cheap materials based on conducting polymers to fabricate efficient super capacitors. The synthesised conducting polymer based nanocomposites were synthesised and characterised by various techniques namely, transmission electron microscopy (TEM), thermogravimetric analysis (TGA), and Fourier transform field emission scanning electron microscopy (FESEM), X-ray diffraction (XRD), infrared spectroscopy (FTIR), BET. The nanocomposites were then fabricated into electrodes to analyse the electrochemical efficiencies employing cyclic voltammetry (CV), galvanostatic charge-discharge (GCD) and electrochemical impedance spectroscopy (EIS) in 1 M of KOH as an aqueous electrolyte. The electrochemical investigation reveals that the electrochemical performance of the nanocomposite doped with nanomaterials was higher as compared to the undoped conducting polyaniline. The CV studies also specified that doped nanocomposites exhibited higher voltammetric current as compared undoped polymers leading to enhanced capacitive nature. The conducting polymer based nanocomposite also presented an improved life cycle capacitance retention.

S 19: Wind: Operation and Stability
Time: 09:20 – 12:00
Room Assignment: Palm Flower B

S 19.1

Control of Doubly Fed Induction Generator of Variable Speed Wind Turbine System using Neural Network

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This paper presents artificial intelligent controller based on Artificial Neural Network (ANN) for Doubly Fed Induction Generator (DFIG) wind turbine system. For the purpose of maintaining constant active power based on PI controller concepts. The ANN controller is based on rotor loop design for a variable speed wind turbine. An active power and reactive control law are created for controlling the rotor voltages of DFIG,

and error signals for both the two powers act as the input to ANN Controller; this approach eliminates the use of current inner-loops and estimation of any flux components. For the purpose of comparison PI-based vector controller is developed. The simulation results based on dynamic performance indicate the superiority of ANN based rotor loop controller over the conventional PI controller.

S 19.2   **Evaluation and Mapping of Wind Energy Potential over Southern Part of India using ANN and GIS Approach**

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Prediction and assessment of wind speed are necessary prerequisites in the sitting and sizing of wind power applications. In this study, an artificial neural network (ANN) model was developed for prediction of wind energy potential in Andhra Pradesh (AP) and Telangana state (TS), India. ANN models are 'black-box' modelling technique, with capability to perform non-linear mapping of a multidimensional input space onto another multidimensional output space without the knowledge of the dynamics of the relationship between the input and output spaces. The geographical parameters (latitude, longitude and altitude) and the month of the year were used as input data, while the monthly mean wind speed was used as the output of the network. Geographical and meteorological data of 30 cities in AP and TS of 20 years (1995–2015) by the India meteorological department, Pune (IMD-Pune) database were used for the training and testing the network. The testing data were not used in the training of the network in order to give an indication of the performance of the system at unknown locations. Statistical error analysis in terms of mean absolute percentage error (MAPE) was conducted for testing data to evaluate the performance of ANN model.

S 19.3   **An Evaluation of Potential Rise in a Wind Turbine Generator Earthing System during a Direct Lightning Strike**

Raghavender Goud Deshagoni[1], Ramesh Rayudu[1], Ciaran P. Moore[1], and Tony Auditorey[2]
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A reliable and robust earthing system design is critical for the lightning protection system of a wind turbine. This paper presents an analysis of the wind turbine earthing impedance and potential rise for a horizontal multi-layer soil model in the event of a direct lightning strike on the wind turbine generator. The influence of soil resistivity and lightning current wave shapes on the wind turbine grounding impedance are analysed. The results show that the wind turbine earthing system is more vulnerable to high frequency components of the lightning strikes. The other findings highlight the impact of soil resistivity values and frequencies over the impedance and potential distribution of the wind turbine generator earthing system.

S 19.4   **A Proposed Method for Calculating Earth Electrode Length for a Wind Turbine Generator Grounding System**

Raghavender Goud Deshagoni[1], Tony Auditorey[2], Ramesh Rayudu[1], and Ciaran P. Moore[1]
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A safe and reliable grounding system plays a critical role in the design of an effective lightning protection system of a wind turbine generator. An accurate design of grounding electrodes is required to achieve the necessary low impedance of a wind turbine generator earthing system. IEC 61400-24 provides guidelines for selecting the minimum length of an earth electrode, however, this standard cannot be utilized for all types of electrode shapes and buried depths. Moreover, it is important to address the frequency dependency of soil resistivity for the selection of electrode length. This paper proposes a novel method enhancing the IEC 61400-24 standard method. Also, a thorough analysis of existing method with suitable recommendations for the selection of electrode length for various dimension and buried depth to address the frequency dependency issue has been provided. Finally, guidelines for the selection of electrode length for the wind turbine grounding design from the lightning protection view point are proposed.

S 19.5   **Optimal Placement and Sizing of DG Based on Single Phase Wind Turbine Generator in Distribution System**

Panaya Sudta, Nathakornphong Veerachayapornkul, Weerakorn Ongsakul, Nikhil Sasidharan, and Jai Govind Singh
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Nowadays the rapid evolution of power systems leads electricity system transfer from centralized fossil fuel to decentralized distributed generation (DG). The distributed generation based on single phase wind turbine generator placement and sizing problem is formulated as a nonlinear integer optimization problem. Single phase wind turbine installation in distribution systems is beneficial and requires optimal placement and sizing of this DG. However, the addition of single phase wind turbine can cause power quality problems such as over voltage levels and increasing of harmonic waveform. Hence, single phase wind turbine should be optimally located and rated taking the presence of power into account. The goal is to minimize the overall cost of total real power losses and maintain voltage level and power quality. The optimal single-phase wind turbine placement and sizing problem is tackled by particle swarm optimization (PSO). To include the presence of real power, the developed PSO is integrated with power distribution system. The modified IEEE 13-bus three phase unbalanced radial distribution system is used to validate effectiveness. This case study is implemented on MATLAB. The results present the necessity of including harmonics in optimal single-phase wind turbine placement and sizing to avoid any possible problems that occur with power quality issue.

S 19.6 **Modeling and Comparative Performance Analysis of Different Bladed Vertical Axis Wind Turbine (VAWT)**

Hafeez Khoharo, Laveet Kumar, and Muhammad Sharif Jamali
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Collective effort on energy sector mainly renewable energy, especially Wind Turbine design and development is of major concern. Nowadays, due to the energy crisis, the Horizontal Axis Wind Turbine (HAWT) is most commonly used due to its high height. Because we can attain high wind speeds and that results in self-starting capabilities of HAWT. Nevertheless, Vertical Axis Wind Turbine (VAWT) titled Savonius Wind Turbines have many advantages over HAWT and Darrieus VAWT. This research aims to model, design and analyze the performance of different bladed Vertical Axis Wind Turbine (VAWT) by considering different design parameters. Different bladed Savonius type VAWT were taken as testing objects and their performance was analyzed with respect to velocity and number of blades in terms of RPM, voltages, torque, and power. The results concluded that three bladed VAWT is much better than other different bladed VAWTs.

S 19.7 **An Optimized ANN Measure-Correlate-Predict Method for Long-term Wind Prediction in Malaysia**

Yong Kim Hwang[1], Mohd Zamri Ibrahim[1], Ali Najah Ahmed[1,2], and Aliashim Albani[1]
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The major issues on the wind measurement campaign are the data measured in a short period and the occurrence of missing data due to the failure of the measurement instrument. Meanwhile, Measure-Correlate-Predict (MCP) method had widely been used to predict the long-term condition and missing data at the measurement site based on nearest Malaysian Meteorological Department (MMD), Meteorological Aerodrome Report (METAR) and extended Climate Forecast System Reanalysis (ECFSR) data. In this research, the long-term wind data at selected potential sites in Malaysia were predicted by optimized Artificial Neural Networks (ANNs). The Genetic Algorithm (GA) was applied to optimize the ANN. Five different ANN MCP models had been designed based on different types of reference data and different temporal scales to predict wind data at three target sites. Weibull frequency distributions and RMSE examined predicted wind data. The prediction of ANN had been improved in between 20.562% to 113.573% by GA optimization. The best R-value obtained from optimization were affected the Weibull shape and scale of predicted data. At last, the result revealed that the optimized ANN model could predict the long-term data for the target site with better accuracy.

S 19.8 **Computational Fluid Dynamics Studies on the Wind Speed Characteristics of an Improved Diffuser Design**

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During the following decades, the Diffuser Augmented Wind Turbine (DAWT) concept has attracted continuous interest as an appropriate concept by the modern Horizontal Axis Wind Turbine (HAWT). This research studies about the optimization of DAWT using the preliminary design based on Kannan et al's research, it was showed that the

final wind speed 61.25% increases over the inlet speed. In this paper, we propose a method that combines preliminary design with varies on the size of flange and inlet shroud using ANSYS software simulation to observe the fluid flow phenomenon in both inside and outside of the diffuser. The simulation boundary conditions refers to Abe and Ohya studies while the diffuser design to be tested refers to T. S. Kannan et al with the addition of small inner diffuser splitter. The best result reaches when combining the performance of inlet shroud and flange with the specific of 0.125D radius and 40° arc angle of inlet shroud, and 0.375D in height of the flange. This design has a total magnification until 1.8575 times or 85.75% increases over the inlet speed.

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S 20: Smart Grid and Green Energy Integration II
Time: 13:00 – 14:40
Room Assignment: Royal Palm Hall

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S 20.1 **Optimization of Virtual Power Plant Topology with Distributed Generation Sources**

Andrey V. Shalukho, Elena N. Sosnina, Ivan A. Lipuzhin, Alexander Yu Kechkin, and Alexander A. Voroshilov
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The article is devoted to the construction of the Virtual Power Plant (VPP) distribution network (DN), which unites sources of distributed generation and a centralized electrical network. Graph theory and structural-topological analysis are used to determining the optimal VPP DN topology. The main idea is to assess the reliability and efficiency of VPP DN on the basis of structural-topological characteristics of its graphs. The results of calculations for a low-voltage VPP DN with a wind power plant and a gas piston unit are presented. The PSCAD model of VPP DN is described, which explores the dependencies of VPP DN parameters on its topologies and operating modes. A physical model VPP DN has been developed: it consists of simulators of wind and solar power plants, power storage devices, loads and power lines. On the basis of the physical model, a study of the quality of electricity in VPP DN depending on the ratio of the power of the centralized electrical network and the distributed generation sources has been carried out. Based on the results of the study, an algorithm for determining the optimal VPP DN topology has been developed.

S 20.2 **Optimal Planning and Operation of Battery Energy Storage Systems in Smart Grids Using Improved Genetic Algorithm Based Intelligent Optimization Tool**

Kannathat Mansuwan[1,2], Peerapol Jirapong[1], Sattawat Burana[1] and Panida Thararak[1]
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In this paper, an improved genetic algorithm (IGA) implemented with reliable power system analysis tool is developed to determine the optimal planning and operation of battery energy storage system (BESS) in smart grid with photovoltaic (PV) generation. The main objectives are maximizing benefit from energy losses reduction and energy shaving enhancement, while minimizing the investment cost. Double layers optimization

technique is implemented for determining the BESS siting and sizing in the first layer, while the maximum energy shaving is calculated in the second layer. The IGA implemented in MATLAB and DIgSILENT programs utilizing an automatic data exchange process is utilized for solving the optimal solution. This approach is tested on a practical 22 kV distribution network of Thailand to present the effectiveness of decision making support tool. The simulation results show that the optimal BESS planning results in mitigating PV intermittency and improvement in smart grid efficiency.

S 20.3 Using Experts' Opinions and Multi-Criteria Decision Analysis to Determine the Weighing of Criteria Employed in Planning Remote Area Microgrids

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Electrification of remote areas with the help of standalone power supply systems, also known as islanded microgrids, is a complex and multi-dimensional problem. This problem needs to address and consider diverse factors such as economic, technical, environmental, social and political. This study has used an analytical hierarchy process-based multi-criteria decision-making approach to obtain a more robust and universally convincing plan for remote area microgrids. To this end, a survey has been con-ducted from worldwide academics, industry experts and consultants. The study reveals that the economic criterion is the most important factor versus other factors.

S 20.4 The Development of Wave Energy Converter System Using Hydraulic Power Take Off at Terengganu Shoreline

Nur Hafizah Tul Huda, Mohd Zamri Ibrahim, Siti Juwairiyah A. Rahman, Aliashim Albani, and Safina Mohad
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This paper presents the conceptual model for 40 kW off-grid UMT Eco Wave Energy System (UEW) to generate the electricity. The idea of this concept is based on the shoreline floater types of wave energy converter. It consists the modelling of a heaving oscillation floater, hydraulic and electric power take off (PTO) system which suitable for Terengganu shoreline. The linear wave theory is applied to model the hydrodynamic behaviour of this system. In addition, the simulation of hydraulic and electric power take off system via Simhydraulic Software based on Simscape platform product for the Simulink Physical Modelling are also discussed.

S 20.5 Performance Analysis of LTE in Rich Multipath and Rural Environments for Wireless Communication in Smart Grid

Md. Ariful Islam, Israt Jahan, Md. Jakaria Rahimi, and Jai Govind Singh
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Smart Grid is a new standard or digital technology which allows both way of communication between utility and customers. Smart grid is also a framework of new equipment, technologies, automatic operations and controls which is very similar to the internet, however in this regard for rapidly changing loads the grid will be digitally reactive by combining these technologies. For digitalization of smart grid, a faster, and

wireless but reliable communication is necessary. On that account LTE could be a better option. Long-Term Evolution (LTE) is a new grade for faster and seamless communication for smart devices and data terminals. In this regard, different scheduling tackles are very helpful. This paper discusses about two very common scheduling algorithms and those are Best Channel Quality Indicator (Best CQI) and Proportional Fair (PF). From simulation it is possible to find out their throughput and BLER (Block Error Rate) by using Transmit Diversity (TxD) and Open Loop Spatial Multiplexing (OLSM). Each time cross relation can be carried out for better comparison experiments.

S 21: Optimization and Planning Analysis
Time: 13:00 – 14:40
Room Assignment: Palm Flower A

S 21.1   **Optimizing Generation Mix using Markovitz mean-Variance Theory**

Arjun C. Unni,Weerakorn Ongsakul, Rajanivedha Ramakrishnan, and Shubham Tiwari
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The energy matrix of every country in the world is more and more occupied by the Renewable Energy Sources(RES). Since the power output from renewable energy sources are depended on the weather conditions it is difficult to depend on a single source for a reliable power delivery. Wind and solar data of three cities in India is collected and an optimal portfolio is developed using modern portfolio theory.

S 21.2   **PSO based Unit Commitment of a Hybrid Microgrid System**

Rajanivedha Ramakrishnan, Jai Govind Singh, and Weerakorn Ongsakul
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Scheduling of generators plays a crucial role in unit commitment problem of a deregulated power market. Due to the increased variation between supply and demand, the power produced by the conventional generators is not sufficient to meet the load demand. Renewable sources are added to the system, to provide additional power to avoid the generation and load imbalances. When the power demand is met, the extra power can be sold back to the grid to yield monetary benefits. In case if, the power demand is not met by the conventional sources as well as the renewable sources, the power is drawn from the grid to meet out the demand. Two scenarios have been considered, with and without the addition of renewable penetration into the system. When renewable sources are not added to the system, the fuel cost and maintenance cost is high due to the conventional generator which supports the demand. When renewable sources are added, the fuel and maintenance is considerably reduced. In this study, renewable sources are free of cost.

S 21.3 **Maintenance Record Reported Form Computerized using a Personal Computer**

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There is critical equipment operating on the power system such as oil-immersed transformers and circuit breaker, the equipment must be maintained strictly on a regular basis to ensure reliability supply. Any maintenance or accident case of equipment must be fully documented, and safety guarded, but a lot of maintenance record reported forms adopted paper form version for saving, so that some shortcomings have been found such as difficulty in saving and finding data. Another severe deficiency that could not be directly diagnosed with the advantages or disadvantages of the equipment is during the test. To improve the deficiency in conventional recorded paper, a novel record reported form is been designed with the application software of EXCEL in a personal computer. The computerized reported form is proven to improve those shortcomings. Specialty, punctual display of equipment is normal or abnormal during the test. This maintenance record reported form consist of two types of function – one is to establish a maintenance record form to diagnose, print, and save storage, and another browse historic data and print using EXCEL application software. This clearly highlights the model's report form superiority and can hence assist in circumventing the shortcomings of the conventional paper form of maintenance record on important equipment. To meet the policy of reducing paper use and to cater to the trend of the data storage for small space, prompt efficiency work for maintenance time, to find data, and record data. Especially, it can obtain the result of diagnosis for the equipment during maintenance period timely. This approach will contribute few efforts for the stability and quality of power supply in power system.

S 21.4 **Control of DC Motor using Genetic Algorithm based PID Controller**

Shubham Tiwari, Ankit Bhatt, Arjun C. Unni, Jai Govind Singh, and Weerakorn Ongsakul
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The paper deals with the optimized tuning of P.I.D controller which is used to control the D C Motor. In this research work different PID tunings techniques are discussed. D.C Motor due to its very simple regulated characteristics is used in this paper. Due to this fact D.C. Motors are widely used in many industrial applications like steel mills, electric trains and many more. Here G.A-P.I.D (Genetic Algorithm – P.I.D) with different performance indices namely Mean Square Error (M.S.E) and Integral of Time multiplied by Absolute Error (I.TA.E) optimization technique is compared with standard P.I.D parameter adjustment technique i.e. Ziegler & Nichols method. Comparison of results are based on standard step responses parameters i.e. maximum overshoot, steady state and rise time.

S 21.5

A Probabilistic Approach for Power Loss Minimization in Distribution Systems

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The number of wind power distributed generators are increasingly integrated in power systems because of having environmental friendly and technically sound characteristics. It is prevalent that the non-optimal size and placement of distributed generation (DGs) can cause high power loss and unexpected voltage profile variation on feeder. This research study focus on the probabilistic approach to design of Distributed Generation (DGs) and its impact on medium voltage (MV) feeders. Monte Carlo simulation based probabilistic power flow considering stochastic nature of wind and solar power generation and uncertainty of load variation are employed. The proposed method is simple that used open source MATLAB software including MATPOWER tools to analyse and design low voltage and medium voltage feeder. This method can furnish several choices to utilities/owners to place WT-DGs and PV-DGs at different suitable nodes. The method will be tested on different case study using Indian practical 22-bus and IEEE 69-bus network and the effect of DGs on the system voltage profile and loss are investigated accordingly.

S 22: Energy Transition Forecasting
Time: 13:00 – 14:40
Room Assignment: Palm Flower B

S 22.1

One Step Ahead, Two Steps Backwards: Energy Transitions and Coal in Developing Countries

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Anthropogenic climate change necessitates a transformation of the current fossil-based energy systems towards renewable energies. Despite large agreement on the huge costs of (climate) inaction, several developing countries currently see a massive uptake of carbon-intense coal-based power generation. This study aims to contextualize investment flows for coal projects, with a focus on the Global South. We applied a bipartite network analysis to investigate investment patterns between donor and recipient countries using a secondary database. The results indicate that China, Japan and South Korea are key players in the massive coal extension currently observed in several developing countries of Asia and Africa. While the analysis presented in this paper aids the problem identification and illustration, the lurking grey energy transition will require further research and policy attention.

S 22.2   **Natural Gas as a Transition Fuel for Indian Power Supply Sector: Emissions and Energy Security – the Trade Off**

Nandini Das[1], Shyamasree Dasgupta[1,2], Oluf Langhelle[3], Joyashree Roy[1], and Mohsen Assadi[3]
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India along with other 147 countries submitted its Intended Nationally Determined Contribution (INDC) to United Nations Framework Convention on Climate Change (UNFCCC) in order to pursue efforts to limit the temperature increase to 1.5 degree centigrade. Although renewable energy has received significant importance in India in this context, it is mentioned in the NDCs that in the short to medium term, coal will continue to dominate in near future to facilitate universal energy access. Given this, we address two policy questions: First, how to address the need of a balancing power supply to support the increasing renewable capacity and second, can coal be partially substituted by natural gas as an alternative less-emitting fuel for the short to medium term? Several alternative scenarios are developed to understand impact of increased penetration of natural gas in power generation on India's future emission profile. Results suggest that with increasing efforts in terms of both fuel-switching in thermal sector and technological up-gradation provide a higher scope of abatement at a comparable cost. Given India's climate commitment at the global level, additional efforts for India can come by transforming its thermal power generation to a more efficient and less emitting one by increasing the use of natural gas. However, this will lead to increase in future demand of natural gas. As domestic supply of natural gas in India is not sufficient to cater this increased demand, this will led to higher import dependency. Therefore, if the goal is to contribute to a sustainable energy trajectory in India, natural gas can play an important role towards decarbonisation of power production both by replacing coal-fired generation and by fostering the integration of large shares of renewable energy into the Indian power system.

S 22.3   **Solar – Grid Hybrid System – A Cost Effective and Improved Renewable Energy Utilization Approach**

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A solar-grid hybrid system design has been proposed in this paper. The design is expected to provide an economical and sustainable power supply to the AC loads. A Differential amplifier and series P channel MOSFET linear regulator technology based charge controller has been used to attain faster charging. An automatic relay based Switching between solar and grid has also been developed utilizing essential power being generated from solar; an automatic switching to solar & reducing power consumption from grid. Vice versa, if renewable output being moderately less then power demand, then it will switch to both solar and grid. Finally, when grid supplies main power when renewable output turns out to be insufficient. A real time online Wi-Fi module based monitoring circuit has been incorporated and adapted to monitor the whole system for efficient operation of the system.

S 22.4

Hour-Ahead Solar Forecasting Program Using Back Propagation Artificial Neural Network

Tanawat Laopaiboon[1], Weerakorn Ongsakul[1], Pradya Panyainkaew[2], and Nikhil Sasidharan[3]
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Solar photovoltaic power generation highly relies on solar irradiance, cloud cover variability, temperature, atmospheric aerosol levels, and other atmosphere parameters. Accurate forecasting of solar power is crucial to very short-term generation scheduling and on-line secure economic operation. In this paper, hour-ahead forecasting using BP-ANN is proposed. The inputs of BP-ANN include previous intervals of solar irradiation, moving average temperature, moving average relative humidity, time of the day and day of the year index. The supervised learning ANN render a higher accuracy with the good convergence mapping between input to target output data. The simulation of hour-ahead solar irradiation forecasting results from ANN render a better performance compared with autoregressive moving average model in terms of mean absolute Error (MAE), root mean square error (RMSE), mean absolute percentage error (MAPE), mean bias error (MBE) and correlation coefficient (Corr).

S 22.5

One hour Ahead Short-Term Electricity Price Forecasting Using ANN Algorithms

Ayushi Yadav[1], Ayush Sahay[2], Mukh Raj Yadav[1], Somiya Bhadari[1], Abha Yadav[1], and Kishan Bhushan Sahay[3]
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For decision making in context of newly formed electricity price market the most essential parameter is price forecasting of electricity. Without price forecasting it is very hectic for producers and consumers to figure out or plan their operation and management of price in today's competitive market. Short term price forecasting is a tool to consumer and power producerfor accurate bidding techniques so as to enhance their net profit.In this research paper artificial intelligence (AI) is being utilized in a connection with fleeting value gauging that is, the hourly lagged forecasted of the power market. Another simulated neural system (SNS) has been utilized to register the estimated cost in Ontario power market utilizing MATLAB R14a.The author used forecasted data are one day and hourly lagged electricity cost of the Ontario electricity market. The reproduction results demonstrate exceptionally exact hourly basis lagged estimates with minimum error in price forecasting.

S 22.5

Confidential Interval Formation of Time-of-Use Customers based on Behavior Analytic by using Gaussian Mixture Model and K-mean Clustering: a Case Study of PEA, Thailand

Pornchai Chaweewat, Jai Govind Singh, and Weerakorn Ongsakul
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Data and information become valuable possession in digital era where we are surrounded with big data. Data mining is supposed to be major and first process to tackle with big data. This study investigates featured features of Time-of-Use (TOU)

based electricity customers using Gaussian mixture process. K-means clustering clusters TOU based electricity customer into various groups i.e., normal and abnormal load profile. Then, confidential interval (CI) corresponding with forecasted α-level prediction is formulated for each customer's major load profile. The formulated CI is test using absolute coverage error (ACE) with the empirical confidence $\hat{\alpha}$. The input data is collected from 900+ PEA's TOU customers during January to December 2016. The outcome of this study shows that feature extraction with data clustering processes using could help to extract intrinsic pattern of metadata of TOU customers.

FIELD VISIT SITES

A. Phuket Solar Company Limited
20/105 Boat Lagoon, Thepkasattri Road. , Phuket – Thailand

Phuket Solar is a full-service renewable energy company, providing customized design, sales, and installation of solar electric systems. Phuket Solar was founded in early 2014 by CEO / Engineer Rosario Antonio Sanna following his widespread success in Southern Italy, between 2007 - 2012, of solar utility scale installations , totaling 28 MegaWatts; where Mr. Sanna directly coordinated all operations and gained his exemplary reputation within the sector. The same knowledge and experience is now the core of Phuket Solar and together with our innovative vision, our technical partnerships and our flexible ability to carry out all sorts of tasks, led us to become Phuket's #1 photovoltaic system contractor. Our mission is to provide complete solar solutions that always outperform customer expectations. MISSION AND VISION We confidently believe that the time for solar power has also arrived in Thailand. Solar energy is an energy option that is safe, environmentally friendly, and affordable. The Government itself promotes the evolution of renewable energy projects with advanced development plans and ambitious goals extending up until 2036. Geographically, Phuket offers a crucial advantage for solar installations ; being at Latitude 8° North of the Equator , this island is at optimal exposure to sun rays which translates into high performance outputs of the solar arrays. In Financial terms, this means the return on a solar investment is much shorter here than in many other Western developed Countries. In light of Phuket's ever growing tourism industry, as a paradise habitat for Expats and locals alike, as well as for future generations to come, Phuket Solar strives to preserve Phuket's unique yet fragile environment. It is committed to seeing Phuket become a "Solar Island", and upholds our ultimate vision of an island powered entirely by renewable energy. For this to take place, renewable energy equipment must be of highest quality, affordable and easily accessible to homeowners, schools, community groups and businesses. We not only provide the products to create a renewable future, but also the expert services to build it and the education to support it. We use the industries best equipment and adopt a best practice policy for design and installation.

B. Phromthep Cape Renewable Energy Power Plant
Promthep Cape, Phuket Province

In 1983, EGAT chose Phromthep Cape, Phuket Province as a site for wind turbine installation. Originally, the 6 small sets of wind turbines were installed and tested. In 1992, two more 10 kW wind turbines were installed and connected to the distribution system of Provincial Electricity Authority (PEA). Moreover, EGAT had installed anemometers to collect the wind data for many continuous years to make sure that the site has the high average wind speed. Later in 1996, EGAT installed a 150 kW commercial-scale wind turbine to supply electricity to PEA distribution system. Apart from wind power, Phromthep Cape Renewable Energy Power Plant is comprised of 8 kW solar cells.

CONFERENCE PAPERS

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Conference papers will also be made available in the IEEE Xplore.

SPONSORS

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.

PTT Exploration and Production Public Company Limited

PTTEP is a national petroleum exploration and production company dedicating itself to providing a sustainable petroleum supply to Thailand and the countries we operate in as well as to bringing in foreign exchange earnings to our country

PTTEP conducts its business as a responsible corporate member of the society to observe the laws of Thailand and the countries we operate in. We strongly support the fundamental human rights in line with the legitimate role of business and give proper regard to health, safety, security and environment consistent with our commitment to contribute to sustainable development of the society where we operate. We also contribute to improving the quality of life and promoting healthcare in the communities through 4 types of corporate social responsibility projects related to basic

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needs, education, environment and culture. PTTEP adheres to our codes of business conduct which encompasses monetary transparency and is reflected in our participation to the disclosure of actual financial information to multi-stakeholders as guided by the applicable laws. PTTEP also strictly comply to the contractual obligations of the projects in the host countries it operates in.

Metropolitan Electricity Authority (MEA)

Metropolitan Electricity Authority (MEA) is a state enterprise, categorized in the energy utility group under the Ministry of Interior, founded on August 1, 1958 following the proclamation of the Metropolitan Electricity Authority Act B.E. 2501 (1958). The objectives of its establishment are as follows: (1) to generate electricity, (2) to acquire and distribute electricity, and (3) to conduct businesses related to electricity as well as other relevant businesses which are beneficial to MEA. In 1961, MEA transferred the ownership of its electricity generating plants to the Electricity Generating Authority of Thailand (EGAT). The Energy Regulatory Commission (ERC), authorized by virtue of the Energy Industry Act B.E. 2550 (2007), has announced a requirement for energy industry operators to acquire licenses to operate energy businesses from the ERC, and to conduct business in accordance with the attached terms in the licenses. MEA has been granted with electricity industry operation licenses for 2 businesses namely, the license for electricity distribution system and the license for electricity distribution.

MEA's core business includes supplying of electricity to the distribution areas of three provinces namely Bangkok, Nonthaburi, and Samut Prakan, covering the distributing area of 3,192 square kilometers which serves the key mission and purpose of MEA establishment. MEA generates its core business revenues equivalent to 99.96 percent of its total revenues.


Banpu Infinergy Company Limited

BANPU INFINERGY is a subsidiary of Banpu Public Company Limited and conducts its business with the vision of becoming a leader in the turnkey electricity business. As such, we combine many types of technology with a determination to generate sustainable energy. And this launched the

beginning of over 30 years of experience in the energy business both domestically and abroad. We have also gained expertise from the management of SOLAR FARM businesses in China and Japan for use in expanding the renewable energy business for Thailand in the future.

BANPU INFINERGY is a comprehensive and professional service provider in solar power generation systems installation. We provide consultation, system design, installation, inspection and maintenance services for industries and large businesses seeking to cut their electricity costs and play a role in sustainable preservation of our planet through renewable energy.

Committed to being the provider of holistic solar energy solutions, Banpu Infinergy is also dedicated to studying the possibilities for optimizing Energy Management System (EMS) and Energy Storage System (ESS) in production control, energy transfer and energy storage, as well as electric vehicles in the future, to take Thailand a step further towards sustainable green energy.
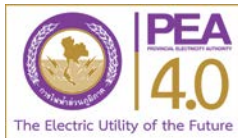
Provincial Electricity Authority (PEA)

Provincial Electricity Authority (PEA) is a government enterprise under the Ministry of Interior. PEA was established by a Royal Decree executed on March 6, 1954 and then published in the Government Gazette on March 16, 1954. The appointment of the board of directors as the control of the management is under the control of the Department of Public Works, Municipal of the Ministry of Interior and the Government by the Minister of Interior has the power to general supervision. The Provincial Electricity Organization was the initial capital in accordance with the laws of 5 Million Baht with the power in the number of 117 areas, consequently, PEA was established in accordance with the law of PEA BE. 1960, as at September 28, 1960, by taking over the mission from the Provincial Electricity Organization action continues.

Provincial Electricity Authority (PEA) is a leading organization in the region, which is focused on providing efficient, reliable electricity services, related business for developing quality of life, sustainability of economics and society.

PEA is responsible for the provision of standardized electricity services and related business to attain the customer's satisfaction on products and services through PEA's continual corporate development plan with the recognition of social and environmental responsibility.

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