ICUE 2014

ASIAN INSTITUTE OF TECHNOLOGY 1959

International Conference and Utility Exhibition on:

Green Energy

for Sustainable Development

19 20 21 March 2014
Jomtien Palm Beach Hotel and Resort
Pattaya City, Thailand

PROGRAMS & ABSTRACTS

CONTENTS

RATIONALE OF THE CONFERENCE

Discussions of economic development will always have industrialization, modernization and urbanization in the equation. But as this generation is a product of past environmental transgressions, we are now all inclined to include environmental sustainability in the picture. We now not only refer economic development to quantitative and qualitative progress in the economy, community and society, but we now also have to consider the kind of natural environment we would be leaving for future generations. Industrialization, modernization and urbanization translate to an insatiable thirst for energy but as demand for energy grow, so do the greenhouse gas emissions. If the aspiration of development is to raise living standards, provide proper access to modern energy services, more efficient use of energy to protect the global environment and ensure reliable energy supplies, then Green Sustainable Development must play a key role. Incorporating elements of low-carbon green growth in economic strategies that would cover technological, financial and investment aspects, as well as national and regional energy development policies geared towards achieving a sustainable green future has now become more important. A low-carbon based type of economy will help mitigate environmental pollution and CO2 emissions caused by fossil fuel use, help reduce reliance to dwindling fossil reserves, and encourage technological innovations.

The 2014 International Conference and Utility Exhibition on: Green Energy for Sustainable Development on 19-21 March 2014 in Pattaya City, Thailand 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 Field of Study, 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.

Key Facts and Figures

- 2300+ Students from 50 + Countries/Territories
- 18000+ Alumni from 85 Countries/Territories
- 28000+ Short-term Trainees from 70+ Countries/Territories
- 120 World Class Faculty from 20+ Countries
- 1000+ Courses
- 32 Fields of Study
- 3 Schools
- 15 Research and Outreach Centers
- 100+ Research Staff and 500+ Support Staff from about 30 Countries
- 500+ Support Staff
- 400 Research & Outreach Projects
- 330 Partners
- 33 Board of Trustee members from 19 Countries

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 collects, repackages, and disseminates information on energy and environmental issues related to energy. The Center's wide range of activities includes publishing, networking, consulting, and other information services for energy conservation and renewable energy promotion.

The current RERIC staffs are as follows:

Director:	Dr. Jai Govind Singh
Research/Information Professional:	Maria Kathrina B. Gratuito
Secretary:	Parichart Khammeerak

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.

RERIC's occasional publications include conference/seminar/workshop proceedings, research reports, directories, environment systems reviewa, and do-it-yourself manuals. For more information about RERIC's publications, please visit www.serd.ait.ac.th/reric. Annual membership fees to RERIC entitle the members to hard copies of the International Energy Journal (IEJ) as well as access to the online journal system at www.rericjournal.ait.ac.th. Members also get 20% discount on other RERIC publications and a discounted rate to trainings/workshops/conference it organizes. Annual membership fees for year 2010 are as follows: USA, Canada, European countries, Australia, New Zealand, Japan, and Middle East *(Individual: US$ 130, Institutional: US$ 275)*; Thailand *(Individual: THB 1,500, Institutional: THB 5,000)*; all other countries not mentioned above *(Individual: US$ 85, Institutional: US$ 160).*

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Prof. Anu Ramaswami	The University of Minnesota	USA
Dr. Anurag K. Srivastava	Washington State University	USA

VENUE

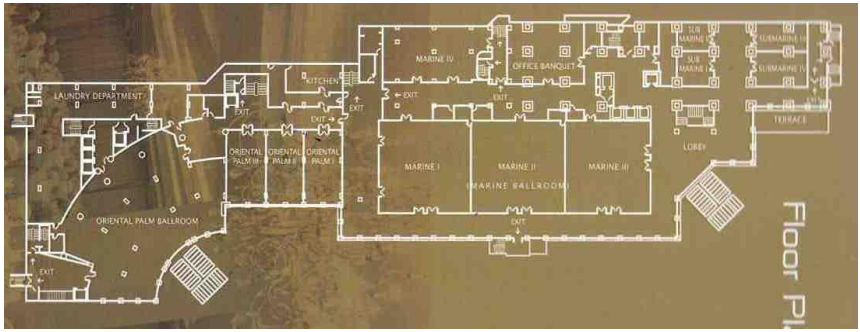
Just over one hour from Bangkok's Suvarnabhumi Airport, Pattaya is a lively beach town that draws visitors from around the world. With activities that include a wide array of water sports, golf, shopping, cabaret shows, an elephant village, and fascinating museums, it's impossible not to have an action-packed Pattaya holiday. Unless of course it's relaxation you crave, in which case there are beach chairs and umbrellas lining the Pattaya shore, where wandering vendors will cater to your every need: from barbequed shrimp to a foot massage.

One of the hottest beach-resort destinations in Thailand, Pattaya may not be idyllic but it certainly makes up for it with a wide variety of activities, accommodation and nightlife venues. Pattaya is a popular beach resort on the Gulf of Thailand just 150 km. southeast of Bangkok – a mere two-hour drive. Pattaya's pulsating nightlife is well known, but local authorities have, in recent years, improved the quality of the beaches and reinvented the resort as a more family-friendly destination. Today, hundreds of thousands of visitors are drawn each year to Pattaya to windsurf, water ski, swim, sunbathe, snorkel, sail, or take trips to nearby islands. Other activities include Bungee jumping, cycling, skydiving, go-Karting, Muay Thai (Thai boxing), and Paintball. Golfers, both novice and expert, are well catered to as well, with a wide selection of golf courses around Pattaya. There's lots of activities to enjoy in Pattaya.

Jomtien Palm Beach Hotel and Resort

The ICUE 2014 official designated hotel is the Jomtien Palm Beach Hotel and Resort located in Pattaya City, Thailand. Accommodations at Jomtien Beach Hotel & Resort are diverse. The 723 guest rooms, ranging from Superior, Deluxe, Mini Suite, Suite, and President Suite rooms, were designed with our guests' comfort and convenience in mind. Combined with scenic sea, beach and hillside views, round-the-clock room service is available to ensure your enjoyable stay at our hotel.

SUMMARY OF ROOM ASSIGNMENTS



Marine I Ballroom

Venue for:

- Opening Ceremony, Keynote Adresses, Plenary Panel Discussion, Closing Ceromony
- Session 1: Greening the Industrial Sector
- Session 5: Low Carbon Development
- Session 9: Green Policies and Programmes
- Session 13: Green Transport

Oriental Palm I

Venue for:

- Pre-Conference Training Workshop on Smart Grid and Renewable Energy (18 March 2014)
- Session 2: Wind Energy
- Session 6: Green Buildings and Infrastructures
- Session 10: GNESD Special Session
- Session 14: Power and Heat

Oriental Palm II

Venue for:

- Session 3: Renewable Energy Integration
- Session 7: Photovoltaics
- Session 11: Electric Power Generation, Transmission and Distribution I
- Session 15: Electric Power Generation, Transmission and Distribution II

Oriental Palm III

Venue for:

- Session 4: Special Track GCP/URCM (NIES) – Energy Resilience
- Session 8: Special Track GCP/URCM (NIES) – Other Aspects of Resilience; and a panel discussion on Resilience in Green Energy and Urban Systems
- Session 12: Bioenergy and Biofuels I
- Session 16: Bioenergy and Biofuels II

	ICUE 2014 PRO
	Day 1: March
08:00 – 09:00	**REGISTRATION**
	Opening Sess
09:00 – 09:15	Opening Remarks – **Prof. Worsak Kanok-Nukulchai** (Interim President, Asian Insti
09:15 – 09:25	Presentation of tokens of appreciation to sponsors
09:25 – 10:15	Introduction of Keynote Speaker 1 *Keynote Address 1:* **Dr. Piyasvasti Amranand** (Chairman, Energy for Environment Fo Presentation of the plaque of appreciation to the Keynote Speaker 1
10:15 – 10:45	*Co*
10:45 – 11:35	Introduction of Keynote Speaker 2 *Keynote Address 2:* **Professor Arnulf Grübler** (Yale University and International Instit Presentation of the plaque of appreciation to Keynote Speaker 2
11:35 – 13:00	*A*
13:00 – 14:55	*Plenary Panel Discussion:* **Energy Technology in Asia Leading Transition to Low Ca** **Chair: Dr. Shuzo Nishioka** (Institute for Global Environmental Strategies (IGES Japan), and Secretary General, LoCARNet/LCS-RNet Secretariat) | **P D D**
14:55 – 15:00	Presentation of the tokens of appreciation to the Chair and the panel members
15:00 – 15:15	*Co*
15:15 – 17:25	Break *Marine I Ballroom* **S 1: Greening the Industrial Sector** | *Oriental Palm I* **S 2: Wind Energy**
19:00 –	*Dinner reception*
	Day 2: March 2
08:30 – 09:20	Introduction of Keynote Speaker 3 *Keynote Address 3:* **Prof. Saifur Rahman** (Advanced Research Institute, Virginia Tech, Presentation of the plaque of appreciation to Keynote Speaker 3
09:20 – 09:35	*Co*
09:35 – 12:00	Break *Marine I Ballroom* **S 5: Low Carbon Development** | *Oriental Palm I* **S 6: Green Buildings and Infrastructures**
12:00 – 12:55	*A*
12:55 – 13:00	*Group gathering at*
13:00 – 16:00	**PTT Gas Separation Plant** | **BLCP Power Station** | **PEA C**
16:00 – 17:30	Travel back to Jomt
	Day 3: March
08:30 – 09:20	Introduction of Keynote Speaker 4 *Keynote Address 4:* – **Dr. Joydeep Mitra** (Michigan State University, USA) – **Reliable** Presentation of the plaque of appreciation to Keynote Speaker 4
09:20 – 09:45	*Co*
09:45 – 12:10	Break *Marine I Ballroom* **S 9: Green Policies and Programmes** | *Oriental Palm I* **S 10: GNESD Special Sessi**
12:10 – 13:10	
13:10 – 16:10	Break *Marine I Ballroom* **S 13: Green Transport** | *Oriental Palm I* **S 14: Power and Heat**
16:10 – 16:25	*Co*
16:25 – 16:50	*Closing Sess*
	End of C

GRAM AT A GLANCE

19, 2014 (Wednesday)

ion (Marine I Ballroom) – *25 minutes*

tute of Technology)

undation) – **Green Energy Transition in Thailand** (45 minutes)

ffee/Tea Break – *30 minutes*

ute for Applied Systems Analysis) – **Green Energy Transition and Technology Innovation** (45 minutes)

Lunch Break – *85 minutes*

rbon World (115 minutes)

rof. Arnulf Grubler (IIASA/Yale University)
Dr. Mikiko Kainuma (NIES/IGES Japan)
Dr. Jiang Kejun (ERI/China)
Prof. P.R Shukla (IIM Ahmadabad/India)
Mr. Rajiv Garg (UNEP/Bangkok)

ffee/Tea Break – *15 minutes*

out Session 1 (130 minutes)

	Oriental Palm II	*Oriental Palm III*
	S 3: Renewable Energy Integration	**S 4: Special track GCP/URCM (NIES) – Energy Resilience**

at Jomtien Palm Beach Hotel and Resort

0, 2014 (Thursday)

USA) – **Opportunities and Challenges for Sustainable Energy Generation** (45 minutes)

ffee/Tea Break – *15 minutes*

out Session 2 (145 minutes)

	Oriental Palm II	*Oriental Palm III*
l	**S 7: Photovoltaics**	**S 8: Special track GCP/URCM (NIES) – Other Aspects of Resilience; and a panel discussion on Resilience in Green Energy and Urban Systems**

Lunch Break – *55 minutes*

the convention center lobby for the field trips

FIELD TRIP

ontrol Center, Central Area 2	Saha Cogeneration Power Plant	Thai Future Energy Company

ien Palm Beach Hotel and Resort, Pattaya

21, 2014 (Friday)

Delivery of Renewable Energy (45 minutes)

ffee/Tea Break – *15 minutes*

out Session 3 (145 minutes)

	Oriental Palm II	*Oriental Palm III*
on	**S 11: Electric Power Generation, Transmission and Distribution I**	**S 12: Bioenergy and Biofuels I**

Lunch Break 60 minutes

out Session 4 (180 minutes)

	Oriental Palm II	*Oriental Palm III*
	S 15: Electric Power Generation, Transmission and Distribution II	**S 16: Bioenergy and Biofuels II**

ffee/Tea Break – *15 minutes*

ion (Marine I Ballroom) – *25 minutes*

Conference

KEYNOTE SPEAKER 1

Green Energy Transition in Thailand

Dr. Piyasvasti Amranand
Chairman, Energy for Environment Foundation
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 between 9th October 2006 and 6th February 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. His last full time job was President of Thai Airways International during the period October 2009 to June 2012. He is currently Chairman of the Energy for Environment Foundation and a member of the board of directors of Kasikorn Bank.

During the 1990's, 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.

Piyasvasti was born in 1953, and graduated from Brasenose College, 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.

KEYNOTE SPEAKER 2

Green Energy Transition and Technology Innovation

Prof. Arnulf Grübler
Professor, Field of Energy and Technology
Yale University, USA
Acting Program Leader, Transitions To New Technologies
International Institute for Applied Systems Analysis, Austria

Professor Arnulf Grübler's research and teaching interests focus on the interplay between energy and technology systems and their implications on the environment, in particular on climate change. His teaching and research focuses on the long-term history and future of technology and the environment with emphasis on energy, transport, and communication systems. He has studied major transitions in energy and technology systems that occurred during the last 300 years and is also an energy/environment futurist developing long-term (100 year) prospective scenarios for energy and climate policy analyses. He welcomes discussions on the role of entrepreneurship in technology innovation and diffusion as well as on formal analyses tools for the development of technology innovation strategies and portfolios in the areas of energy systems and climate protection. Professor Grubler is a resident faculty member in the Field of Energy and Technology at the School of Forestry and Environmental Studies at Yale University, New Haven, USA.

The remainder of the year, Professor Grübler is a senior research scholar at IIASA, the International Institute for Applied Systems Analysis in Laxenburg, Austria. He first joined IIASA in 1976 to work with the Energy Systems Program and currently works as a Senior Research Scholar and Acting Program Leader of the Transitions to New Technologies Program.

Prof. Grübler received his master's degree in engineering from the Technical University of Vienna, where he was also awarded his PhD. He completed his Habilitation (venia legendi in systems science of environment and technology) at the Mining University Leoben, Austria. He is also foreign member elect of the Russian Academy of Natural Sciences.

Prof. Grübler has been serving as Lead and Contributing Author and as Review Editor for the Second, Third, Fourth, and Fifth Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC, co-recipient of the 2007 Nobel Peace Prize). He was also Convening Lead and Coordinating Author for three knowledge modules of the Global Energy Assessment completed in 2012. He currently serves on the editorial boards of Carbon Management and Journal of Industrial Ecology.

He has published widely as author, coauthor, or editor of twelve books, three special journal issues, over 100 peer reviewed articles and book chapters, and over 30 additional professional papers in the domains of (modeling of) technological change and diffusion, long wave theory, historical transitions in energy and transport systems, long-term future scenarios, energy technology innovation systems and policy, climate change, and resource economics.

Examples of his latest publications include the book Energizing Sustainable Cities: Assessing Urban Energy, (edited together with David Fisk), Earthscan, 2013; and two major review articles on energy technology innovations systems and innovation portfolio biases: "The Energy Technology Innovation System", Annual Review of Environment and Resources 2012, 37:137-162 (with K. Sims Gallagher, L. Kuhl, G. Nemet, and C. Wilson); and "Marginalization of End-use Technologies in Energy Innovation for Climate Protection". Nature Climate Change, Vol. 2, 26 October 2012:780-788.

KEYNOTE SPEAKER 3

Opportunities and Challenges in Sustainable Energy Generation

Professor Saifur Rahman*
Joseph R. Loring Professor & Director
Advanced Research Institute
Virginia Tech, USA

Abstract:

This presentation focuses on the opportunities and challenges of electricity generation from renewable and sustainable sources. These include solar, wind, hydro and ocean energy. This addresses the issues of availability, reliability, sustainability and economic viability of these resources as well as the technical challenges of integrating them with the electrical power grid. The presentation will follow two tracks – one will introduce the teaching and coursework opportunities available as these topics gain interest among students and gain recognition with industryas they begin to value their relevance. The second is the research track, which will focus on the opportunities seen by industry as they try to integrate these technologies into their generation mix. This will also explore programs from governments and development organizations as they evaluate the contribution from these sources to reduce carbon emissions, provide a sustainable solution for long-term energy needs and provide job opportunities through new products and services.

*__Prof. Saifur Rahman__ is the Joseph R. Loring professor of electrical and computer engineering and the founding director of the Advanced Research Institute at Virginia Tech. He is a Fellow of the IEEE and a distinguished lecturer of the Power & Energy Society. He served as the founding Editor-in-Chief of the IEEE Transactions on Sustainable Energy from 2009 to 2012. He is the chair of the National Science Foundation (NSF) Advisory Committee on International Science and Engineering. He holds a BS degree in electrical engineering from Bangladesh University of Engineering and Technology. He received an MS in electrical sciences from State University of New York at Stony Brook and a Ph.D. in electrical engineering from Virginia Tech. Saifur Rahman directs the Center for Energy and the Global Environment and the Consortium for Intelligent Grid Research at Virginia Tech. He served as a program director in the Engineering Directorate at NSF from 1996 to 1999. He was a research scientist at the Tokyo Electric Power Company, Japan in 1992-93. He has also worked as an electrical engineer with Progress Energy in North Carolina and the Brookhaven National Laboratory in New York. He has consulted for the World Bank, the Asian Development Bank, the United Nations Development Program and the US Agency for International Development. He has served as the chair of the IEEE Publications Board, the Lifelong Learning Committee, Periodicals Committee and the Products and Services Committee. He is currently serving as the vice president for Publications for the IEEE Power & Energy Society, and a member of the IEEE-USA Energy Policy Committee.

KEYNOTE SPEAKER 4

Reliable Delivery of Renewable Energy

Dr. Joydeep Mitra[†]
Associate Professor of Electrical Engineering
Michigan State University, East Lansing, USA
Director of the Energy Reliability & Security (ERISE)
Laboratory, and Senior Faculty Associate
Institute of Public Utilities

Since the beginning of this century we have witnessed an acceleration in the adoption of renewable energy resources and technologies. Various forces – social, political, economic, regulatory and technological – have conspired to create a climate that fosters the development and proliferation of numerous technologies that enable the conversion, control and integration of renewable energy resources. So overpowering is this force that even skeptics have been goaded into seemingly enthusiastic acceptance of the new reality of renewable portfolio standards.

Although the mix of renewable resources is diverse, ranging from wind and solar to tidal and biomass, the bulk of today's investments are going into wind and solar, both of which are considered variable resources because they are available not upon demand, but upon the whims of nature. This creates several challenges and opportunities in exploiting their benefits, both when operating them in isolation and when operating them in coordination withother resources. While the challenges are mostly technological, the opportunities lie in the technological, economic and regulatory domains. Numerous solutions have been proposed for mitigating the challenges, ranging from storage and transmission expansion to demand response and "smart grid" control technologies. Reliable delivery of renewable generation requires creative solutions that are dependent not only on technology but also on geography

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Dr. Joydeep Mitra is an Associate Professor of Electrical Engineering at Michigan State University, East Lansing, Director of the Energy Reliability & Security (ERISE) Laboratory, and Senior Faculty Associate at the Institute of Public Utilities. He received a Ph.D. in Electrical Engineering from Texas A&M University, College Station, and a B.Tech.(Hons.) in Electrical Engineering from Indian Institute of Technology, Kharagpur. He has five years of industry and consulting experience ranging from power system hardware installation to modeling and simulation of energy markets, and fourteen years of academic experience. He has conducted research in power system modeling, analysis, stability, control, planning and simulation, and is known for his contributions to power system reliability analysis and reliability-based planning.
He has over 100 publications in the power systems area, including an edited book, an IEEE Standard, book chapters and technical articles. Prof. Mitra's research has been funded by the U.S. Department of Energy, the National Science Foundation, National Laboratories, and several electric utilities in the U.S. Prof. Mitra is a Senior Member of the Institute of Electrical & Electronic Engineers (IEEE), where he has membership in the Power and Energy Society (PES), the Industry Applications Society (IAS), and the Standards Association (SA). He is currently Vice-Chair of the IEEE-PES Power System Analysis, Computation and Economics Committee, and past Chair of several Subcommittees. He serves as an Editor for the IEEE Transactions on Smart Grid and Power Engineering Letters, and engages actively in several IEEE activities such as organizing conference tracks and contributing to the development of IEEE standards.

and politics.

Globally, the proliferation of variable generation has been accompanied by other events and forces that affect today's energy outlook in ways that go far beyond renewable portfolios and climate change. With reigning uncertainty concerning nuclear generation, the imminent retirement of several large coal plants, and newfound natural gas resources, a new dimension is emerging in the energy outlook for the future. The ramifications – technological, economic and political – of the rapidly growing interdependency between electricity and natural gas, will soon create further challenges in energy assurance.

From many different perspectives, the emerging energy landscape will present new features that have either not been encountered, or not been fully appreciated before. This presentation will discuss the most significant factors affecting energy reliability in this new age of renewable generation. It will outline the effect of various drivers, from public policy to the economic downturn, on today's energy outlook. It will discuss technological challenges in integration of renewable resources, particularly in the areas of system reliability and security. It will analyze some of the most important innovations and solutions proposed, and opportunities inthe technological, economic and regulatory domains.It will discuss the issues and effects arising from interdependencies between various infrastructures, particularly between electricity and natural gas. Finally, the presentation will also enumerate some of the major opportunities that lie before today's industry and how they can rise to the challenges presented by the emerging energy outlook.

PLENARY PANEL DISCUSSION

Energy Technology in Asia Leading Transition to Low Carbon World

19 March 2014 (Wednesday), 13:00 – 14:55
Marine I Ballroom

Chair:

Dr. Shuzo NISHIOKA
Senior Research Advisor
Institute for Global Environmental Strategies (IGES)
Chairman, Environment Council of Tokyo Metropolis
Member, Central Council of Environment Japan
Secretary General, Low Carbon Society Research Network (LCS-RNet) / Low Carbon Asia Research Network (LoCARNet)
PhD. Control Engineering, University of Tokyo

After 12 years engineering experience in Asahi Chemical Co. Ltd, he joined the National Institute for Environmental Studies of Japan (NIES). Research areas there were regional and global environmental assessment and environmental policy. He served as professor of Tokyo Institute of Technology and Keio University in 1997-2001 and as Executive Director of NIES in 2001-2007.

From late 1980's, he devoted his expertise in climate change issues and engaged with IPCC from 1988 to 2007 mainly on impact assessment methodology. From 2004 - 2009, he lead a strategic research of Japan Low Carbon Society Project, to explore the scenario of 70% GHG reduction in 2050 in Japan. This works was extended to Japanese Prime Minister Fukuda's Low Carbon Society policy (60-80% reduction in 2050) declared at Toyako G8 Summit. His recent work focuses on international collaboration for supporting Asian countries' leap-fogging to low carbon world.

Panel Members:

Prof. Arnulf Grübler
Professor, Field of Energy and Technology
Yale University, USA
Acting Program Leader, Transitions To New Technologies
International Institute for Applied Systems Analysis, Austria

Dr. Mikiko Kainuma
Fellow
Center for Social and Environmental Systems Research
National Institute for Environmental Studies (NIES), Japan

Dr. Kainuma received her B.S., M.S., and Ph.D. degrees in applied mathematics and physics from Kyoto University in Kyoto, Japan.

She joined NIES in 1977, and since 1990, she has been engaging in the development of Asia-Pacific Integrated Model(AIM),which assesses policy options for stabilizing the global climate, particularly in the Asian-Pacific region, with the objectives of reducing greenhouse gas emissions and avoiding the impacts of climate change. From 2006 to March, 2011, she headed Climate Policy Assessment Research Section at the Center for Global Environmental Research in NIES.Currently she is a Fellow at the Center for Social and Environmental Systems ResearchinNIES, and serves as an adjunct professor at Japan Advanced Institute of Science and Technology.

She is a Lead Author of Intergovernmental Panel on Climate Change (IPCC) Fourth and Fifth Assessment Report(Working Group III: Mitigation of Climate Change). She has also published a book with Springer publications in 2003 entitled “Climate Policy Assessment”.

She is the recipient of the following awards:

2011 Academic Award by the Society of Environmental Science, Japan
2010 Remarkable Contribution to Science and Technology 2010: NIce STEP Scientists by the National Institute of Science and Technology Policy (NISTEP)
1994 Nikkei Global Environmental Technology Award

Dr. Jiang Kejun
Senior Researcher
Energy Research Institute
P.R. China

Dr. Jiang Kejun started research work in 1993 on climate change relative to energy policy analysis. Since 1997, he worked with IPCC for Special Report on Emission Scenario, acting as lead author for IPCC WGIII AR4 Chapter 3, and now as the Coordinating Lead Author in IPCC AR5. He gained Ph.D. in Social Engineering Department of Tokyo Institute of Technology.
Related Link: Energy Research Institute (Chinese)

Prof. P.R. Shukla
Indian Institute of Management, Ahmedabad
India

P.R. Shukla is a Professor in the Public Systems Group at the Indian Institute of Management, Ahmedabad, India. He is a lead author of several international reports on energy, environment, climate change and development; including nine reports of the IPCC. He has been a member of Indian delegation to the COP8 and COP9. Prof. Shukla is a consultant to Governments and numerous international organizations. He has led several international research projects and is a member of several international teams working on integrated assessment modeling and policy studies. Prof. Shukla has been a member of several prestigious National and International Policy Committees. He has co-authored thirteen books and numerous publications in international journals in the areas of energy, environment, climate change and development policies. He holds a Ph.D. degree from Stanford University

Rajiv Garg
Programme Officer
Technology Transfer Unit, Energy Branch
UNEP/ROAP, Bangkok

Mr. Rajiv Garg is a Certified Energy Auditor and Manager by the Government of India. He has a Post Graduate Certificate in Industrial Pollution Prevention and Control, Masters in Environment and Water Resources Engineering, Bachelors in Civil Engineering from India.

His current responsibilities and duties involves: Project Management and Implementation of activities for the Pilot UNEP- ADB Climate Technology Network and Finance Center; Facilitate Implementation of activities of SEAN-CC Network of Climate Change Focal Points; Provide Technical Backstopping and implementation of activities for the project on Capacity Building in Development of Policy Framework for Promotion of Low Carbon Emission Societies in Central Asia; Project Management of GEF funded project on Phasing out Incandescent Lamps through Lighting Market; Transformation in Vietnam; and Providing technical and advisory inputs to the SWITCH Asia project on Harmonization of energy efficiency Standards for room air conditioners in ASEAN countries.

He worked with both the public and private sector and helped develop policy level studies and analysis for the Government of India on energy efficiency and technology related issues. Prior to joining UNEP, he was working as Energy Economist for the Bureau of Energy Efficiency, Government of India. Working for BEE, he was the lead and main contributor to the development of Perform Achieve and Trade Scheme (PAT), a cap and trade scheme) in India. He also provided technical backstopping to the Indian delegation to climate change negotiations on various issues related to technology transfer, NAMAs, Sectoral approaches etc

PRESENTATION SCHEDULES

Day 1: 19 March 2014 (Wednesday)

S 01: Greening the Industrial Sector
Time: 15:15 – 17:25
Room Assignment: Marine I Ballroom

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 01.1 Student Award Entry	**The Challenges for Fossil Fuel Power System Associated with Integration of Large Scale Renewable Generation** *I. Knõš, M. Landsberg and J. Valtin* Tallinn University of Technology, Estonia	Estonia
S 01.2	**Energy Management in Steel Rolling Plant** *G.S. Grewal[1], B.S. Rajpurohit[1], J.G. Singh[2]* [1]School of Computing and Electrical Engineering Indian Institute of Technology Mandi, India [2]School of Environment, Resources and Development Asian Institute of Technology, Thailand	India
S 01.3	**A Study of Energy Effectiveness in a Cooling Tower** *Dang Quoc Phu and Dang Tran Tho* School of Heat Engineering and Refrigeration Hanoi University of Science and Technology, Vietnam	Vietnam
S 01.4 Student Award Entry	**Automatic Control of Soot and Unburnt Hydro Carbons from Flares in Oil and Gas Industry** *R. Srinivasarao and K.V.S.G. Murali Krishna* Jawaharlal Nehru Technological University, Kakinada, Andhra Pradesh, India	India
S 01.5 Student Award Entry	**Waste Heat Recovery for Power Generation using Organic Rankine Cycle in a Pulp and Paper Mill** *Ahiwe Chinwendu Francis and Supachart Chungpaibulpatana* Department of Manufacturing Systems and Mechanical Engineering Sirindhorn International Institute of Technology Thammasat University	Thailand
S 01.6	**Oily Waste Metal Recycle Using Circulation-type a Superheated Steam Degreasing System** *Naoki Maruyama[1], Youhei Watanabe[1], Hiroaki Ito[1], Yaowateera Achawangkul[1] and Masafumi Hirota* Graduate School of Engineering Mie University, Japan	Japan
S 01.7	**Principal Characteristics of Thermoacoustic Sound Generator and Refrigerator's Application** *Naoki Maruyama[1], Yoshikatsu Iwasaki[1], Mitsunori Saito[1], Yujiro Kitaide[1], Kouji Takiguchi[2], Shin Ishida[2], Yuuhei Yamagami[2], Toshiaki Tsuchiya[2] and Masafumi Hirota[1]* [1] Graduate School of Engineering Mie University, Japan [2] Fuji electric Co., Ltd., Japan	Japan

S 02: Wind Energy
Time: 15:15 – 17:25
Room Assignment: Oriental Palm I

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 02.1	**Developing a Method to Analyse the Electricity Cost of Wind Power** *Ahmad Zahedi* James Cook University, Australia	Australia
S 02.2	**Offshore Wind Resource Assessment of the Gulf of Thailand** *J. Waewsak[1], M. Landry[2] and Y. Gagnon[2]* [1]The Solar and Wind Energy Research Laboratory (SWERL), Research Center in Energy and Environment Thaksin University, Thailand [2]The Université de Moncton, Edmundston (NB), Canada	Thailand
S 02.3	**Multi-objective Economic Dispatch Considering Wind Generation Uncertainty Using Non-dominated Sorting Particle Swarm Optimization** *Anongpun Man-Im[1], Weerakorn Ongsakul[1], Jai Govind Singh[1] and Chanwit Boonchuay[2]* [1]Energy Field of Study, School of Environment, Resources, and Development, Asian Institute of Technology (AIT), Thailand [2]Rajamangala University of Technology Rattanakosin, Thailand	Thailand
S 02.4 Student Award Entry	**Experimental Study on Sectional Performance of Horizontal Axis Wind Turbine at Optimum Operation by Using LDV System** *T. Phengpom, Y.Kamada, T. Maeda, J.Murata, Y. Kagisaki and S. Nishimura* Division of Mechanical Engineering Graduate School of Mie University, Japan.	Japan
S 02.5	**Input-Output linearization of Wind Energy System Based on PMSG for Direct Active and Reactive Power Control via Sliding Mode Approach** *Navid Bolouki[1], Karim Abbaszadeh[2] and Sam Roozbehani[2]* [1]Islamic Azad University- South Tehran Branch [2]K.N.Toosi University, and Tehran, Iran	Iran
S 02.6	**Design and Simulation of High Efficiency Counter-Rotating Vertical Axis Wind Turbine Arrays** *P. Chaitanya Sai, Richa S. Yadav, R. Nihar Raj and G.R.K. Gupta* Department of Mechanical Engineering National Institute of Technology Warangal – India	India

S 03: Renewable Energy Integration
Time: 15:15 – 17:25
Room Assignment: Oriental Palm II

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 03.1	**Performance of a Greenhouse Solar Dryer for Drying Macadamia Nuts** *C. Phusampao[a,e1]*, W. Nilnont[b,e2], S. Janjai[a,e3]* [a]Solar Energy Research Laboratory, Department of Physics, Faculty of Science Silpakorn University, Thailand [b]Department of Mechanical Engineering Faculty of Engineering and Architecture Rajamangala University of Technology Suvarnabhumi, Thailand	Thailand
S 03.2 Student Award Entry	**Computational Fluid Dynamics for Biomass Producer Gas Burner Development to be used in a Cremation Process** *Y. Achawangkul[1], N. Maruyama[1], M. Hirota[1], C. Chaichana[2] and P. Teeratitayangkul[2]* [1]Graduate School of Engineering Mie University, Japan [2]The Department of Mechanical Engineering Faculty of Engineering Chiang Mai University, Thailand	Japan
S 03.3	**Solar and Biomass Potential of Pathum Thani Province in Thailand: An Hourly Simulation of Various Scenarios of Electricity Consumption and Production using Solar and Biomass** *Tobias Kullack and Supachart Chungpaibulpatana* School of Manufacturing Systems and Mechanical Engineering, Sirindhorn International Institute of Technology Thammasat University, Thailand	Thailand
S 03.4	**Determination of the Performance of Cookstoves Using the Controled Cooking Test: Benin Case Study** *C.A. Houngan[1], C. Awanto[1], M. Anjorin[1], B.A.M. Lawani[1], M. Feidt[2]* [1]Laboratory of Applied Energy and Mechanics (LEMA)/EPAC-UAC, 01BP: 2009 Cotonou BENIN [2]Faculté des Sciences; ENSEM, LEMTA 2, Avenue de la Fôret de Haye TSA 60604 54518 VANDOEUVRE-LES-NANCY cedex	Benin
S 03.5 Student Award Entry	**Thin-layer Drying Kinetics of Osmotic Dehydration of Cherry Tomato** *S. Nabnean[1], S. Thapa[1], and S. Janjai[2]* [1]School of Energy, Environment and Materials King Mongkut's University of Technology Thonburi, Thailand [2]Department of Physics Faculty of Science Silpakorn University, Thailand	Thailand
S 03.6	**Modeling of the Solar Photovoltaic Systems to Fulfill the Energy Demand of the Domestic Sector of Pakistan using RETSCREEN Software**	Pakistan

Aamir Mehmood[1], Furqan Ali Shaikh[2] and Adeel Waqas[1]
[1]Center for Energy Systems, National University of Sciences and Technology, Islamabad, Pakistan
[2]Asian Institute of Technology, Thailand

S 04: Special track on "Energy Resilience" by NIES, Japan
Time: 15:15 – 17:25
Room Assignment: Oriental Palm III
Moderator: Yoshiki Yamagata

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 04.1	**Smart Community Clustering for Sharing Local Green Energy** *Yoshiki Yamagata, H. Seya and S. Kuroda* National Institute for Environmental Studies, Japan	Japan
S 04.2	**A Dynamic Solar Irradiance Model for Assessing Solar PV Power Generation Potential in Urban Areas** *S.N. Benger[1], S. Zhou[2], H. Guan[1]* [1]The School of the Environment Flinders University, Australia. [2] The School of Remote Sensing Nanjing University of Information Science and Technology, China	Australia
S 04.3	**Towards an Agent-Based Model of Urban Electricity Sharing** *Thomas Brudermann[1] and Yoshiki Yamagata[2]* [1]Institute of Systems Sciences, Innovation and Sustainability Research (ISIS) University of Graz, Austria [2]Center for Global Environmental Research National Institute for Environmental Studies, Japan	Austria
S 04.4	**Towards Collective Arrangements to Foster Photovoltaics in Agriculture** *Thomas Brudermann, Kathrin Reinsberger, Anita Orthofer and Alfred Posch* Institute of Systems Sciences, Innovation and Sustainability Research (ISIS) University of Graz, Austria	Austria
S 04.5	**Spatially explicit land use and energy scenario of Tokyo using household level micro-data** *H. Seya, Y. Yamagata and K. Nakamichi* National Institute for Environmental Studies, Japan	Japan
S 04.6	**Creating Municipality Level Floor Space Stock Data in Japan by Spatial Statistics Based Areal Interpolation Method** *D. Murakami[1], H. Seya[2] and Y. Yamagata[2]* [1]University of Tsukuba, Tsukuba, Japan, and Center for Global Environmental Research, National Institute for Environmental Studies, Japan [2]Center for Global Environmental Research, National Institute for Environmental Studies, Japan	Japan

S 04.7	**Design and Evaluation of an Electricity Consumption Metering and Visualization System for Households** *Kanae Matsui[1] and Yoshiki Yamagata[2]* [1]Graduate School of Media Design, Keio University, and Center for Global Environmental Research, National Institute of Environmental Studies [2]Center for Global Environmental Research National Institute of Environmental Studies	Japan

Day 2: 20 March 2014 (Thursday)

S 05: Low Carbon Development
Time: 09:35 – 12:00
Room Assignment: Marine I Ballroom

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 05.1	**Development of a Demand-Side Marginal Cost of Carbon Abatement Curve for the Emirate of Abu Dhabi** *Afshin Afshari[1], Christina Nikolopoulou, Miguel Martin* Masdar Institute, Abu Dhabi	United Arab Emirates
S 05.2	**Analysis of Energy Use and CO_2 Emissions of Korean Industry Sector under Carbon Policies** *Zulfikar Yurnaidi, Minho Baek, and Suduk Kim* Energy System Division Ajou University, Republic of Korea	Republic of Korea
S 05.3 Student Award Entry	**Thailand's Low Carbon Societies 2050: Policy Analyses of Peak CO_2 Scenario** *P. Chunark[1], K. Promjiraprawat[1], B. Limmeechokchai[1], T. Masui[2],T. Hanaoka[2] and Y. Matsuoka[3]* [1]Sirindhorn International Institute of Technology (SIIT) Thammasat University, Thailand [2]National Institute for Environmental Studies (NIES), Japan [3]University of Tokyo, Japan	Thailand
S 5.4 Student Award Entry	**Impact of Energy Poverty Alleviation Actions on Energy Demand and CO_2 Emission: A Case Study of Sri Lanka** *Pradeep Jayatilaka and Bundit Limmeechokchai* Sirindhorn International Institute of Technology Thammasat University, Thailand	Thailand
S05.5	**Challenges and Opportunities of Sustainable Green Growth Strategies for Mega Cities: A Case Study of Kolkata** *Joyashree Roy* Jadavpur University, Kolkalta, India	India
S 05.6	**Achieving Low Carbon Buildings through Policy Instruments – Sharing the Trakhees-EHS Dubai Experience** *P.R.Jagannathan*	United Arab Emirates

	Trakhees-EHS, Dubai	
S 05.7	**Development of Thailand's Nationally Appropriate Mitigation Actions (NAMAs) for Low Carbon Society: Energy Security and Co-Benefit Aspects** *Bundit Limmeechokchai[1] and Pornphimol Winyuchakrit[2]* [1]Sirindhorn International Institute of Technology Thammasat University, Thailand. [2]Department of Energy Technology Rajamangala University of Technology Tawan-ok, Chon-buri, Thailand	Thailand
S 05.8	**Heat Pumps and Demand Side Management for Renewable Energy Integration in Sustainable Communities** *C. Brandoni[1], G. Ciriachi, F. Polonara[2], A. Arteconi[1]* [1]Università degli Studi e-Campus, Italy [2]Department of Industrial Engineering and Mathematical Science Università Politecnicadelle Marche, Italy	Italy

S 06: Green Buildings and Infrastructures
Time: 09:35 – 12:00
Room Assignment: Oriental Palm I

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 06.1	**Properties of Concrete Material for Thermal Energy Storage** *Nhine Nwe Htun, Sukruedee Sukchai, Saranagon Hemavibool* School of Renewable Energy Technology (SERT) Naresuan University, Thailand	Thailand
S 06.2	**Impacts of Shading Effect from Nearby Buildings on Heating and Cooling Energy Consumption in Hot Summer and Cold Winter Zone of China** *Toshiaki Ichinose* National Institute for Environmental Studies (NIES), Japan	Japan
S 06.3	**Artificial Neural Networks Based Prediction for Thermal Comfort in an Academic Classroom** *T. Songuppakarn, W. Wongsuwan, and W. San-um* Faculty of Engineering, Thai-Nichi Institute of Technology (TNI), Thailand	Thailand
S 06.4 Student Award Entry	**Exergetic Performance Analysis and Comparison of Various Building Heating Options** *H. Tuzcu[1], H. Gunerhan[1], and A. Hepbasli[2]* [1]Department of Mechanical Engineering Ege University, Turkey [2]Department of Energy Systems Engineering Yasar University, Turkey	Turkey
S 06.5	**Investigation of the Optimal Heat Flux Density for the Refrigerated Warehouses Design** *Christophe Awanto, Aristide Comlan Houngan and Malahimi Anjorin* Laboratory of Applied Energy and Mechanics (LEMA)/EPAC-UAC, Benin	Benin

S 06.6	**Life Cycle Assessment of Self-Help Housing: case of Baan Man Kong Program** *Sasima Charoenkit* Energy Field of Study School of Environment, Resources and Development Asian Institute of Technology, Thailand	Thailand
S 06.7 Student Award Entry	**Optimum Green Building Label for an Office Building in Thailand** *Vichuda Mettanant*, Thosapon Katejanekarn* Building Energy Systems Laboratory Department of Mechanical Engineering Faculty of Engineering and Industrial Technology Silpakorn University, Thailand	Thailand
S 06.8	**Practical Case Study on the Development of Green Standard for Energy and Environmental Design in Thailand** *Bong Chun Kim[1] and Thanapat Arnmanee[2]* [1]National IT industry Promotion Agency (NIPA), Korea [2]The Department of Socialized Housing Project Development National Housing Authority, Thailand	Republic of Korea

S 07: Photovoltaics
Time: 09:35 – 12:00
Room Assignment: Oriental Palm II

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 07.1	**Developing a Method to Accurately Estimate the Electricity Cost of Grid-Connected Solar PV in Bangkok** *A Zahedi* James Cook University, Australia	Australia
S 07.2	**Cationic Polymerization Ultraviolet Curing Method for Preparing Epoxy Resin Encapsulation of Solar Cell: Used for Portable Photovoltaic Devices** *Dong Mengdi[1], Yang Biao[2], You Bo[3], Lin Yandan[1], Sun Yaojie[1], Zhuang Zhong[4]* [1]Institute for Electric Light Sources, Fudan University, P.R. China. [2]School of Architecture, University of Sheffield, Sheffield UK. [3]Department of Material Science, Fudan University, P.R. China. [4]School of Information Science and Technology, Peking University, P.R. China.	China
S 07.3	**Estimating Photosynthetically Active Radiation Using an Artificial Neural Network** *P. Pankaew, S. Pattarapanitchai, S. Buntoung, R. Wattan, I. Masiri, A. Sripradit, S. Janjai** Department of Physics Faculty of Science Silpakorn University, Thailand	Thailand
S 07.4	**Performance Evaluation of Photovoltaic Module at Different Tilt Angle in Kuwait** *Hussain Bunyan and Wesam Ali* Electronic Engineering Department	Kuwait

	College of Technological Studies Public Authority of Applied Education and Training, Kuwait.	
S 07.5	**Drip Irrigation Powered by Solar Cell for Dry Rainfed and No Electricity Area** *B. Tangwongkit, R. Tangwongkit and P. Chontanaswat* Farm Mechanics Department Faculty of Agriculture at Kamphaeng Saen Kasetsart University, Kamphaeng Saen Campus, Thailand	Thailand
S 07.6	**Generation of Typical Meteorological Year Data sets for 20 Stations in Thailand** *S. Pattarapanitchai, K. Tohsing, P. Pankaew, S. Janjai* Departments of Physics Faculty of Science Silpakorn University, Thailand	Thailand
S 07.7	**Determination of PV Module Power Output Degradation after Long Term Operation** *Tariq Aziz, Nipon Ketjoy and Chatchai Sirisamphanwong* School of Renewable Energy Technology Naresuan University, Thailand	Thailand
S 07.8	**PCMs Performances Impact on Flat Plate Solar Collector H2OSS** *C. Cristofari[1], G. Notton[1], J.L. Canaletti[1] and C. Lamnatou[2]* [1]University of Corsica, Georges Peri Laboratory [2]Environmental Science Department, University of Lleida, Spain	France

S 08: Special track on "Other Aspects of Energy Resilience" and a Panel Discussion on Resilience in Green Energy and Urban Systems
Time: 09:35 – 12:00
Room Assignment: Oriental Palm III
Moderator: Hiroshi Maruyama

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 08.1	**General Resilience: Taxonomy and Strategies** *Hiroshi Maruyama[1], Roberto Legaspi[1], Kazuhiro Minami[1] and Yoshiki Yamagata[2]* [1]Research Organization of Information and Systems The Institute of Statistical Mathematics, Japan [2]Center for Global Environmental Research National Institute for Environmental Studies, Japan	Japan
S 08.2	**Evaluating the Sustainability of an Ecological System Based on Evolutionary Multi-agent Simulations** *Kazuhiro Minami[1], Roberto Legaspi[1], Tomoya Tanjo[1], Hiroshi Maruyama[1], and Yoshiki Yamagata[2]* [1]Research Organization of Information and Systems The Institute of Statistical Mathematics, Japan [2]Center for Global Environmental Research National Institute for Environmental Studies, Japan	Japan
S 08.3	**Major Principles and Criteria for Development of an Urban Resilience Assessment Index** *Ayyoob Sharifi[1], Yoshiki Yamagata[2]* [1]Global Carbon Project, National Institute for Environmental	Japan

	Studies, Japan [2]Center for Global Environmental Research, National Institute for Environmental Studies, Japan	
S 08.4	**The Necessity of Using Sky View Factor in Urban Planning: A Case Study of Narmak neighborhood, Tehran** *Mojtaba Rafieian[1], Hadi Rezaei Rad[1], Ayyoob Sharifi[2]* [1]College of Art and Architecture Tarbiat Modares University [2] Global Carbon Project, National Institute for Environmental Studies, Japan	Iran
S 08.5	**Design and Implementation of a Risk Indicator Distribution System for Flood Situations** *Kei Hiroi[1] and Yoshiki Yamagata[2]* [1]Graduate School of Media Design, Keio University [2]National Institute of Environmental Studies	Japan
Panel Discussion (Moderator: Hiroshi Maruyama)		

Day 3: 21 March 2014 (Friday)

S 09: Green Policies and Programmes
Time: 09:45 – 12:10
Room Assignment: Marine I Ballroom

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 09.1	**Designing an Energy Planning Concept for Enhancing the Dissemination of Renewable Energy Technologies in Developing Countries** *Rikke Lybæk*, Jan Andersen, Søren Lund, and Tyge Kjær* Department of Environmental, Social and Spatial Change (ENSPAC) University of Roskilde, Denmark	Denmark
S 09.2	**Establishing a Robust Sustainability Index for the Assessment of Bioeconomy Regions** *Jakob Hildebrandt[1], Alberto Bezama[1] and Daniela Thrän[1,2,]* [1] Department of Bioenergy, Helmholtz Centre for Environmental Research - UFZ, Germany [2] Abteilung Bioenergysysteme, Deutsches Biomasseforschungszentrum GmbH – DBFZ, Germany	Germany
S 09.3	**Energy-Growth Nexus: Evidence from a Panel of ASEAN Regional Forum Countries** *Rudra P. Pradhan[1] and Yuosre Badir[2]* [1]Vinod Gupta School of Management Indian Institute of Technology Kharagpur, India [2]Asian Institute of Technology, Thailand	India
S 09.4 Student Award	**Going Green and Energy Security** *W.L. Choong, B.W. Ang, and T.S. Ng* The Department of Industrial and Systems Engineering	Singapore

Entry	National University of Singapore	
S 09.5	**Long term Scenarios for Bioenergy in India** *K. Bhaskar and P.R. Shukla* Indian Institute of Management, Ahmedabad	India
S 09.6 **Student** **Award** **Entry**	**The Short-term Effects of Air Pollution on Health in Sfax (Tunisia): An ARDL Cointegration Procedure** *H. Elkadhi[1] and R. Ben Hamida[2]* [1]Laboratory of Applied Economics and Finance (LEFA), Institute of Advanced Business Studies of Carthage (IHEC), Tunis, Tunisia; and Centre for Studies and Research on International Development (CERDI), Clemont-Ferrand, France. [2]Unit of Research in Development Economics (URED) Sfax, Tunisia; Centre for Studies and Research on International Development (CERDI), Clemont-Ferrand, France.	Tunisia
S 09.7	**Policies and Measures to Remove Energy Efficiency Barriers in Thai Buildings toward NAMAs** *Yumiko Asayama[1] and Bundit Limmeechokchai[2]* [1]Center for Social and Environmental Systems Research National Institute for Environmental Studies, Japan [2]Sirindhorn International Institute of Technology Thammasat University, Thailand	Japan
S 09.8	**Baseline Scenario Selection for Sectoral Climate Mitigation Action in Power Generation: a Case Study on the Grid Emission Factor as Intensity Benchmark in Thailand** *A. Lehmann, J. Nylander, J. Huenteler and T. Schmidt* Climate Policy Advisory Berlin	Germany

S 10: GNESD Special Session
Time: 09:35 – 12:10
Room Assignment: Oriental Palm I

Ref. No.	Title, Authors, Affiliation	Country of Origin
	Brief Introduction of GNESD *Emmanuel Ackom* Global Network on Energy for Sustainable Development (GNESD) facilitated by UNEP	
S 10.1	**Biofuel Sustainability in the Global South: Case Studies from Asia, Africa and Latin America** *Emmanuel Ackom* Global Network on Energy for Sustainable Development (GNESD) facilitated by UNEP UNEP Risoe Centre Denmark Technical University	Denmark
S 10.2 **Student** **Award** **Entry**	**Utilization of Solar and Biomass for Rural Electrification in Bangladesh** *Md. Ahsan Habib and Supachart Chungpaibulpatana* School of Manufacturing Systems and Mechanical Engineering, SIIT, Thammasat University	Thailand
S 10.3 **Student** **Award**	**Sustainable Rural Electrification in Thailand: Analyses of Energy Consumption and CO_2 Emissions** *N. Kongwanarat and B. Limmeechokchai*	Thailand

Entry	Sirindhorn International Institute of Technology Thammasat University	
S 10.4	**Renewable Energy based Mini-grids for Enhancing Electricity Access: Experiences and Lessons from India** *Debajit Palit[1], and Gopal K Sarangi[2]* [1]The Energy and Resources Institute, India [2]The TERI University, India	India
S 10.5	**The Implementation of Micro Hydro Projects in Remote Villages on the Border of Indonesia and Malaysia: Lessons Learnt** *Sari Murni[1], Tania Urmee[1], Jonathan Whale[1], John Davis[1] and David Harries[2]* [1]Murdoch University, Australia. [2] University of Western Australia, Australia	Australia
S 10.6	**Eco Village Concept for Green Economic Development: Iskandar Malaysia as a Case Study** *H. Hashim[1], M.F. Shukery[2], L.J. Shiun[1], H.C. Siong[1], H.M. Yusof[3]* [1]Universiti Teknologi Malaysia, Johor [2]Universiti Putra Malaysia, Selangor [3]Iskandar Regional Development Authority	Malaysia
S 10.7	**Towards Green and Sustainable Society: a Case of Engineering Faculty, Universitas Indonesia** *Gabriel Andari Kristanto, Cindy Priadi, Mulia Orientilize, Arief Udhiarto, Erly Bahsan* Universitas Indonesia, Kampus Baru	Indonesia
S 10.8	**Share Knowledge to Increase Energy Access – GNESD Energy Access Knowledge Base** Xiao Wang Global Network on Energy for Sustainable Development (GNESD) facilitated by UNEP UNEP Risoe Centre Denmark Technical University	Denmark

S 11: Electric Power Generation, Transmission and Distribution I
Time: 09:35 – 12:10
Room Assignment: Oriental Palm II

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 11.1	**Analysis of Switching Transient Overvoltages and Protection Techniques for the Energization of the Connected 115 kV Underground and Submarine Cables** *P. Tharárak, P. Jirapong and P. Jan-ngoen* Department of Electrical Engineering Faculty of Engineering Chiang Mai University, Thailand	Thailand
S 11.2 Student Award Entry	**A Phase Shifted PWM Technique for Common-mode Voltage Reduction in Five Level H-bridge Cascaded Inverter** *N.L.H. Bang, N.V. Nho, N.K.T. Tam and N.M. Dung* Department of Electrical Electronics Engineering	Vietnam

	Ho Chi Minh City University of Technology, Vietnam	
S 11.3	**Restructuring of a Low Voltage Distribution System into a High Voltage Distribution System -For an Improved Voltage and Power Loss Profile** *K. Spandana and Varsha Reddy. A* Department of Electrical Engineering Osmania University, India	India
S 11.4	**Analysis of Impacts of SVC on Voltage Collapse Mechanism and Maximum Loadability** *Dinh Thuc Duong and Kjetil Uhlen* Department of Electric Power Engineering Norwegian University of Science and Technology, Norway	Norway
S 11.5 Student Award Entry	**Simulation and Experiment of Hybrid Modulation Strategy with Common-mode Voltage Reduction for Seven-Level Hybrid Cascaded Inverter** *N.L.H. Bang, N.V. Nho, N.K.T. Tam and N.M. Dung* Department of Electrical Electronics Engineering Ho Chi Minh City University of Technology, Vietnam	Vietnam
S 11.6	**Impacts of PMUs in DistributionNetworks with High Penetration of Distributed Generation** *SubasRatnaTuladhar and Jai Govind Singh* Energy Field of Study School of Environment, Resources and Development Asian Institute of Technology, Thailand	Thailand
S 11.7	**Proposed Implementation Methodology for a Hybrid Energy Management System with Renewable Source Integration** *Sardar Farhan Ali Cheema, Rana Farhan Akram, and Muhammad Aqeel Aslam* Department of Electrical and Power Engineering PNEC-NUST, Karachi, Pakistan	Pakistan
S 11.8	**Impact of High Solar Rooftop PV Penetration on Voltage Profiles in Distribution System** *Rung Punyachai[1], Weerakorn Ongsakul[1] and Uwe Schmidt[2]* [1]Asian Institute of Technology [2] Institute of Electrical Power Systems and High Voltage Engineering, Technische Universität Dresden, Germany	Thailand

S 12: Bioenergy and Biofuels I
Time: 09:35 – 12:10
Room Assignment: Oriental Palm III

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 12.1	**Environmental and Social Impacts of Jatropha-Based Biodiesel: A Case Study in Thailand** *Pornpimon Boonkum[1], Makoto Nohtomi[1], Jitti Mungkalasiri[2], Wanwisa Thanangkano[2], Katsuya Nagata[1], and Hiroshi Onoda[1]* [1]The Graduate School of Environment and Energy Engineering Waseda University, Japan [2]The National Metal and Materials Technology Center,	Japan

	Thailand	
S 12.2	**Biodiesel Purification: Comparison and Optimization of Common Washing Processes** *D.Y.C. Leung* The University of Hong Kong	Hong Kong
S 12.3	**Large Scale Transport Energy Production from Microalgae in Persian Gulf Knowledge Island** *Nasrin Moazami, Reza Ranjbar and Alireza Ashori* Iranian Research Organization for Science and Technology	Iran
S 12.4	**Development of a Generic Methodology for Assessment of Microalgae Cultivation Potential Using GIS** *Karabee Das and P. Abdul Salam* Energy Field of Study Asian Institute of Technology, Thailand	Thailand
S 12.5	**Comparison the Water Footprint of Oil Palm Plantation in Surat Thani and Rayong provinces of Thailand** *Jittraporn Jaimung, Achara Ussawarujikulchai and Kanchana Nakhapakorn* Faculty of Environment and Resource Studies Mahidol University, Thailand	Thailand
S 12.6	**Bioenergy Education and Training for the Youth - Does it Matter for the Sustainability of Bioenergy?** *Pradipta Halder* School of Forest Sciences University of Eastern Finland	Finland
S 12.7	**Cost and Benefit Analysis of Bio Energy Alternatives in India** *Trupti Mishra* Indian Institute of Technology Bombay, India	India
S 12.8	**Investigation on Optimum Blend Ratio and Microwave Pretreatment Condition of Primary and Secondary Sludge from Sewage Treatment Plants (STP) to Enhance Biogas Production in an Anaerobic Digester** *Sivansankari R. , Kumaran P., and Saifuddin Normanbhay* Center of Renewable Energy, University Tenaga Nasional	Malaysia

S 13: Green Transport
Time: 13:10 – 16:10
Room Assignment: Marine I Ballroom

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 13.1	**Comparative Analyses of Low Carbon Measures in the Transport Sector: the Cases of Thailand and Sri Lanka** *S. Selvakkumaran and B. Limmeechokchai* Sirindhorn International Institute of Technology Thammasat University	Thailand
S 13.2 Student Award Entry	**Analysis of Low Carbon Society in Thai Transport Sector – The AIM/Enduse Modeling Approach** *S. Selvakkumaran[1], B. Limmeechokchai[1], T. Masui[2], T. Hanaoka[2] and Y. Matsuoka[3]* [1]Sirindhorn International Institute of Technology (SIIT),	Thailand

	Thammasat University. [2]National Institute of Environmental Studies, Japan. [3]University of Kyoto	
S 13.3	**Sustainable Low Carbon Transport Scenarios for India** *P.R. Shukla[1], Subhash Dhar[2], Shivika Mittal[1]* [1]Indian Institute of Management, Ahmedabad, India [2]UNEP Riso Centre, Denmark	India
S 13.4 Student Award Entry	**Technical and Environmental Impact of Electric Vehicles in Distribution Networks** *Jun Su, Charalampos E. Marmaras, Erotokritos S. Xydas* Cardiff School of Engineering Cardiff University, United Kingdom	United Kingdom
S 13.5	**Determining Key Predictors Influencing Intention to Use Electric Vehicles in Malaysia** *Yew-Ngin Sang and Hussain Ali Bekhet* Graduate Business School, College of Graduate Studies Universiti Tenaga Nasional (UNITEN), Putrajaya, Malaysia	Malaysia
S 13.6	**The Energy Management Control Strategy for Electric Vehicle Applications** *A. Wangsupphaphol, N.R.N. Idris, A.Jusoh, N.D.Muhamad, and Low Wen Yao* Faculty of Electrical Engineering Universiti Teknologi Malaysia	Malaysia
S 13.7 Student Award Entry	**Optimal Placement of EV Fast Charging Stations Considering the Impact on Electrical Distribution and Traffic Condition** *Prakornchai Phonrattanasak and Nopbhorn Leeprechanon* Department of Electrical and Computer Engineering Thammasat University, Thailand	Thailand
S 13.8	**Green Energy and Sustainable Urban Transport Transition: a Co-benefits Assessment for Ahmedabad, India** *P. Chokshi[1], P.R. Shukla[1], M. Pathak[2] and K. Bhaskar[1]* [1]Indian Institute of Management – Ahmedabah, India [2]CEPT University, Ahmedabad, India	India

S 14: Power and Heat Time: 13:10 – 16:10 Room Assignment: Oriental Palm I		
Ref. No.	**Title, Authors, Affiliation**	**Country of Origin**
S 14.1	**Design of Strategic Information in the Deregulated Indian Power Market: an agent-based Approach** *Vivek Mohan[1], Nimal Madhu[1], Weerakorn Ongsakul[1], Jai Govind Singh[1], and Reshma Suresh M P* Energy Field of Study School of Environment, Resources and Development Asian Institute of Technology, Thailand	Thailand
S 14.2 Student Award	**An Experimental Investigation of a Co-generation Energy System Using a Tubular SOFC: A Renewable Energy Solution for Power and Heat**	Malaysia

Entry	*K.R. Ullah, R.K. Akikur, H.W. Ping[1], Member, IEEE, R. Saidur,* S.A. Hajimolana, M. A. Hussain Faculty of Engineering University of Malaya, Malaysia	
S 14.3	**Study of the Characteristics of Cellular Premixed Flames on Ceramic Porous Board for $CH_4/C_2H_6/CO_2$ Mixtures** *Kaewpradap A[1], Pimtawong T.[1], Tongtrong P.[1], Jugjai S.[1], Kadowaki S[2]* [1]Department of Mechanical Engineering King Mongkut's University of Technology Thonburi, Thailand [2] Department of System Safety Nagaoka University of Technology, Japan	Thailand
S 14.4	**Turbulent Convection in a Solar Air Heater Channel with Baffles/Winglets** *S. Skullong, S. Tamna and P. Promvonge* [1]Kasetsart University, Sri Racha Campus, Chonburi [2]Thai-Nichi Institute of Technology, Bangkok [3]King Mongkut's Institute of Technology Ladkrabang, Bangkok	Thailand
S 14.5	**Heat Transfer and Flow Friction Behaviours in a Channel with Multiple 30° V-Ribs** *C. Khanoknaiyakarn[1], W. Jedsadaratanachai[2] and P. Promvonge[2]* [1]King Mongkut's Institute of Technology North Bangkok Rayong [2]King Mongkut's Institute of Technology Ladkrabang	Thailand
S 14.6	**Optimization of Operating Parameters to Maximize the Curent Density without Dehydration at the Anode Membrane Interface of a PEM Fuel Cell using Taguchi Method** *S.S. Lingeswara Rao, A. Shaija and S. Jayaraj* National Institute of Technology Calicut, Kerala, India	India
S 14.7	**Parametric Study on Geographic Factors for Napier Grass Plantation in Thailand** *M. Fakkao, C. Phianchurat, B. Hammachukitatikul, N. Limjeerajarus* Thai-Nichi Institute of Technology	Thailand
S 14.8	**Thermal Characteristics in Turbulent Channel Flows with V-Baffle Vortex Generators** *Y. Kaewkohkiat[1],* W. *Jedsadaratanachai[1], P. Eiamsa-ard[2], P. Promvonge[1] and S. Eiamsa-ard[3]* [1]King Mongkut's Institute of Technology Ladkrabang [2]Phetchaburi Rajabhat University, Petchaburi [3]Mahanakorn University of Technology, Bangkok	Thailand
S 14.9	**Study of a Concentrating Solar Collector Integrated in the Roof** *J.L. Canaletti, C. Cristofari, G. Notton, J. Panighi* University of Corsica, G. Peri Scientific Research Center	France

S 15: Electric Power Generation, Transmission and Distribution II
Time: 13:10 – 16:10
Room Assignment: Oriental Palm II

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 15.1	**Benefits Associated with Distributed Generation to Remove Transmission Overloads** *A.K. Singh and S.K. Parida* Indian Institute of Technology, Patna	India
S 15.2	**Optimal Placement of Vehicle-to-Grid Charging Station in Distribution System using Particle Swarm Optimization with Time Varying Acceleration Coefficient** *Jukkrapun Prasomthong[1], Weerakorn Ongsakul[1], Jan Meyer[2]* [1]Asian Institute of Technology [2] Institute of Electrical Power Systems and High Voltage Engineering, Technische Universität Dresden, Germany	Thailand
S 15.3	**Robust Optimization-Based AC Optimal Power Flow Considering Wind and Solar Power Uncertainty** *Titipong Samakpong, Weerakorn Ongsakul and Jirawadee Polprasert* Asian Institute of Technology	Thailand
S 15.4	**Potential of Smart Grid in Thailand: a Development of WADE Smart Grid Model** *Songkran Pisanupoj, Weerakorn Ongsakul, Jai Govind Singh* Asian Institute of Technology	Thailand
S 15.5	**Chaotic based PSO with Time Varying Acceleration Coefficients for Security Constrained Optimal Power Flow Problem** *Jirawadee Polprasert and Weerakorn Ongsakul* Asian Institute of Technology	Thailand
S 15.6	**Synchronization Control and Droop Control of Microgrid Operation** *Pornchai Chaweewat, Jai Govind Singh and Weerakorn Ongsakul* Asian Institute of Technology	Thailand
S 15.7	**Improving of Uncertain Power Generation of Rooftop Solar PV Using Battery Storage** *Anchuleeporn Chersin[1], Weerakorn Ongsakul[1], Joydeep Mitra[2]* [1]Asian Institute of Technology [2]Michigan State University	Thailand
S 15.8	**Voltage Stability Assessment of DFIG Wind Turbine in Different Control Modes** *Chanokwan Veerasathian[1], Weerakorn Ongsakul[1], Joydeep Mitra[2]* [1]Asian Institute of Technology [2]Michigan State University	Thailand
S 15.9	**Investigation of Step, Touch and Surface Potentials of 11 kV/66 kV Substations** *M.A. Salam, S.P. Ang, W. Voon, M. Rafiuddin and M. Aridoon* Institute Technology Brunei	Brunei

S 16: Bioenergy and Biofuels II
Time: 13:10 – 16:10
Room Assignment: Oriental Palm III

Ref. No.	Title, Authors, Affiliation	Country of Origin
S 16.1	**Techno-Economic Evaluation of Biogas Production from Food Waste for Electricity Generation** *Regina Kulugomba[1], Sahataya Thongsan[2] and Sarayooth Vivuidth[2]* School of Renewable Energy Technologies (SERT) Naresuan University, Thailand	Thailand
S 16.2	**Solid Concentration Influence on Biogas Yield from Food Waste in an Anaerobic Batch Digester** *B. Deepanraj, V. Sivasubramanian, S. Jayaraj* National Institute of Technology Calicut, Kerala, India	India
S 16.3	**Production of Thermoelectric Power from the Infectious Waste of Hospitals of Lahore** *Mohammad Rafiq Khan and Zainab Ali* Center of Policy and Environment Lahore School of Economics, Pakistan	Pakistan
S 16.4	**SWOT Analysis of Renewable Energy** *Bahadir Aydin* War College Academy, Istanbul, Turkey	Turkey
S 16.5	**A Feasibility Study of Renewable Energy and Carbon Emission Reduction in Iskandar Malaysia** *S.T. Tan, W.S. Ho, H. Hashim and C.T. Lee* Universiti Teknologi Malaysia	Malaysia
S 16.6	**Solar still Coupled with a Modified Biomass Cook Stove – an Experimental Study** *K. Sampathkumar* Tamilnadu College of Engineering, Coimbatore, Tamilnadu	India
S 16.7	**Pre-Treatment of Sewage Sludge to Enhance Biogas Production to Generate Green Energy for Reduction of Carbon Footprint in Sewage Treatment Plant (STP)** *Hephzibah David, Kumaran Palanisamy, Saifuddin Normanbhay* Center of Renewable Energy, University Tenaga Nasional	Malaysia
S 16.8	**Catalytic Gasification of Empty Palm Fruit Bunch (EPFB) over Mixed Metal Oxide Catalysts for Hydrogen Production** *Yun Hin Taufiq-Yap* University Putra Malaysia	Malaysia

DETAILED ABSTRACTS

S 01: Greening the Industrial Sector
Time: 15:15 – 17:25
Room Assignment: Marine I Ballroom

S 01.1 Student Award Entry

The Challenges for Fossil Fuel Power System associated with Integration of Large Scale Renewable Generation

I. Knõš, M. Landsberg and J. Valtin
Tallinn University of Technology,Estonia
Izabella.Knos@elering.ee

This paper presents the challenges that are associated with the integration of wind power into the power systems based on fossil-fuel generation. These challenges include indirect effects associated with international trade and the development of the generation mix in the neighbouring countries. LCOE, that is widely used due to simplicity and possibility to compare the unit costs of different technologies over their economic life alone do not provide information of profitability or competitiveness of power plant. The economic evaluation of any power generating technology should be complemented by its market value as the interaction between regions can have strong effect on the generation costs. It was proposed to analyse the influence of different share of RES, different level of CO2 prices on electricity export, import prices and generation cost of Estonian power plants. The expression of import, export prices provide important information of power system operation effects on power plants generation costs. This can be used for estimation of cost-optimal and competitive penetration level of RES for designing of cost-efficient power system to policy makers and investors. The main conclusion is that the more RES capacity in the system, the higher will be difference between export and import electricity prices. The stronger CO2 policy will be, the higher will be profit for RES technologies and less for conventional power plants and the more needs for subsidies for base load and regulation power plants. In addition, the paper presents the interrelations between integrated RES capacity, CO2 price, electricity market price and LCOE.

S 01.2

Energy Management in Steel Rolling Plant

G.S. Grewal[1], B.S. Rajpurohit[1], J.G. Singh[2]
[1]School of Computing & Electrical Engineering
Indian Institute of Technology Mandi, Mandi 175001, HP, India.
[2]School of Environment, Resources and Development
Asian Institute of Technology, Pathumthani 12120, Thailand
gurinderbir_singh@students.iitmandi.ac.in

Induction machines (IMs) account for a bulk portion of electric energy consumed in industrial applications. The efficiency and power factor of the IMs have been remarkable impact on running cost. In this work, a practical field work data have been taken up as Jindal Steel Plant (JSP) in India, where there were more than 300 Induction Machines ranging from small one HP to large 200 HP. Furthermore, it has been observed that most of IMs had more than required capacity rating, the load sharing between transformers were inadequate, ten large variable speed IMs tripped off sometime due to load fluctuation and, power factor of plant's electric supply was also poor, hence, all these factors had significant impact on overall energy losses as well as machine's performances. Therefore, in this work, several techniques/approaches have been

suggested in terms of replacing with efficient designed and appropriate capacity rating of Induction Machines as well as Transformers, rescheduling of transformer loads and, improvement of power factor to reduce the overall energy and monetary losses in this Steel Plant. Moreover, the effectiveness of all these proposed approaches have been analyzed in terms of energy and demand saving, payback period of new investment with assumed life time of machines.

S 01.3

A Study of Energy Effectiveness in a Cooling Tower

Dang Quoc Phu and Dang Tran Tho
School of Heat Engineering and Refrigeration
Hanoi University of Science and Technology, Vietnam
tho.dangtran@hust.edu.vn

Cooling tower (CTW) is widely used in a variety of engineering application where there is a need to release the heat from a hot water flow into a cooler atmosphere. As a result, operation of any CTW depends not only its own configuration but also on climatic conditions under which it is employed. In this study, a laboratory-scale CTW with a maximum heat capacity of 89,000 kJ/hr was made to study effect of air humidity and temperature, air-to-water flow ratio, specific surface area and packed bed height of the CTW on its energy effectiveness that is characterized by water temperature and water flow rate at the outlet of CTW. Based upon the experimental results, two correlations were developed to estimate these parameters. The calculated results has shown a good agreement with the experimental ones.

S 01.4
Student Award Entry

Automatic Control of Soot and Unburnt Hydro Carbons from Flares in Oil and Gas Industry

R. Srinivasarao and K.V.S.G. Murali Krishna
Jawaharlal Nehru Technological University
Kakinada, Andhra Pradesh, India-533003
rekhapalli_sri@yahoo.co.in

Flaring is a high-temperature oxidation process used to burn waste gases from industrial operations. Smoke results from combustion, depends on waste gas components, quantity and distribution of combustion air. Flares stacks are used in industries are often assisted with steam to ensure complete combustion and to avoid any unburnt hydro carbons. In this process, flares are often sooty due to insufficient steam. This results in black carbon from flares. Soot particles in the air are a contributing factor in respiratory diseases. The fine particles less than 3micron are the worst causes of lung damage due to their ability to penetrate into the deep air passage. This paper explains the health effects of soot and particulate matter. New scientific evidence has led to recognition of the significant role of black particles (black carbon – BC) as one of the short-lived climate forcers. Measures focused on BC and methane is expected to achieve a significant short-term reduction in global warming. The black carbon or soot from flares can be minimized by controlling steam to flare by automation. Flare gas flow measurement by ultrasonic flow meter gives a high turn down ratio of 2000:1. This paper explains the methodology of control of soot from flares by steam to hydro carbon ratio control and how the combustion efficiency varies with the amount of steam. The economical benefit of saving steam by automation is not only credit to the company but also carbon credit to the world.

S 01.5 Student Award Entry

Waste Heat Recovery for Power Generation using Organic Rankine Cycle in a Pulp and Paper Mill

Ahiwe Chinwendu Francis and Supachart Chungpaibulpatana.
Department of Manufacturing Systems and Mechanical Engineering
Sirindhorn International Institute of Technology, Thammasat University
P.O.Box 22, Pathum Thani 12121, Thailand
ahiwec@yahoo.com

In achieving a sustainable greener future, more awareness on potential energy recovery in industrial processes is important as their energy demand continues to grow. This paper discusses how unused thermal energy can be effectively recovered in pulp and paper mills, hence improving mill's energy efficiency and increase clean energy generation. Pulp and paper mills usually feature medium grade heat in the recovery boiler stack of black liquor due to limited boiler efficiency and safety reasons. The unused heat is to be recovered and used to generate power using an Organic Rankine Cycle (ORC). The waste heat from the ORC is also recovered and used for water heating. This technology promises a reasonable payback time with no or little supervision of operation. Analyzing the characteristics of the available waste heat, a waste heat recovery heat pipe (thermal oil) loop is integrated at the back end of the boiler recovery to harness the heat which is delivered to the ORC. Heat from the condensing unit of the ORC is used to preheat water for process use. A modeled ORC power plant is used to determine power generated from a pulp and paper mill. The simulation study shows that using an ORC-based power generation greatly improve the mill energy efficiency reduce fossil fuel electricity consumption and decrease CO2 emission.

S 01.6

Oily Waste Metal Recycle Using Circulation-type a Superheated Steam Degreasing System

Naoki Maruyama, Youhei Watanabe, Hiroaki Ito, Yaowateera Achawangkul and Masafumi Hirota
Graduate School of Engineering, Mie University
Tsu, Mie, 514-8507 Japan
maruyama.naoki@mie-u.ac.jp

In order to improve quality of oily metal waste for recycling materials disposed from metalworking factories, the degreasing system plays an important role. It is necessary to introduce the system in municipal and industrial waste management. In this paper, an energy consumption of a practical circulation-type superheated steam degreasing system was used for oily metal waste, which was disposed from a metalworking factory. It was compared to a once-through type superheated steam degreasing system. A demonstration system was constructed, and the energy balances of the mentioned systems were evaluated. Then, flow rates of materials required for the recycle system were estimated, and energy balances from the system were theoretically evaluated and compared. As a result, the circulation-type superheated steam waste recycle system that was applied to process the oily metal waste provides a promising high-quality material recycle and energy-saving waste recycle system.

S 01.7 Principal Characteristics of Thermoacoustic Sound Generator and Refrigerator's Application

Naoki Maruyama[1], Yoshikatsu Iwasaki[1], Mitsunori Saito[1], Yujiro Kitaide[1], Kouji Takiguchi[2], Shin Ishida[2], Yuuhei Yamagami[2], Toshiaki Tsuchiya[2] and Masafumi Hirota[1]
[1]Graduate School of Engineering, Mie University
Tsu, Mie, 514-8507, Japan
[2] Fuji Electric Co., Ltd., Yokkaichi, Mie, 510-8631, Japan
maruyama.naoki@mie-u.ac.jp

The simplified thermoacoustic refrigerator and sound generator is introduced and the characteristics of this equipment are evaluated in this paper. A continuous oscillatory sound in the resonance tube generated by a thermoacoustic engine was converted to cold heat using a thermoacoustic refrigerator. This concept involves a refrigerator without a refrigerant and moving parts, which is different from the currently popular, conventional refrigerant cycle. The performance of the thermoacoustic system is experimentally examined, and then theoretically estimated based on the experimental results. The purpose of this study is to find an optimal system configuration and system condition to achieve a high-performance thermoacoustic refrigerator and sound generator. The characteristics and performance of a thermoacoustic sound generator and refrigerator are evaluated separately from the experimental and theoretical point of view in this paper.

S 02: Wind Energy

Time: 15:15 – 17:25
Room Assignment: Oriental Palm I

S 02.1 Developing a Method to Analyse the Electricity Cost of Wind Power

Ahmad Zahedi
James Cook University
Queensland, 4811, Australia
ahmad.zahedi@jcu.edu.au

In terms of costs of owning and operation, the wind power differs from conventional thermal power plant as the most of these costs are known in advance. Wind power is considered as capital-intensive technologies. Operation and maintenance costs of wind power are relatively low, when compared to thermal power plants, and of course the input fuel (wind energy) is free, meaning that fluctuating fuel costs have no impact on wind power generation costs. The objective of this paper is to present the results of a study conducted to identify and determine the cost components of electricity produced by a wind farm before the installation process. For estimation of wind power production cost, the characteristics of the site, where the wind farm is installed, and the power curve of wind turbine provided by manufacturer were used as well as the life cycle cost and time value of money were used. The study results show that the wind power production costs range from approximately 0.07-0.10 $/kWh at those sites with low average wind speeds, to approximately 0.05 – 0.07 $/kWh at windy coastal sites. This study focuses on the annualized life cycle cost and the production cost in $/kWh. This way of cost estimation allows us to make comparison between wind power-generated electricity cost and the electricity production cost of the other power generating

technologies.

S 02.2 Offshore Wind Resource Assessment of the Gulf of Thailand

J. Waewsak[1], M. Landry[2] and Y. Gagnon[2]
[1]The Solar and Wind Energy Research Laboratory (SWERL)
Research Center in Energy and Environment, Thaksin University
Paprayom, Phatthallung 93110, Thailand
[2]The Université de Moncton, Edmundston (NB), Canada
jompob@tsu.ac.th

The Royal Thai Government recently launched its latest policy regarding the installation of 1,800 MW wind power capacity by 2025. While onshore wind power has significant limitations due notably to land use constraints and public acceptance, offshore wind energy offers good opportunities of development and is thus an interesting alternative. The main objective of this paper is to present the offshore wind resource assessment of the Gulf of Thailand, which covers an area of 320,000 km^2. A coupled mesoscale-microscale model is used, along with R1 NCEP/NCAR global reanalysis database, to generate a high resolution wind resource map. Results show that interesting potential areas for offshore wind farm development have wind speeds of up to 6.5 m/s, especially in the upper part of the Gulf of Thailand, covering a surface of 2,112 km^2. With a total potential installed capacity of 5,000 MW, the annual energy production is estimated at 9.64 TWh/year.

S 02.3 Multi-objective Economic Dispatch Considering Wind Generation Uncertainty Using Non-dominated Sorting Particle Swarm Optimization

Anongpun Man-Im[1], Weerakorn Ongsakul[1], Jai Govind Singh[1] and Chanwit Boonchuay[2]
[1]Energy Field of Study, School of Environment, Resources, and Development Asian Institute of Technology (AIT), Thailand
[2]Rajamangala University of Technology Rattanakosin, Thailand
st113280@ait.asia

In this paper, a non-dominated sorting particle swarm optimization (NSPSO) is proposed for solving multi-objective economic dispatch considering wind power uncertainty. Two objectives including operation cost and system risk in terms of wind power penetration are considered. The Pareto fronts of optimal solutions are compared with non-dominated sorting genetic algorithm II (NSGA II). Simulation results on the modified IEEE 30-bus test system indicate that NSPSO can provide a better trade-off Pareto front solution in a less computation effort.

S 02.4 Student Award Entry

Experimental Study on Sectional Performance of Horizontal Axis Wind Turbine at Optimum Operation by Using LDV System

T. Phengpom, Y.Kamada, T. Maeda, J.Murata, Y. Kagisaki and S. Nishimura
Division of Mechanical Engineering, Graduate School of Mie University
Tsu, Mie, Japan
phengpom@mach.mie-u.ac.jp

In the present, we are trying to find alternative energy to replace fossil fuels. Wind power is a good choice as alternative energy. Wind power produces the electricity without producing greenhouse gases or other pollutants. Wind power is converted to electricity by using wind turbines. The performance of wind turbine generator depends on the rotor blade shape. Generally, sectional performance in axial and tangential flow directions is used to design rotor blades. The designed sectional flow is different from actual one with span-wise flow. For this reason, this study would like to study sectional performance in three dimensional directions for the wind turbine rotor blades, designed by including span-wise flow effect in the future. A model wind turbine with 2.4 m diameter is tested in the large wind tunnel. The velocity filed, count number of local velocity, and standard deviation of velocity in three dimensions are discussed.

S 02.5

Input-Output linearization of Wind Energy System Based on PMSG for Direct Active and Reactive Power Control via Sliding Mode Approach

Navid Bolouki[1], Karim Abbaszadeh[2] and Sam Roozbehani[2]
[1]Islamic Azad University- South Tehran Branch, Iran
[2]K.N.Toosi University, Tehran, Iran
navid.bolouki@gmail.com

This paper proposes a new direct power control (DPC) for wind turbine system driven by permanent synchronous generator (PMSG) in order to track maximum absorbable power in different wind speeds. The desired optimum power is determined for per wind speed by lookup table. Finally new direct power control (DPC) employs input output linearization and sliding mode nonlinear controller for robust control of active and reactive power and obtaining maximum power from wind turbine. Also constant switching frequency and required pulse for converters is achieved by using space vector modulation (SVM). Simulation results on 5.7-KW wind turbine are provided Results show that the proposed controller has low error for tracking maximum power in presence wind speed variation.

S 02.6

Design and Simulation of High Efficiency Counter-Rotating Vertical Axis Wind Turbine Arrays

P. Chaitanya Sai, Richa S. Yadav, R. Nihar Raj and G.R.K. Gupta
Department of Mechanical Engineering, National Institute of Technology
Warangal, India
niharrajraparthy@gmail.com

Technology to abstract energy from the wind using Vertical Axis Wind Turbines (VAWTs) has rarely been adopted for large scale power production, owing to low power coefficient of the individual turbines, as compared to Horizontal Axis Wind Turbines (HAWTs). In the last few years, much research has been done to make VAWTs more

economical and efficient to increase power generated per turbine. But besides improving coefficient of power through design changes, research now focuses on maximizing power generated per unit area. Arranging VAWTs in specific layouts of Counter Rotating Arrays can enhance power production in low wind speed areas and thus increase the W. This paper analyses Counter Rotating VAWT Arrays in terms of coefficient of power and power density and further compares efficiencies in various arrangements. The effect of angle of attack on the performance of the array has also been studied further explaining the effects of arrangements on Wind Farm Power Density as well as the Total Wind Farm Power.

S 03: Renewable Energy Integration
Time: 15:15– 17:25
Room Assignment: Oriental Palm II

S 03.1

Performance of a Greenhouse Solar Dryer for Drying Macadamia Nuts

C. Phusampao[1], W. Nilnont[2], S. Janjai[1]*
[1]Solar Energy Research Laboratory, Department of Physics, Faculty of Science, Silpakorn University, Nakhon Pathom73000, Thailand
[2]Department of Mechanical Engineering, Faculty of Engineering and Architecture, Rajamangala University of Technology Suvarnabhumi, Nonthaburi 11000, Thailand
pchayapat@hotmail.com

A multi-purpose greenhouse solar dryer was used to dry in-shell macadamia nuts in order to investigate its performance. The dryer comprises a parabolic roof structure covered with polycarbonate sheets on a concrete floor. The dryer is 9 m in width, 12.4 m in length and 3.45 m in height. Six 15-W DC fans powered by two 50-W PV modules were used to ventilate the dryer. The dryer was installed at a macadamia nuts producer in Loei Province, Thailand. In investigating the performance of the dryer, three drying tests were conducted. For each test, 730 kilograms of in-shell macadamia nuts were dried in the dryer. It was found that the moisture content of the macadamia nuts was reduced from 16% (wb) to 3% (wb) within 5 days, which is shorter than the natural sun drying for 3 days. Results obtained from these tests also showed that drying air temperatures in the dryer varied from 35°C to 60°C. The macadamia nuts dried in this dryer were completely protected from animals and rain. In addition, good quality of macadamia nuts was obtained. The estimated payback period of this greenhouse solar dryer for drying macadamia nuts is about 1 year.

S 03.2
Student Award Entry

Computational Fluid Dynamics for Biomass Producer Gas Burner Development to be used in a Cremation Process

Y. Achawangkul[1], N. Maruyama[1], M. Hirota[1], C. Chaichana[2] and P. Teeratitayangkul[2]
[1]Graduate School of Engineering, Mie University
Tsu, Mie, 514-8507 Japan
[2]Department of Mechanical Engineering, Faculty of Engineering
Chiang Mai University, Chiang Mai 50020, Thailand
yaowateera@gmail.com

In this paper, the Computational Fluid Dynamics (CFD) has been applied for burner design and development in order to simulate the flow and significant characteristics of producer gas combustion, such as when pollution is released. The producer gas's

constituents were taken by GC analysis, whereas the amount of combustion air was determined from 1 mole, assuming a combustion equivalent ratio of 0.9. From CFD simulation, it was found that the maximum temperature occurring from combustion is 1,800 K, and the temperature inside the crematory reached its maximum at 1,100 K. The turbulent intensity and turbulent kinetic energy of a burner, which are described as blending characteristics of fuel and air, are equal to 180% and 10.2 m^2/s^2, respectively. In addition, 6.78 x 10^{-5} $kmol/m^3$-s of the maximum NO formation rate was found, and there was no unburned CO released inside the crematory model. Hence, employing CFD assistance for the burner's design and development can save costs for the actual experimental rig implementation and reduce the time spent on conducting experiments.

S 03.3 Solar and Biomass Potential of Pathumthani Province in Thailand: an Hourly Simulation of Various Scenarios of Electricity Consumption and Production using Solar and Biomass

Tobias Kullack and Supachart Chungpaibulpatana
School of Manufacturing Systems and Mechanical Engineering
Sirindhorn International Institute of Technology, Thammasat University
Pathumthani, Thailand, 12121
tobias.kullack@gmail.com

Nowadays the renewable energy implementation and development is being discussed widely in Thailand with its 20-Year Energy Efficiency Development Plan (2011 - 2030) and additionally the 10-Year Alternative Energy Development Plan 2012 - 2021 (AEDP 2012 – 2021), which is targeting on increasing the share of renewable energy and alternative energy uses by 25 percent instead of fossil fuels within the next 10 years. To reach such an ambitious setting target, several measures must be established with data support from relevant feasibility studies. In this paper, a green city model – in which a 100 % renewable electricity supply is employed in the province – is proposed to be a feasibility study and Pathum Thani, a province in the vicinity of Bangkok, is selected as a case study. Different scenarios are discussed and analyzed for their possibilities.

S 03.4 Determination of the Performance of Cookstoves Using the Controled Cooking Test: Benin Case Study

C.A. Houngan[1], C. Awanto[1], M. Anjorin[1], B.A.M. Lawani[1], M. Feidt[2]
[1]Laboratory of Applied Energy and Mechanics (LEMA)/EPAC-UAC
01BP: 2009 Cotonou, Benin
[2]Faculté des Sciences; ENSEM, LEMTA 2
Avenue de la Fôret de Haye TSA 60604 54518
VANDOEUVRE-LES-NANCY cedex, Benin
hounaris@yahoo.fr

Biomass cook stoves are widely used in developing countries. These stoves generally use wood fuel which represents about 60 to 86% of the total primary energy consumption in Africa; a few exceptions are observed in northern Africa countries and South Africa where this rate is lower. For some African regions, this rate raises up to 90-98% of the total consumption. In Benin, the estimations of the June 1993 environmental action plan reveal that the forest declines in area by 100 thousand hectares every year. The purpose of this study is to evaluate the influence of the type of meal and the type of stove on its performances.

S 03.5 Student Award Entry

Thin-layer Drying Kinetics of Osmotic Dehydration of Cherry Tomato

S. Nabnean[1], S. Thapa[1], and S. Janjai[2]
[1]School of Energy, Environment and Materials
King Mongkut's University of Technology Thonburi
Bangkok, 10140, Thailand
[2]Department of Physics, Faculty of Science, Silpakorn University
Muang, Nakhon Pathom 73000, Thailand
n_sarawut@hotmail.com

This paper was aimed to study the thin-layer drying of osmotic dehydration of Thai cherry tomato (Queen cherry tomato) and to investigate the thin-layer drying kinetics of osmotic dehydration of cherry tomato by using a convective air dryer. The osmotic dehydration of cherry tomato was dried under controlled conditions of temperature of 50°C, 60°C and 70°C and relative humidity (rh) of the drying air from 20% to 30% with the airflow rate fixed at 1 m/s. According to the experiment result, the drying rate curve showed that drying process took place only in the falling rate period. Seven different thin-layer models (Newton, Page, Henderson and Pabis, Logarithmic, Wang and Singh, Two-term, Modified Henderson and Pabis) were fitted to the experimental data of osmotic dehydration of cherry tomato. Additionally, diffusivity of osmotic dehydration of cherry tomato was investigated at 50°C, 60°C and 70°C. The drying parameters of osmotic dehydration of cherry tomato were found to be a function of drying air temperature and relative humidity. The Page model was revealed to be the best and it was followed by the Newton models. The agreement between the predicted and experimental values for the Page model is excellent, so that this can be used to provide design data for simulation and optimization of the dryer for efficient operation. The effective moisture diffusivity of osmotic dehydration of cherry tomato increased when the drying temperature increased. The value was in the range of 1.0442×10^{-10} to 5.1533×10^{-10} $\left(\mathrm{m}^2/\mathrm{s}\right)$.

S 03.6

Modeling of the Solar Photovoltaic Systems to Fulfill the Energy Demand of the Domestic Sector of Pakistan using RETSCREEN Software

Aamir Mehmood[1], Furqan Ali Shaikh[2] and Adeel Waqas[1]
[1]Center for Energy Systems, National University of Sciences and Technology
Islamabad, Pakistan
[2]Asian Institute of Technology, Thailand
engrfurqanali@gmail.com;

Pakistan is facing severe energy crisis even having a great potential of renewable energy resourcesespecially solar energy.Pakistan has~2.9 million MW potential of electricity generation using solar energy (PV) which is hardly exploited. Current articleis focused to analyze the implementation of solar photovoltaic for the domestic sector of Pakistan where blackouts of 6 to 7 hours are common. Current study is conducted for six major cities of Pakistan named Karachi, Islamabad, Lahore, Multan, Quetta and Peshawar occupying different climatic and geographical positionsusing RETSCREEN software. Weather information of these cities is imported from RETSCREEN software database reported by NASA. The role of solar irradiance and load correlation with respect to ambient conditions is compared and resultant solar fraction is observed.Modeling work is evaluated on the basis of NPV, IRR, payback periods and GHG emissions reduction obtained for pointing out the feasibility of solar PV

implementation leading towards green growth of Pakistan.Results indicate that implementation of a 5kW standalone solar PV system will result in 0.6-0.7tCO_2 reductions in GHG emissions in different regions of Pakistan under prevailing climatic conditions. Installation of solar PV systems will contribute largely in sharing power loadthat will lead to improved energy situation and reduced environmental emissions concerns in the country.

S 04: Special track on "Energy Resilience" by NIES, Japan
Time: 15:15 – 17:25
Room Assignment: Oriental Palm III
Moderator: Yoshiki Yamagata

S 04.1 **Smart Community Clustering for Sharing Local Green Energy**

Yoshiki Yamagata, H. Seya and S. Kuroda
National Institute for Environmental Studies (NIES)
Tsukuba, 305-8506, Japan
yamagata@nies.go.jp

This paper extends the concept of our proposed [1]–[3] electricity sharing system as a complement or alternative to a feed-in tariff (FiT) to achieve CO_2-neutral transportation in cities. In our proposed system, electricity generated from widely introduced solar photovoltaic panels (PVs) is stored in the "cars not in use" in a city. In Japan, almost half of the cars in the central Tokyo metropolitan area are used only on weekends and thus are kept parked during weekdays. These cars represent a huge new potential storage depot if they were replaced by electric vehicles (EVs), that is, they could be used as storage batteries in a V2G system. The results of our previous study [3] showed that although the entire electricity surplus (PV supply minus demand) could be stored without waste if 12% of the EVs not in use were utilized as storage batteries at an aggregate (city) level in August (with maximum solar irradiance), there exist significant regional mismatches at the local district level. Hence, based on the geographical electricity surplus estimates, this paper develops a metaheuristic-based spatial clustering algorithm to find optimal spatial clusters where local mismatches between electricity surplus and storage potential is minimized, and self-sufficient green electricity is achieved.

S 04.2 **A Dynamic Solar Irradiance Model for Assessing Solar PV Power Generation Potential in Urban Areas**

S.N. Benger[1], S. Zhou[2], H. Guan[1]
[1]The School of the Environment, Flinders University
Adelaide, Australia
[2]The School of Remote Sensing, Nanjing University of Information Science and Technology, China
simon.benger@flinders.edu.au

Solar irradiance models are commonly used for determining incident solar radiation on a surface. However, such models are seldom capable of capturing the full temporal dynamics of solar irradiance or accounting effectively for spatial variability. We present a model which is used in combination with high resolution LIDAR city surface models to simulate solar irradiance across the urban surface throughout the day. The model can be used to fully assess the solar PV energy generating capacity of an urban area of any

size with results filtered by municipal GIS dataset attributes if required. The model can be used to help guide urban PV investment strategies and policies aimed at promoting low carbon or smart city concepts. It allows for full assessment and utilisation of structurally integrated urban solar power generation.

S 04.3 Towards an Agent-Based Model of Urban Electricity Sharing

Thomas Brudermann[1] and Yoshiki Yamagata[2]
[1]Institute of Systems Sciences, Innovation and Sustainability Research
University of Graz, Merangasse 18, 8010 Graz, Austria
[2]Center for Global Environmental Research
National Institute for Environmental Studies (NIES)
Onogawa 16-2, Tsukuba, 3058506, Japan
Thomas.Brudermann@uni-graz.at

Research on urban resilience is increasingly receiving attention by both policy makers and researchers. In the on-going debate, the focus is usually placed on economic and infrastructural aspects. Human factors, such as collective behavior change in the face of environmental threats or in the aftermath of extreme events, have up to present not been investigated extensively. In this research, we aim to include human factors and investigate behavioral reactions to a large-scale electricity black-out via means of social simulation. Our overall research question is: Can an electricity sharing system replace the electricity market, when supply is scarce and no market mechanisms exist anymore? To investigate possible scenarios of behavioral reactions we aim to develop an agent-based simulation model, and aim to hint to crucial implementation aspects for electricity sharing systems for emergency cases.

S 04.4 Towards Collective Arrangements to Foster Photovoltaics in Agriculture

Thomas Brudermann, Kathrin Reinsberger, Anita Orthofer and Alfred Posch
Institute of Systems Sciences, Innovation and Sustainability Research
University of Graz, Merangasse 18, 8010 Graz, Austria
Thomas.Brudermann@uni-graz.at

Agriculture is energy-intense, but also has a huge potential for generating energy directly at the point of use from renewables, e.g. biomass, photovoltaics and wind. In this paper, we investigate two models of collective arrangements among farmers in the federal state of Styria, Austria. These arrangements have the purpose to facilitate adoption of photovoltaics on farms. We contrast the two models and analyze aspects in the decision making of involved farmers. Although the arrangements are fundamentally different, we find that motives and concerns of farmers are similar in both models.

S 04.5 Spatially Explicit Land Use and Energy Scenario of Tokyo using Household Level Micro-Data

H. Seya, Y. Yamagata and K. Nakamichi
National Institute for Environmental Studies (NIES)
Onogawa 16-2, Tsukuba, 3058506, Japan
seya.hajime@nies.go.jp

Studies have suggested the importance of implementing climate change mitigation and adaptation measures in combination with considering possible co-benefit and trade-off

among them. However, quantification of such co-benefit/trade-off at city scale is still its infancy. Accordingly, using a micro zone level spatial explicit land use model which we have developed, this study assesses the co-benefit of a mitigation measure (compact city policy) and an adaptation measure (retreat from high flood hazard areas) from the view point of CO2 emissions and expected loss due to the damage by river floods. For the assessment of residential CO2 emissions, this paper utilizes the microdata of the National survey of family income and expenditure. We show an example of effective compact city policy which attains co-benefit with an adaptation measure.

S 04.6 Creating Municipality Level Floor Space Stock Data in Japan by Spatial Statistics Based Areal Interpolation Method

D. Murakami[1,2], H. Seya[2] and Y. Yamagata[2]
[1]University of Tsukuba, Tsukuba, 305-8573 Japan
[2]Center for Global Environmental Research
National Institute for Environmental Studies (NIES), Tsukuba, 305-8506 Japan
muraka51@sk.tsukuba.ac.jp

In Japan, data on regional hourly electricity demand data by sector (residential, commercial, transport, etc.) are not publicly available; hence estimating it by bottom-up approach is important not only for electricity production and distribution companies, but also for urban planners. One of the conventional methods to estimate this is using the intensity method, in which regional electricity demand is estimated by multiplying electricity intensity (demand per floor) by floor space in each zone. Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT) begins to publish the building stock survey from 2010, and the applicability of intensity method has dramatically raised. However, the statistics is only available at prefecture level, while more spatially finer data are required for regional electricity planning. Hence, here, we create municipality level floor space stock data by downscaling the prefecture level stock data.

We conduct the downscaling by applying primal geographical methods, including the areal weighting interpolation method, the dasymetric method, the linear regression-based method. These methods have actively been discussed, and effectiveness of them, particularly the dasymetric method, has been demonstrated in many geographical literatures. On the other hand, downscaling is a recent hot topic in tics. Thus, we also apply two spatial statistical methods, including a geostatistics-based method, which captures spatially dependence spatial process in data, and our proposed geographically weighted regression-based method, which captures spatial heterogeneity by allowing parameters vary over space. The spatial statistical methods are theoretically sophisticated in that they explicitly minimize the error variances due to downscaling. However, their effectiveness in practical applications is still unclear. Thus, comparative analysis of the aforementioned methods would be important to conduct the stock data downscaling accurately.

This study first applies the geographical and the spatial statistical methods for the residential floor stock data, which are available at municipality level, and accuracies of these methods are compared. The result suggests that, whereas each of the methods are fairly accurate, the spatial statistical methods possibly introduce odd results in some particular situation. Also, we discuss how the odd results can be avoided.

Based on the comparative analysis, the commercial floor stock data, which is not available at municipality level, are downscaled.

S 04.7 **Design and Evaluation of an Electricity Consumption Metering and Visualization System for Households**

Kanae Matsui[1, 2] and Yoshiki Yamagata[2]
[1]Graduate School of Media Design, Keio University
[2]Center for Global Environmental Research
National Institute for Environmental Studies (NIES), Tsukuba, 305-8506 Japan
kanaematsui04@kmd.keio.ac.jp

An energy efficient household is one of the solutions in the approach to create a green society because the quantity of electricity being consumed in households is rapidly increasing. In this paper, we report on the implementation of an electricity consumption metering and online visualization system installed in 30 households with the objective of encouraging behavioral change. The system provides the following information about each household: 1) electricity consumption, 2) cost, and 3) CO2 emissions. Each piece of information is refreshed at one-minute intervals. This type of information is stated has having the potential to change people's behavior toward electricity conservation. The system comprises three main parts: 1) an electricity consumption data metering, 2) storage and processing, and 3) information provision. The metering part measures the electricity consumed via sensors set in the electric switchboard in each household. The data storage and processing part stores the data from the metering part and processes the three types of information. The information provision part provides the information to households via websites on the Internet. To test the effect of information provision on behavioral changes, we conducted an experiment comprising two phases: 1) before information provision and 2) after information provision. Each phase was conducted over two weeks, after which we compared the amount of electricity consumed before the information provision with that consumed after to provide quantitative results. Further, we evaluated each household's conscious change toward electricity consumption to provide qualitative results. The results show both quantitative and qualitative changes for some households. Consequently, we also investigated what types of information drove their behavioral changes.

S 05: Low Carbon Development
Time: 09:35 – 12:00
Room Assignment: Marine I Ballroom

S 05.1 **Development of a Demand-Side Marginal Cost of Carbon Abatement Curve for the Emirate of Abu Dhabi**

Afshin Afshari[1], Christina Nikolopoulou and Miguel Martin
Masdar Institute
Abu Dhabi, United Arab Emirates
aafshari@masdar.ac.ae

The best way to achieve emissions' reduction in the near and mid-term is increasing the demand-side energy efficiency--this is especially true in developing countries where the potential for demand reduction is significant and achievable at relatively lower cost. An ideal candidate for the implementation of demand-side energy efficiency measures is the building sector, since it contributes to a large extent to the total amount of GHGs emitted worldwide. In the Emirate of Abu Dhabi, the relative contribution of the building sector to the total GHG emissions is even higher than the worldwide average. This is due to the lower level of industrial activity, the inefficiency of the envelope and technical systems of the existing buildings, as well as harsh climatic conditions requiring the use

of energy intensive air-conditioning equipment. The air-conditioning load in buildings is the ideal target for demand-side management because it constitutes approximately 70% of the total energy consumption. Using a detailed engineering model of a typical Abu Dhabi building as specified by the Emirate's Urban Planning Council, we proceed to evaluate the energy impact of different retrofits through numerical simulation. Extrapolating the results to the whole Emirate, we present a demand-side Marginal Abatement Cost Curve (MACC). A surprising number of the abatement levers analyzed in this study exhibit a positive net present value (NPV), if the cost-reflective price of electricity is used for the life-cycle assessment.

S 05.2

Analysis of Energy Use and CO_2 Emissions of Korean Industry Sector under Carbon Policies

Zulfikar Yurnaidi, Minho Baek and Suduk Kim
Energy System Division, Ajou University
Suwon, Republic of Korea 443-749
viczhoel@gmail.com

This study develops the industry sector of Korea from the general aggregated form to a technologically detailed energy model within the framework of Integrated Assessment Model. The industrial sector is expanded to 12 subsectors (including cement), which utilizes seven types of energy services, that in turn consumes five forms of fuels: biomass, coal, electricity, gas, and refined liquids. The upgraded model then is then set as reference, on top of which scenarios are applied: carbon policies and advance energy efficiencies. All scenarios results on both lower energy consumption in industry sector and CO_2 emission. The detailed model show that some subsectors or energy services get impacted by the scenarios differently than others. For example, the carbon policy affects the iron and steel, chemical, and cement subsectors stronger than others. Another one is boilers and machine drive services that are more responsive to the energy technology improvement. The utilization of and IAM also gives advantage of comprehensive analysis, allowing us to examine different path to reach a policy target and observe the ripple effect of a policy, among others.

S 05.3
Student Award Entry

Thailand's Low Carbon Societies 2050: Policy Analyses of Peak CO_2 Scenario

P. Chunark[1], K. Promjiraprawat[1], B. Limmeechokchai[1], T. Masui[2], T. Hanaoka[2] and Y. Matsuoka[3]
[1]Sirindhorn International Institute of Technology (SIIT), Thammasat University
[2]National Institute for Environmental Studies (NIES), Japan
[3]University of Tokyo
puttipongchunark@gmail.com

Thailand is a fast growing economic country due to the increasing energy consumption, and it results in increasing CO_2 emissions. The objective of this study is to analyze the prospect of CO_2 reduction potential of Thai power sector under business as usual (BAU) and Low Carbon Peak CO_2 (LCP) scenario during 2005-2050 using AIM/Enduse model. Results show that natural gas plays an importance role in 2050 in the BAU, however, natural gas is eliminated from the electricity generation system in 2050 in the LCP scenario. Coal and lignite consumption tends to increase during the study period in the LCP scenario due to the penetration of CCS technology with advanced clean technology in 2020. The CO_2 emission in the BAUwill be approximately 321 $MtCO_2$ in 2050. However, the CO_2 emission will be about 160 $MtCO_2$ in 2050 in the LCP scenario which

can mitigate CO_2 emissions around 55% when compared to the BAU.Finally CO_2 abatement cost is also presented.

S 05.4 Student Award Entry

Impact of Energy Poverty Alleviation Actions on Energy Demand and CO_2 Emission: A Case Study of Sri Lanka

Pradeep Jayatilaka and Bundit Limmeechokchai
Sirindhorn International Institute of Technology, Thammasat University
Pathumthani 12121, Thailand
prjayatilaka@gmail.com

This study aims at investigation of impacts from three energy poverty alleviation actions, namely electrification, penetration of efficient technologies and urbanization on residential sector energy demand and CO_2 emission in Sri Lanka. The Long-range Energy Alternative Planning (LEAP) package is used by taking the time horizon as 2009-2030. Five scenarios are modeled; namely i) reference, ii) electrification, iii) penetration, iv) urbanization and the v) combined scenario. Results showed that combined, penetration and urbanization actions reduce the energy demand by 9.25%, 7.5% and 1.54% respectively, while electrification increases the energy demand by 1.35%. Furthermore, in the fuel mix demand for biomass has significantly reduced in the combined and the penetration scenarios while LPG has increased due to all actions. On the other hand, CO_2 emission was increased in the electrification, the urbanization and the combined scenarios where electrification effect has the highest increase with 9.4% while in the penetration scenario it has reduced by 10.8%.

S05.5

Challenges and Opportunities of Sustainable Green Growth Strategies for Mega Cities: A Case Study of Kolkata

Joyashree Roy
Jadavpur University, Kolkalta, India
joyashreeju@gmail.com

Megacities in India are historically the major economic growth centres and Kolkata is the oldest and the most densely populated mega city. An assessment of sustainable development challenges and possible green growth strategies give rise to some interesting insights those are generalisable as well. Sustainable development priority assessment for Kolkata district brings forth the issues which go beyond just green growth indicators. So in this paper we start with flagging broader multidimensional larger challenges of sustainable development based on empirical findings using composite sustainable development index. We realise this is important for final negotiation towards implementation with city-scale development decision makers. Second part of the study presents a well defined boundary for green growth. Using sector wise data base available from official sources results are derived to show which economic sector has how much green growth investment potential compared to a baseline. The potential assessment is based on effective and efficient technology deployment scope. However, case studies on behaviourial response also highlight the scope of take back effect due to behaviourial response parameter of rebound effect. Third part summarises practical issues in grabbing the opportunities for green growth in a fast growing developing country context.

S 05.6 Achieving Low Carbon Buildings through Policy Instruments – Sharing the Trakhees-EHS Dubai Experience

P.R.Jagannathan
Trakhees-EHS, Dubai, United Arab Emirates
Paravasthu.Jagannathan@trakhees.ae

The aim of the paper is to draw attention to the humongous role the regulatory authorities have in spurring and steering the growth of low carbon buildings in a region. Despite the fact that built environments offer greatest low cost opportunities for carbon emission reductions and energy efficiency, it continues to be in a state of neglect due to several constraints. Embracing genuine sustainability in the built environment requires conscious and committed efforts of several stakeholders with the regulatory body holding a nodal position in this challenge. The work draws serious attention into the critical interventions that a regulatory authority should exercise at different phases of the project to make sure that the built environments in the making are seamlessly transformed from a seemingly green design to practical compliance thereby setting the stage for green operations. It discusses, elucidates and shares the experience of Trakhees-Environment, Health & Safety (EHS) a Regulatory body based in Dubai and demonstrates the achievements it has made in the field of low carbon buildings through responsible policy instruments. The paper concludes with recommendations and message for enforcement agencies and policy makers.

S 05.7 Development of Thailand's Nationally Appropriate Mitigation Actions (NAMAs) for Low Carbon Society: Energy Security and Co-Benefit Aspects

Bundit Limmeechokchai[1] and Pornphimol Winyuchakrit[2]
[1]Sirindhorn International Institute of Technology, Thammasat University
Pathumthani, Thailand
[2]Department of Energy Technology
Rajamangala University of Technology Tawan-ok, Chonburi, Thailand
win.pornphimol@gmail.com

NAMAs is proposed to be the way for reducing greenhouse gases emission in the developing countries under "Low Carbon Society" concept. In this study, the proposed three CO_2 countermeasures under the three national energy strategies: the Alternative Energy Development Plan (AEDP), the 20-Year Energy Efficiency Development Plan 2011–2030 (EEDP), and the Building Energy Code (BEC) are investigated. Additionally, this study considers changes of energy security and co-benefits from these proposed mitigation countermeasures. Results indicate that these three countermeasures could reduce CO_2 emissions by 13,239 kt-CO_2 in the 2020NAMA scenario, compared to the 2020BAU scenario. Moreover, results of energy security as well as co-benefit analyses show that the proposed CO_2 countermeasures in Thailand's NAMAs will not only reduce CO_2 emissions but also improve energy security and contribute to several co-benefits, which enhance sustainable energy and environment development.

S 05.8 **Heat Pumps and Demand Side Management for Renewable Energy Integration in Sustainable Communities**

C. Brandoni[1], G. Ciriachi, F. Polonara[2] and A. Arteconi[1]
[1]Università degli Studi e-Campus
Via Isimbardi 10, 22060, Novedrate, Como, Italy
[2]Department of Industrial Engineering and Mathematical Science
Università Politecnicadelle Marche, 60100 Ancona, Italy
f.polonara@univpm.it

The introduction of renewable energy is a key policy for sustainable communities. Some of them are variable energy resources (VERs) since their production varies over the time and are not easily and perfectly predictable. An increasing share of VERs can, indeed, badly impact on the electricity grid. The paper focuses on assessing the effect of introducing a high share of VERs production, taking as reference case a small-size sustainable community, located in Central Italy, which aims to reach, at least, a 30% CO_2 emission reduction by 2025. Different energy scenarios have been considered on the basis of local energy policies defined by the Municipal Energy Plan, MEP. Demand Side Management (DSM) strategies related to the introduction of heat pumps (HP) systems powered by the excess derived from VERs, have been studied to reduce the impact into the power grid. In particular the performed analysis is aimed at finding the optimal configurations necessary to achieve thermal comfort in buildings where HP systems are introduced when Demand Side Management strategies are in action.

S 06: Green Buildings and Infrastructures
Time: 09:35 – 12:00
Room Assignment: Oriental Palm I

S 06.1 **Properties of Concrete Material for Thermal Energy Storage**

Nhine Nwe Htun, Sukruedee Sukchai and Saranagon Hemavibool
School of Renewable Energy Technology (SERT)
Naresuan University, Phitsanulok 65000, Thailand
hnin.nway.htun@gmail.com

The selection of concrete composition has significance for concrete storage system. This research has been investigated the properties of concrete composition based on local materials in Thailand in order to determine a suitable concrete composition for thermal energy storage. The concrete samples were tested in the laboratory to determine thermal conductivity, specific heat, density, coefficient of thermal expansion, thermal diffusivity, compressive strength and permeability as well as to calculate the volumetric heat capacity of three different compositions of concrete which were (water : cement : sand : limestone : steel fiber) 0.35 : 1 : 1.2 : 1.8 : 0.03, 0.55 : 1 : 1.6 : 2.3 : 0.03 and 0.65 : 1 : 1.7 : 2.6 : 0.03. The results showed that the optimum mixing ratio of concrete was 0.55 : 1 : 1.6 : 2.3 : 0.03 which was obtained at the highest thermal conductivity 2.465 W/mK, highest specific heat 1928 J/kgK, highest volumetric heat capacity 5244.16 KJ/m^3K and lowest thermal diffusivity 1.28x$10^{-3}$$m^2$/s. This optimum ratio should be applied for the thermal concrete storage for the solar thermal power plant.

S 06.2 **Impacts of Shading Effect from Nearby Buildings on Heating and Cooling Energy Consumption in Hot Summer and Cold Winter Zone of China**

Toshiaki Ichinose
National Institute for Environmental Studies (NIES)
Tsukuba, 305-8506 Japan
toshiaki@nies.go.jp

In the roadmap for reduction of CO2 emission, the main menus are introduction of equipment with high energy efficiency and building materials with high thermal insulation. However, reductions of emission through urban or building block design are not discussed well now. Actions from micro scale viewpoint will be also important. For example, referring to meteorological and social conditions in studied cities, effects of several actions have to be evaluated and effective actions have to be advocated in building block scale. Shading effects from nearby buildings in building block scale affects to residential space cooling, space heating and illumination.
In cities of the central China, like Shanghai, with large annual climatic variability, numerical simulations on indoor electricity use in eQUEST, a model for computing building energy use developed by US DOE, are performed. As a parameter on shape of building blocks, W/H, namely street width / height of building, that is, inverse of aspect ratio, is adopted and the optimal design of residential building blocks in viewpoint of energy consumption is studied.
In this study, we select five major cities, Shanghai, Wuhan, Changsha, Chengdu, Chongqing, in the hot summer and cold winter zone of China to investigate. We expect there might be conflicts of countermeasures between summer and winter, namely actions for reduction between space cooling and space heating. We compute indoor air conditionings load affected by outdoor meteorological conditions and illumination load by shading effect from nearby buildings through whole year numerical simulation. For indoor energy consumption, building orientation and street width are important. In case of facing south, impact of shading in winter noon is large. On the other hand, in case of facing east or west, impact of solar gain in summer morning and evening is large. Therefore, we need to choose prioritized actions in consideration to the orientation. Each purpose of energy use shows different performance to the parameter of W/H. The larger W/H gives the larger space cooling load. On the contrary, it gives the smaller space heating load and illumination load. As the result, we can find 1.5 as the optimal value of W/H and to cut down the growing of cooling load in narrow canopy zone, opening windows and in-taking outdoor cooler air is recommended. Prioritized countermeasures considering shape of building blocks are necessary.The standard meteorological data is used as reference for building design. In inland three cities, Changsha, Chengdu and Chongqing, temperatures in winter are relatively higher. In winter, these cities are not influenced by winter cold monsoon from the Siberian High.
In the hot summer and cold winter zone of China, shading effect from nearby buildings reached to 10 to 20% in case of space cooling energy decrease and 0 to 20% in case of space heating energy increase. In Shanghai and Wuhan, these two effects are canceled each other. However, in Changsha, Chengdu and Chongqing, the increasing effect for space heating is not obvious. This reason might be a small solar radiation in winter.

S 06.3 Student Award Entry

Artificial Neural Networks Based Prediction for Thermal Comfort in an Academic Classroom

T. Songuppakarn, W. Wongsuwan, and W. San-um
Faculty of Engineering, Thai-Nichi Institute of Technology (TNI)
Bangkok, Thailand, 10250
wipawadee@tni.ac.th

A predictive models were developed to determine the thermal comfort level for the academic classroom by using artificial neural networks (ANNs). The paper reports experimental and theoretical analysis on a problem of achieving a desired thermal comfort level. The proposed method focused on the classical artificial (feed forward) neural networks (ANN) and the time-series NARX feedback neural networks to achieve the thermal comfort assessed using the predicted mean vote (PMV). The field measurements were conducted in a selected classroom of the Thai-Nichi Institute of Technology (TNI), Thailand. The predicted PMV agreed well with tested PMV data. Therefore, the results would be further demonstrating the feasibility and performance of the approach to achieve the classroom thermal comfort.

S 06.4 Student Award Entry

Exergetic Performance Analysis and Comparison of Various Building Heating Options

H. Tuzcu[1], H. Gunerhan[1] and A. Hepbasli[2]
[1]Department of Mechanical Engineering, Ege University
İzmir 35040 Turkey
[2]Department of Energy Systems Engineering, Yasar University
İzmir 35100 Turkey
halil.tuzcu@gmail.com,

Heating, cooling and lighting appliances in buildings account for more than one third of the world's primary energy demand. Therefore, they are considered one of the main parts of the energy consumption in buildings. This study deals with energy/exergy and sustainability performance comparison of a building heating energy system from the primary energy production to the building envelope. A four story building located in Eskisehir, Turkey, is considered for the analysis. The indoor and outdoor air temperatures of the building are 22°C and -12°C, respectively. For heating applications, three options are studied, namely (i) standard boiler, (ii) condensing boiler and (iii) ground heat pump water–water, as driven by renewable and non-renewable energy sources. Energy and exergy analysis methods, which are based on the lowex approach, are performed to evaluate their performances and compare them through energy and exergy efficiencies and sustainability index. Energy and exergy flows are also studied and illustrated accordingly to have an insight into for possible improvements in the system components. Also, the energetic and exergetic renewability ratios are employed here along with sustainability index. For a building with a net area of 2430.4 m^2, the total exergy efficiencies of the considered heating systems are 25.3%, 6.1%, and 6.9%, respectively for three cases. The sustainability index for three cases found as 1.196, 1.236 and 1.274, respectively.

S 06.5 **Investigation of the optimal heat flux density for the refrigerated warehouses design**

Christophe Awanto, Aristide Comlan Houngan and Malahimi Anjorin
Laboratory of Applied Energy and Mechanics (LEMA)/EPAC-UAC
01BP: 2009 Cotonou, BENIN
hounaris@yahoo.fr

Cold warehouses are relatively high energy consuming systems, and their construction are growing. In the design of these buildings, the choice of the insulation thickness is an important factor that affects the owning and operating costs. In practice, it is common to use heat flux density values or R-values given in the technical literatures. These values seem to neglect the possible effects of parameters such as local energy and insulation cost. This work investigates the influence of these parameters on the optimal value to be adopted for the thermal flux density in the design process of warehouses. A mathematical model of the flux is developed. The objective function to be minimized is the present value of the owning and operating costs of the system. Simulations are made using different parameters values: 25 and 45°C for the external air temperature; -20 and 8°C for the products storage temperature; 150000 to 250000 XOF/m^3 of insulation and 75 to 200 XOF/kWh of electricity. Contour plots of the optimal thermal flux density are drawn. The results indicate that the optimal heat flux density varies with the site air temperature and the storage room one. Moreover, it is seen that higher values of the thermal flux density can be adopted compared to that given in technical literature (up to 11 $W.m^{-2}$ vs 6 or 8 $W.m^{-2}$). However, these high values of the thermal heat flux involves the use of high power refrigerating units, increasing the energy consumption.

S 06.6 **Life Cycle Assessment of Self-Help Housing: case of Baan Man Kong Program**

Sasima Charoenkit
Energy Field of Study, School of Environment, Resources and Development
Asian Institute of Technology, Thailand
Sirirat.Muneesawang@ait.ac.th

The several life cycle assessment (LCA) studies of residential buildings conducted in the last decade. In Thailand have focused on conventional houses and very few studies have considered those built for the poor. This study conducted a LCA of self-help housing by using two dwelling types in the Baan Mankong Program as case study. Results indicate that over 85% of the total life cycle energy is the operational energy which is 8.6-17.5 GJ/m^2 or 86-92% and the embodied energy is 1.0-1.5 GJ/m^2. About 75% of embodied energy comes from building materials particularly concrete and steel. Measures to include compact development and the use of less energy intensive materials. The other measure to reduce operational energy is the use of energy efficient appliances which can reduce up to 26% of household electricity consumption.

S 06.7 Student Award Entry

Optimum Green Building Label for an Office Building in Thailand

Vichuda Mettanant and Thosapon Katejanekarn*
Building Energy Systems Laboratory, Department of Mechanical Engineering
Faculty of Engineering and Industrial Technology, Silpakorn University
Nakhon Pathom 73000, Thailand
vichuda.mettanant@gmail.com

This article presents a study on evaluation of an optimum level of Thailand's green building label for an office building. The sample building was a 4-storey office building with a total floor area of 1,295.91 m^2 comprising 741.69-m^2 conditioned area and 554.22-m^2 unconditioned area. The air conditioning system was a central system using an air-cooled water chiller. The building as originally designed was treated as the base case. It was evaluated to obtain the scores according to the Thailand's green building standard (Thai's Rating of Energy and Environmental Sustainability for New Construction and Major Renovation, TREES-NC). The building energy consumption was assessed by using the EnergyPlus software. In order to earn more scores to achieve higher green building labels (i.e., certified, silver, gold, and platinum levels), all possible measures related to the 8 topics in TREES-NC were listed and relevant costs and benefits of each measure were estimated. The measures that required none or small investments were considered first, followed by the ones that required some investments and provided benefits in form of savings (e.g., electricity and water savings). The measures that needed investments but gave no financial benefits were considered last. Then, financial analysis was carried out to see which green building label would give optimum returns. The results showed that 'gold label' was the optimum level. If the building could achieve the gold label, energy and water savings would be 30.20% and 66.70%, respectively, compared with the base case. The investment would be 4.18% higher and the payback period would be 4.16 years which were the lowest compared with the other labels. The net present value (NPV), the internal rate of return (IRR), and the benefit-to-cost ratio (BCR) at the gold label were found to be 938,662.28 Baht, 24.00%, and 2.006, respectively, which were the highest compared with the other labels. The IRR of the silver label was 11% lower than that of the gold label while the platinum label provided a negative NPV.

S 06.8

Practical Case Study on the Development of Green Standard for Energy and Environmental Design in Thailand

Bong Chun Kim[1] and Thanapat Arnmanee[2]
[1]National IT Industry Promotion Agency (NIPA)
113 Jungdae-ro, Songpa-gu, 138-711 Seoul, Korea
[2]Department of Socialized Housing Project Development, National Housing Authority
905 Nawamin Street, Khlong Chan, Bangkapi, Bangkok, Thailand, 10240
pkokimbc@naver.com

This is the practical case study on the development of Green Standard for Energy and Environmental Design in Thailand. There are 4 kinds of energy & environmental rating system today in Thailand. Each system will be introduced for awareness of the characteristics and issues from those systems. Then, G-SEED of South Korea will be introduced that focus on what is it and how to operate it. Some kinds of evaluation program and items for consideration will be recognized go through main structure, operation, design and calculation of G-SEED for Thailand. Green evaluation category, Innovation category to go green and None-green housing performance category will be

recognized and recommended for development of G-SEED in Thailand. It is certainly timely that we should have a comprehensive building environmental assessment method and rating system in Thailand.

S 07: Photovoltaics
Time: 09:35 – 12:00
Room Assignment: Oriental Palm II

S 07.1 **Developing a Method to Accurately Estimate the Electricity Cost of Grid-Connected Solar PV in Bangkok**

Ahmad Zahedi
James Cook University
Queensland, 4811, Australia
ahmad.zahedi@jcu.edu.au

Solar photovoltaic electricity is more expensive compared with conventional electricity at retail level. As a result, general public members do not find the solar PV electricity an attractive option to use for generating a portion of their electricity need. To promote PV electricity utilization and to make it more attractive, Governments of some countries like Germany, Japan, USA, Australia, and etc. have introduced solar PV incentive programs. Most of grid-connected photovoltaic (PV) systems on residential or commercial buildings in these countries are installed by individuals interested in generating part of their electricity emission-free. For some of these people the economics of the PV electricity is likely to be of secondary importance, while majority of them would like to see financial return to become interested to use PV electricity. The objective of this paper is to present the results of a study conducted on the economic aspects of solar PV to estimate the electricity price of grid-connected rooftop PV system under climate conditions and geographical location of Bangkok (at the latitude of 13.5° N, and longitude of 100.5° E), to see if the use of PV electricity is attractive and affordable by residential customers. The results of this study will help to determining an appropriate feed-in tariff for solar PV electricity in Bangkok.

S 07.2 **Cationic Polymerization Ultraviolet Curing Method for Preparing Epoxy Resin Encapsulation of Solar Cell: Used for Portable Photovoltaic Devices**

Dong Mengdi[1], Yang Biao[2], You Bo[3], Lin Yandan[1], Sun Yaojie[1], Zhuang Zhong[4]
[1]Institute for Electric Light Sources, Fudan University
Shanghai 200433, P.R. China
[2]The School of Architecture, University of Sheffield, Sheffield, United Kingdom
[3]The Department of Material Science, Fudan University
Shanghai 200433 P. R. China
[4]The School of Information Science and Technology, Peking University; Beijing 100871, P.R. China
yjsun@fudan.edu.cn

The optical surface of solar cell module with microstructure needs to be permanently protected by encapsulation. Currently, glue dripping procedure is the most popular process for the epoxy resin encapsulation of solar cells, while this process cause several obvious defects. In the present paper, a cationic polymerization Ultraviolet (UV) curing epoxy resin coating was formed and cured afterwards under the high pressure

mercury lamp for encapsulating the solar cell, which was used mainly on portable PV devices. It turns out that this new method has several advantages over the glue dripping procedure currently used, with higher photoelectric conversion efficiency and better performance in impact resistance and flexibility.

S 07.3 Estimating Photosynthetically Active Radiation using an Artificial Neural Network

*P. Pankaew, S. Pattarapanitchai, S. Buntoung, R. Wattan, I. Masiri, A. Sripradit, S. Janjai**
Department of Physics, Faculty of Science, Silpakorn University
Nakhon Pathom 73000, Thailand
serm@su.ac.th

Photosynthetically active radiation (PAR) is a portion of solar radiation in the wavelength band of 400-700 nm providing energy for photosynthesis of plants. In this work, we proposed to estimate PAR from atmospheric parameters using an artificial neural network (ANN). The input data of the ANN are solar zenith angle (θz), cloud index derived from MTSAT-1R satellite together with precipitable water from NCEP/NCAR database and aerosol optical depth from AERONET of NASA. The PAR data at 4 stations in Thailand, namely Chiang Mai (18.78°N, 98.98°E), Nakhon Pathom (13.82°N, 100.04°E) and Songkhla (7.20°N, 100.60°E) for the years 2008-2010 and Ubon Ratchathani (15.25°N, 104.87°E) for the years 2009-2010 were used to train the ANN. The estimated PAR using ANN was validated at these stations in the year 2011. It was found that the estimated PAR from ANN and those obtained from the measurements were in good agreement, with root mean square difference (RMSD) of 10.2%.

S 07.4 Performance Evaluation of Photovoltaic Module at Different Tilt Angle in Kuwait

Hussain Bunyan and Wesam Ali
Electronic Engineering Department, College of Technological Studies
Public Authority of Applied Education and Training
State of Kuwait
dr.wesamma@hotmail.com

In this paper we will study the performance of a Silicon Photovoltaic (PV) with different tilt angle arrangement in State of Kuwait (latitude 30˚ N). In the study the PV system is installed facing South, collecting maximum solar radiation at noon, and their angles are from 0^0 to 90^0 respectively, during full year at the Solstice and Equinox periods, aiming for the best output power towards vertical (90^0) panel. The results shows that both the final yields and performance ratio of the PV system with 50˚ tilt angle, the output power is higher in six months, equal in two months and lower less than 10% in six months to the latitude tilt angle (30˚) during a full year.

S 07.5 Drip Irrigation Powered by Solar Cell for Dry Rainfed and No Electricity Area

B. Tangwongkit, R. Tangwongkit and P. Chontanaswat
Farm Mechanics Department, Faculty of Agriculture at Kamphaeng Saen,
Kasetsart University KamphaengSaen Campus
NakhonPathom, 73140 Thailand
borpitkasetsart@gmail.com

The objectives of this research were to design and test a suitable set of drip irrigation powered by solar cell for sugarcane field in dry rainfed and no electricity area. This design was based on 1.5 m of sugarcane row width and 40 m of drip tape length. A drip tape was laid on soil surface and it could be rotated to other sugarcane plots. The components of the set were a 1 m^3 water tank installed at 1 m high and water was easily refilled, 12 volt DC water pressure pump with maximum head and flow rate of 2.80 bar and 1.02 m^3/hr, stand alone inverter with solar charge controller of 12 V capacity, a crystalline solar cell with maximum power of 120 Wp ±3%, 18.0 V, 6.67 A, 12V and 75 A battery, a ¢ 1″ and 140 mesh type of disk filter, a ¢1″ ball valve and ¢1″ main pipe drip tape with drip spacing of 0.20 m. The test results indicated that maximum number of drip tape usage at a time was 5 drip tapes with 0.20 m drip spacing, 40 m of drip tape length and 1.5 m of sugarcane row width at 1 bar of water pressure. The system provided average dripper flow rate (qs) of 0.82 L/hr, maximum dripper flow rate of 0.98 L/hr, minimum dripper flow rate of 0.63 L/hr, difference between maximum and minimum dripper flow rate of 35.85%, emission uniformity (EU) of 76.83%, precipitation rate of 2.73 mm/hr and total water flow rate of 820.00 L/hr to irrigate 300 m^2 area at a time. Total cost of installation was 545 US$: 29 US$ for drip set, 510 US$ for solar cell set and 6 US$ for labor.

S 07.6 Generation of Typical Meteorological Year Data Sets for 20 Stations in Thailand

S. Pattarapanitchai, K. Tohsing, P. Pankaew, S. Janjai
Departments of Physics, Faculty of Science, Silpakorn University
Nakhon Pathom, 73000
pan30826@gmail.com

In this work a typical meteorological year (TMY) data sets for 20 solar radiation monitoring stations in Thailand were generated by using the Sandia National Laboratory method. A 10-year period of hourly global solar radiation, air temperature, relative humidity and wind speed from these stations were used to generate the TMY data sets. To investigate their performance, the TMY data sets were employed as input data of the TRNSYS simulation program to simulate photovoltaic systems. The electricity production calculated using the TMY data sets were in good agreement with those computed employing the 10-year period hourly meteorological data.

S 07.7 Determination of PV Module Power Output Degradation after Long Term Operation

Tariq Aziz, Nipon Ketjoy and Chatchai Sirisamphanwong
School of Renewable Energy Technology, Naresuan University
Phitsanulok, Thailand
atariqaziz26@yahoo.com

This work has been undertaken to examine the warranties offered by the PV module

manufacturers for degradation after long term field operation under Thailand weather conditions. Samples from the four lots of PV modules comprising on mono crystalline, poly crystalline and amorphous silicon, with different duration of field operation ranging from 9 to 14 years were tested for I-V curve characteristics under field conditions and measured values were corrected to Standard Test Conditions (STC) values by using correction procedure inscribed in IEC 60891 standard. The corrected values of output power and other parameters were compared with nameplate data for calculation of degradation during the period of operation. The actual degradation in output power for two lots of mono and one lot of poly crystalline silicon was found remarkably high (3.9, 3.0 & 2%/year) when compared with the warrantees (0.8-1%/year generally). However, interestingly the lot comprising on thin film amorphous-Si modules showed higher values of output power than nameplate. There were no visible defects in the modules except yellowing and discoloring. The enhanced degradation rates can be attributed to the quality of modules along with the effects of harsh field weather conditions.

S 07.8 **PCMs performances Impact on Flat Plate Solar Collector H2OSS**

C. Cristofari[1], G. Notton[1], J.L. Canaletti[1] and C. Lamnatou[2]
[1]University of Corsica, Georges Peri Laboratory, Vignola, UMR CNRS 6134-Sanguinaires road - F20000 Ajaccio, France
[2]Environmental Science Department, University of Lleida, Spain
cristofari@univ-corse.fr

The solar industry is relatively mature, the cost of these products is stabilized and it is likely to evolve quite slightly over the upcoming years: other than a scale effect resulting from rapid growth markets, only a technological breakthrough in the act of conception, could significantly change the economic level. The following barriers are identified (in order of importance): financial, technical and psychological (the psychological barriers are related with the aesthetics and the rigidity of the architectural codes. The problems, both technical and aesthetic, are the obvious obstacles to the development of this type of systems. For these reasons, in the frame of the present work, a new flat plate solar collector with high building integration and a prototype of this collector were developed. A numerical thermal model, developed in Matlab® environment by using a finite difference model was validated. Then, the model is used to experiment different organic, inorganic and eutectic phase change materials in order to identify the most appropriate PCM for our configutration.

S 08: Special track on "Other Aspects of Energy Resilience" and a Panel Discussion on Resilience in Green Energy and Urban Systems
Time: 09:35 – 12:00
Room Assignment: Oriental Palm III
Moderator: Hiroshi Maruyama

S 08.1 **General Resilience: Taxonomy and Strategies**

Hiroshi Maruyama[1], Roberto Legaspi[1], Kazuhiro Minami[1] and Yoshiki Yamagata[2]
[1]Research Organization of Information and Systems, Institute of Statistical Mathematics, 10-3 Midori-cho, Tachikawa, Tokyo 190-8562, Japan
[2]Center for Global Environmental Research, National Institute for Environmental Studies (NIES), Onogawa 16-2, Tsukuba, 3058506, Japan
hm2@ism.ac.jp

Because resilience thinking has increasingly been used in various disciplines and domains and extended with a broader scope of concepts, it is difficult to find a unified and encompassing definition by which it can be accurately referred to. Furthermore, to elucidate and synthesize all resilience theories and conceptual frameworks that have been put forward will require volumes of written work. We therefore argue in this paper that research works pursuing the common strategies of system resilience require a language that can help describe the specific contexts in which resilience is applied. We propose here a taxonomy for general resilience that consists of four orthogonal dimensions, namely, type of shock or perturbation, target system, phase of concern, and type of recovery. Furthermore, it has also been observed that despite its domain-dependency, there exist resilience strategies that cut across multiple disciplines and domains, specifically, redundancy, diversity and adaptability. There is another, however, which we argue here in detail that is equally compelling, i.e., a strategy that can break the rigid stability that leads to greater fragility and a more severe collapse with prolonged period of severity. Specifically, the strategy is to deliberately inject or induce regularly small "controlled" shocks into the system to regulate the build-up of complexity and rigidity among its components and their connections. Doing so will not only prolong the period of stability of the system, but also shorten the period of severity in the wake of a severe shock.

S 08.2 **Evaluating the Sustainability of an Ecological System Based on Evolutionary Multi-agent Simulations**

Kazuhiro Minami[1], Roberto Legaspi[1], Tomoya Tanjo[1], Hiroshi Maruyama[1], and Yoshiki Yamagata[2]
[1]Research Organization of Information and Systems, Institute of Statistical Mathematics, 10-3 Midori-cho, Tachikawa, Tokyo 190-8562, Japan
[2]Center for Global Environmental Research, National Institute for Environmental Studies, Onogawa 16-2, Tsukuba, 3058506, Japan
minami.at.uiuc@gmail.com

Resilience to a disruptive change in the ecological system is an essential property that makes our society sustainable. There seems to be a consensus among many researchers in various disciplines that diversity and adaptability are two of the key features of resilient systems to be able to persist in, recover from, or even reorganize as a response to, time of crises. However, it has yet to be unambiguously shown how these features stand together, complementary or otherwise, in providing resilience to an ecological system that involves the flow of energy between those that convert and supply it and those that consume. In this paper, we present an evolutionary multi-agent

system for evaluating the effectiveness of these features and show several insights drawn from our preliminary results.

S 08.3 Major Principles and Criteria for Development of an Urban Resilience Assessment Index

Ayyoob Sharifi[1] and Yoshiki Yamagata[2]
[1]Global Carbon Project, National Institute for Environmental Studies (NIES)
305-8506 Tsukuba, Japan
sharifi.ayyoob@nies.go.jp
[2] Center for Global Environmental Research
National Institute for Environmental Studies (NIES), 305-8506, Tsukuba, Japan
yamagata@nies.go.jp

The notion of resilience is rapidly gaining ground in the urban sustainability literature. Development of an assessment framework for evaluating the extent of resiliency of urban areas can be an effective way of incorporating resiliency-related issues into urban planning process. It is important to identify resilience-related principles and criteria that should be embedded into the assessment framework. This study aims to introduce a set of criteria that can be used to develop an urban resilience assessment Index. Criteria for assessment of the resilience of urban areas are divided into several main themes that cover various dimensions of sustainability. These themes are further broken down into major criteria to account for a variety of resilience-related aspects.
The resilient assessment index has the capacity to provide decision makers with a clear and comprehensive picture of the resilience of the development proposal and supports them in making better informed decisions.

S 08.4 The Necessity of Using Sky View Factor in Urban Planning: A Case Study of Narmak neighborhood, Tehran

Mojtaba Rafieian[1], Hadi Rezaei Rad, Ayyoob Sharifi
[1]College of Art and Architecture, Tarbiat Modares University, 14115-111 Tehran, Iran
[2]Global Carbon Project, National Institute for Environmental Studies (NIES)
305-8506 Tsukuba, Japan
sharifi.ayyoob@nies.go.jp

Urban heat island is a phenomenon caused by increased urban activities and transformations in the natural environment. Increased urban population and increase in the height of buildings, particularly in metropolitan areas, have led to vast changes in the urban geometry, amount of released heat, pollution rate, and meteorological parameters. All these factors contribute to the occurrence of heat island phenomenon in urban areas.
Sky View Factor (SVF) is one of the main factors related to pollution, temperature variations, heat island, and other environmental parameters. Housing density policies stipulated in Tehran's detailed plan would possibly have several impacts on the sky view factor. The SVF axis of the Envi-met software uses various parameters such as topography, wind velocity, and urban morphology to simulate and measure sky view factor.
This study aims to evaluate impacts of the future high rise developments, in the Narmak neighborhood of Tehran, through modeling future changes in the sky view factor. For this purpose, data related to Haft Hoz square located in the Narmak neighborhood were obtained, simulated and analyzed using SVF. Results indicate that in the business as usual scenario the factor's value would be in a range between 0.19 and 0.77. Whereas, by implementing the scenario proposed in the detailed plan the factor will decrease to

fall in a range between 0.08 and 0.69. This reduction in the intensity will possibly increase heat island impacts in the study area. This study emphasizes the necessity of taking compensatory policy measures and incorporating environmental considerations in urban development plans.

S 08.5 Design and Implementation of a Risk Indicator Distribution System for Flood Situations

Kei Hiroi[1] and Yoshiki Yamagata[2]
[1]Graduate School of Media Design, Keio University, Japan
[2]National Institute of Environmental Studies (NIES), Japan
k.hiroi@kmd.keio.ac.jp

Effective measures against global warming must integrate both mitigating and adaptive strategies. Accordingly, this study aims to develop information systems adapted to flooddamage, such as electricity infrastructures, by using green energy in urban areas. Rapid urbanization has caused significant increases in heavy rain; therefore, people in flood-risk areas need risk information, such as precipitation data and river levels,to help prevent flood damage. However, such people generally cannot recognize the risks of flood damage because existing information only provides observation data or alerts. To reduce flood damage, information must be provided on the risk of massive floods and inundation. Therefore, we propose risk indicators for flood situations. Urbanization exposes people to a variety of infrastructural and individual vulnerabilities. The existing hazard map based on observation data shows the same level of risk for all people in flood-risk areas, leading people to over- or underestimate their risk. In contrast, flood risk indicators can be customizedaccording to individual vulnerabilities. Therefore, we proposea common interface for a communication system to calculate risk indicators based on observation data. This risk indicators show common risk for people at risk situations. Our system collects common risk indicators and customizes them according to three vulnerability factors: environmental, social, or human. Such risk indicators can reflect situationally relative risk levels using real-time data. Disaster prevention agencies can in turn use our risk indicators to assess people'sflood risks. Additionally, social factors such as power failurecan impede the distribution of risk indicators.As immediate estimation requires rapid distribution to vulnerable people,we propose a common communication system interface for the immediate distribution of risk indicators to vulnerable people.

S 09: Green Policies and Programmes

Time: 09:45 – 12:00
Room Assignment: Marine I Ballroom

S 09.1 Designing an Energy Planning Concept for Enhancing the Dissemination of Renewable Energy Technologies in Developing Countries

Rikke Lybæk, Jan Andersen, Søren Lund, and Tyge Kjær*
Department of Environmental, Social and Spatial Change (ENSPAC)
University of Roskilde, 4000 Roskilde, Denmark
rbl@ruc.dk

This paper stresses the need for adapting a sustainable energy planning concept, which

can support the implementation of renewable energy in developing countries; exemplified by a Vietnamese case. Many developing countries heavily rely on fossil fuel resources and will face energy supply security challenges in the future. At the same time their policies on renewable energy, tools and action plans supporting renewables are weak. Thus, to support a local dissemination of renewable energy we suggest applying the sustainable energy planning concept to speed up the utilization of renewables in developing countries, while relevant policies, tools and plans etc. simultaneously are being deployed, enhancing the framework conditions for renewable energy implementation.

S 09.2 **Establishing a Robust Sustainability Index for the Assessment of Bioeconomy Regions**

Jakob Hildebrandt[1], Alberto Bezama[1] and Daniela Thrän[1,2,]
[1]Department of Bioenergy, Helmholtz Centre for Environmental Research - UFZ, Permoserstraße 15, 04318 Leipzig, Germany
[2]Abteilung Bioenergysysteme, Deutsches Biomasseforschungszentrum GmbH – DBFZ, Torgauer Straße 116, 04347 Leipzig, Germany
jakob.hildebrandt@ufz.de

The Bioeconomy strategy fosters the integration of the agricultural, chemical, pulp and paper industries and the energy sector for obtaining sustainable bio-based materials and bioenergy. Basically all industrial sectors relying on biomass are facing economic burdens by resource competition. The cascade and coupled use stand as potential solutions for cross-sectoral cooperations to mutually enhance economic competitiveness. However the monitoring of trade-offs between sustainability goals of individual industries and the overall system demands extensive knowledge-based elicitations. The challenge of establishing a sustainability index arising from stakeholder´s subjective perceptions of multidimensional issues requires to develop an integrated methodology out of nowadays most accepted and reliable assessment tools. This paper positions a sustainability index tool by reexamining the methodologies with regard to their appropriateness and generic strengths and weaknesses.
The proposed combination of reference point approaches with preference–based elicitations is claimed as appropriate for establishing specific utility functions of sub-goals for bioeconomy.

S 09.3 **Energy-Growth Nexus: Evidence from a Panel of ASEAN Regional Forum Countries**

Rudra P. Pradhan[1] and Yuosre Badir[2]
[1]Vinod Gupta School of Management, Indian Institute of Technology Kharagpur, India
[2]Asian Institute of Technology Bangkok, Thailand
rudrap@vgsom.iitkgp.ernet.in

Energy plays an important role in economic growth. As a result, the causal nexus between the two has been the central and topical issue in energy economics. The investigation of this causal nexus is important for two reasons. First, government can properly formulate the energy policy. For instance, if it is found the evidence of causality (unidirectional/ bidirectional) between energy consumption and economic growth, then any policy to increase/ decrease energy consumption would have effect on economic growth. Second, it can provide substantial supports to the debate regarding the causal nexus between energy consumption and economic growth. There are many studies relating the causal nexus between energy consumption and economic growth, both at

aggregate and disaggregate level. Advancing on earlier work, this paper uses panel vector autoregressive (VAR) model to 26 ASEAN Regional Forum (ARF) countries for examining the causal nexus between electricity consumption and economic growth. Our novel panel-data estimation method allows for more robust estimates by utilizing variation between countries as well as variation over time. The study finds unidirectional causal flows from electricity consumption to economic growth and discusses their implications in the development policy.

S 09.4
Student Award Entry

Going Green and Energy Security

W.L. Choong, B.W. Ang and T.S. Ng
Department of Industrial and Systems Engineering
National University of Singapore, Singapore
isecwld@nus.edu.sg

Interest in both environmental sustainability and energy security has been growing. In this paper, we study the role of environmental sustainability in determining a country's energy security. From the literature, it is found that there are growing efforts by researchers to quantify energy security using energy security indexes. In some recent studies, a key dimension of these indexes is environmental sustainability which is quantified using a pre-determined set of sustainability indicators. From seven such studies, three commonly used core and four supplementary sustainability indicators can be identified. Several major issues in index systems design and energy security index creation are correlation between these indicators, what are the appropriate weights to be assigned to them, and data availability and quality. Energy security generally involves broader issues at the national level. Possible tradeoffs between environmental sustainability, energy security, and economic competitiveness, commonly known as "the energy trilemma", are highlighted.

S 09.5

Long term Scenarios for Bioenergy in India

K. Bhaskar and P.R. Shukla
Indian Institute of Management
Ahmedabad, India
kalyanb@iimahd.ernet.in

The National Action Plan for Climate Change of India considers renewable energy as a key thrust area. This paper focuses on one such renewable energy source, bioenergy which exists in diverse forms and finds applications in varied energy supply and demand sectors. Two long term scenarios for bioenergy up to 2050, business-as-usual (BAU) and green energy (GE) are assessed using a bottom up energy system model ANSWER-MARKAL. The analysis focuses on three major end use sectors, transport, electricity, and residential. Overall energy demand in 2050 increases under GE on account of increased penetration of renewables and biomass. CO_2 emissions rise by 87% under GE compared to 346% rise under BAU during the period 2010 to 2050. Co-benefits in terms of better energy security, energy access, and reduced emissions are obtained under GE.

S 09.6 Student Award Entry

The Short-term Effects of Air Pollution on Health in Sfax (Tunisia): An ARDL Cointegration Procedure

H. Elkadhi[1, 3] and R. Ben Hamida[2, 3]
[1]Laboratory of Applied Economics and Finance (LEFA), Institute of Advanced Business Studies of Carthage (IHEC), Tunis, Tunisia
[2]Unit of Research in Development Economics (URED) Sfax, Tunisia
[3]Centre for Studies and Research on International Development (CERDI), Clemont-Ferrand, France.
elkadhi.hayfa@gmail.com

The purpose of this study is to explore the short-term causal link between air pollution and the frequency of cardiovascular and respiratory diseases in urban area of Sfax (Tunisia). We insist also on the influence of meteorological factors in the intensification of the adverse effects of the pollutants. Using the Autoregressive Distributed Lag (ARDL) cointegration procedure introduced by Pesaran. M and Shin.Y (1999) and extended by Pesaran. M and al. (2001), the results shows that there is a significant link between pollutant emissions especially dioxide sulfur (SO_2) and the ozone (O_3) and hospital admissions for cardiovascular and respiratory diseases. We also concluded that the meteorological factors especially temperature and the wind velocity affecting the distribution of pollutants in the air and on the occurrence of these diseases.

S 09.7

Policies and Measures to Remove Energy Efficiency Barriers in Thai Buildings toward NAMAs

Yumiko Asayama[1] and Bundit Limmeechokchai[2]
[1]Center for Social and Environmental Systems Research
National Institute for Environmental Studies (NIES), Tsukuba, Japan
[2]Sirindhorn International Institute of Technology, Thammasat University, Thailand
asayama.yumiko@nies.go.jp

This study analyzed policies and countermeasures to remove barriers hindering the improvement of energy efficiency in designated buildings under the framework of Thailand's Nationally Appropriate Mitigation Actions (NAMAs). The study was conducted by means of literature reviews and interviews with relevant Thai officials. It was found that while Thailand has addressed energy efficiency in the designated buildings through ministerial regulations together with voluntary programs and financial instruments, the strength of the regulations is insufficient to enhance the compliance of dispersed energy end-users due to limitations in the monitoring mechanism. A number of barriers are interrelated, making them difficult to conduct stringent measurement, reporting, and verification (MRV), monitoring of the implementation measures. The establishment of a precise institutional management mechanism for MRV is required to collect the necessary baseline information, formulate policies, and disseminate them with a view to positively influencing the implementation of countermeasures to facilitate the NAMAs toward 2020.

S 09.8 **Baseline Scenario Selection for Sectoral Climate Mitigation Action in Power Generation: a Case Study on the Grid Emission Factor as Intensity Benchmark in Thailand**

A. Lehmann[1], J. Nylander[2], J. Huenteler [3] and T. Schmidt[3]
[1]Climate Policy Advisory Berlin
[2] Climate Policy and Markets Advisory Sweden
[3]ETH Zurich, Switzerland
anna.lehmann@climatepolicyadvisory.com

In the context of international climate policy design and negotiations, sectoral mitigation actions are discussed as options to scale up greenhouse gas mitigation and avoid dangerous climate change. One potential obstacle for crediting sectoral GHG mitigation actions is the need to agree on a credible'baseline scenario' representing the business-as-usual case of sectoral emissions. This paper explores different options for choosing indicators and technology scenarios to establish a baseline scenario for the power sector in Thailand. We argue that absolute technology diffusion targets are not suitable for calculating baseline emissions, since it is not clear whether and how Thailand will achieve its ambitious renewable energy targets. We further show that setting a baseline scenario for the emission intensity per unit of electricity - instead of absolute emissions – circumvents the significant uncertainty resulting from projections for power demand growth. However, the methodology currently used by the Thai government to calculate the emission intensity would need to be reformed to include emissions from imported electricity to ensure effective regional mitigation and avoid carbon leakage. Moreover, transparency and data collection issues need to be addressed to facilitate measurement, reporting and verification of emission reductions beyond the business-as-usual scenario.

S 10: GNESD Special Session
Time: 09:45 – 12:00
Room Assignment: Oriental Palm I

S 10.1 **Biofuel Sustainability in the Global South: Case Studies from Asia, Africa and Latin America**

Emmanuel Ackom
Global Network on Energy for Sustainable Development (GNESD)
UNEP Risoe Centre
Denmark Technical University, Denmark
emmackom@yahoo.com

Biomass is a major energy source in most rural communities in developing countries. Developing countries spend substantial amount of national revenue on petroleum-based transportation fuel importation. Additionally, agricultural sectors in some of these countries seem economically challenged. Liquid biofuel appears to be a good option for improving rural agricultural economies and to reducing nations' dependence on crude-oil based transportation fuels. With the exception of sugar cane ethanol, biofuels derived from first generation (food derived) feedstock are usually affected by environmental and social sustainability concerns. Harvesting crop residues which are co-products of existing agricultural activities in developing countries has the potential benefit of avoidance of land use changes, GHG emissions mitigation, net positive energy balance, reduced water consumption and does not pose any risk of threatening food security. However, there exists considerable competition for agricultural residues for use as

animal fodders, fertilizers and for maintaining soil organic matter. This study undertaken by the Global Network on Energy for Sustainable Development (GNESD) investigates case studies across the world namely Thailand, Brazil, Argentina, Kenya and Senegal. This paper presents an overview of biofuel development in the selected countries, assesses current production practices and the role of policies. The study estimates the availability of feedstock and the amount that could be sustainably extracted while maintaining soil health and minimizing any potential competition for the resource from other sectors. Technical potential for liquid biofuel production based on current conversion technologies and rates have been estimated. Learning from experiences from Brazil, the presentation will show how agro-mapping for bioenergy cultivation (that takes into consideration key sustainability requirements) could be an important first step in undertaking bioenergy activities properly.T he study concludes by providing south-south lessons and recommendations for policy makers aimed at improving environmental sustainability of biofuel in developing countries.

S 10.2 Student Award Entry

Utilization of Solar and Biomass for Rural Electrification in Bangladesh

Md. Ahsan Habib[1] and Supachart Chungpaibulpatana[2]
School of Manufacturing Systems and Mechanical Engineering
Sirindhorn International Institute of Technology, Thammasat University
Pathumthani-12120, Thailand
ahsanhabib61@gmail.com

Electricity is a far-way dream for many families in developing countries rural area like Bangladesh. In Bangladesh nearly 75% of the population lives in rural areas and access to electricity in rural areas is only 22%. Ensuring improved electricity supply is essential for socio-economic development and environmental sustainability. It has a direct influence on the life situation of the rural poor, affecting their productivity, health, education, and gender-related issues. The government of Bangladesh has a noble vision to provide electricity for all citizens by the year 2021. Suitable geographic location and as an agricultural country, Bangladesh is richly endowed with solar and biomass energy. So, solar and biomass energy together with national grid electricity is an appropriate option to meet the electricity requirements of people in rural areas. This paper examines Bangladesh rural area electricity demand and supply security by solar and biomass energy together with national grid electricity from 2010-2030 by using long range energy alternative planning system (LEAP) model. The results show that the total electricity demand of rural area in Bangladesh is about 27 TWh and is easily mitigated by solar and biomass energy together with national grid electricity. Solar and biomass electrification will provide direct and indirect benefits to the users of the system, with many implications of a permanent nature. Reduction of environment polluted kerosene usage is the main impact. A rural family can get bright light, watch TV, uses fan and power their mobile phones by using environment friendly renewable energy. Rural business can enhance their productivity and increase income through extended working hours and attracting more consumers.

S 10.3 Student Award Entry

Sustainable Rural Electrification in Thailand: Analyses of Energy Consumption and CO_2 Emissions

N. Kongwanarat and B. Limmeechokchai
Sirindhorn International Institute of Technology, Thammasat University
Pathumthani-12120, Thailand
faankong@gmail.com

Electrification can bring about many changes which would improve living conditions of the population. However, electrification would also put a strain on the national energy supply; thus, it should be implemented in a sustainable manner. This study employs the Long-range Energy Alternatives Planning (LEAP) model to analyze future energy demand, investment costs, and CO_2 emissions of three scenarios on different electrification technologies, which aim to provide electricity to unregistered rural households. The business-as-usual (BAU) scenario, which represents Thai residential sector without any increase in electrification rates, is also presented. The three scenarios are the Full Rural Electrification (RUE) through centralized grid, the Sustainable Solar Electrification (SSE), and the Sustainable Biomass Electrification (SBE). The RUE proves to be the highest cost scenario with the highest consumption and emissions, while SSE is the least expensive scenario with the least amount of energy demand. Lastly, the SBE has the least amount of emissions and can reduce the most amount of traditional biomass demand.

S 10.4

Renewable Energy based Mini-grids for Enhancing Electricity Access: Experiences and Lessons from India

Debajit Palit[1] and Gopal K Sarangi[2]
[1]The Energy and Resources Institute, Lodhi Road, New Delhi 110003, India
[2]The TERI University, Vasant Kunj, New Delhi-110070, India
debajitp@teri.res.in

Conventional grid extension has been the predominant mode of electrification in India. However, renewable energy based mini-grids have also been used for providing electricity access in remote areas, forested habitations, and islands. This paper, based on extensive literature review, interview with key stakeholders, and field visits to selected sites, captures the nuances of renewable energy based mini-grid developments in India. It also shares the experiences and lessons from the mini-grid programs by comprehensively analyzing multiple dimensions such as coverage and trend, technical designs, institutional arrangements, financial mechanism, tariffs, and operation and maintenance aspects. Finally, the paper suggests takeaway points for improving the rural electricity access level through renewable energy based mini-grids to compliment the grid electrification efforts in India.

S 10.5 **The Implementation of Micro Hydro Projects in Remote Villages on the Border of Indonesia and Malaysia: Lessons Learnt**

Sari Murni[1], Tania Urmee[1], Jonathan Whale[1], John Davis[1] and David Harries[2]
[1]Murdoch University, WA 6150, Australia.
[2]University of Western Australia, WA 6010, Australia
t.urmee@murdoch.edu.au

Implementing micro-hydro system (MHS) in a remote or rural location in an off-gridarea is a complicated process. Technical, social, economic andorganisationalissues need to be considered as well as the policy environment in which they are implemented.An understanding of the demand for electricity,of the benefits and impactsthat they can potentially have, as well as the roles of all stakeholders in the different stages of the MHS project, are also required. This paper presents the findings of a survey of stakeholders involved with two MHS projects in the highlands of Borneo. The survey results confirm that in order to ensure project success, particular attention needs to be paid to key critical factors.The performance and reliability of the MHSs were found to be strongly influenced by the role of the local micro-hydro management committee, and the relationship between the committee and the other members of the local community. The more successful schemes tended to be associated to more proactive committees that clearly informed the villagers about the issues of MHS and its sustainability. Other factors that were found to have an influence on project success were village cultural (which was related to the size villages) and the national energy policy framework in which the programs are planned and implemented.

S 10.6 **Eco Village Concept for Green Economic Development: Iskandar Malaysia as a Case Study**

H. Hashim[1], M.F. Shukery[2], L.J. Shiun[1], H.C. Siong[1] and H.M. Yusof[3]
[1]Universiti Teknologi Malaysia, Johor, Malaysia
[2]Universiti Putra Malaysia, Selangor, Malaysia
[3]Iskandar Regional Development Authority, Malaysia
haslenda@cheme.utm.my

Renewable Energy (RE) based on town concept in Iskandar Malaysia (IM) that can serve as a global model for a smart eco - village in tropical countries is proposed. In this research, renewable energy (RE) based distributed energy generation (DEG) system for Kulai eco-village (KEV) driven by integrating of biomass, biogas and solar energy. Thus, this paper discusses RE supply and demand side estimation ahead of implementation of RE DEG. The preliminary study has shown that energy supply from local RE included from oil palm biomass, landfill and solar was greater than energy demand for basic amenities at KEV such as lights, air-conditioner, and water heater by 221 times. The results of this study support the idea that it is possible to utilize local renewable energy as green energy resource and will become a first green eco town (GET) showcase from design, construction and operations.

S 10.7

Towards Green and Sustainable Society: a Case of Engineering Faculty, Universitas Indonesia

Gabriel Andari Kristanto, Cindy Priadi, Mulia Orientilize, Arief Udhiarto, Erly Bahsan
Civil Engineering Department, Universitas Indonesia, Kampus Baru Universitas Indonesia, Depok 16424, Indonesia
gakristanto@gmail.com

Over the last five years, Universitas Indonesia (UI) has developed an on line "green" ranking for world universities respect with respect to green campus and sustainability in the universities all over the world. In line with this program, six focus areas defined by Indonesia research Agenda, also in conjunction with the MDGs, the research theme of Engineering Faculty of the University of Indonesia (FTUI) for the period of 2010-2014 is Integrated Design in Urban Eco-technology for Quality of Life and Humanity. Consistent with this theme, FTUI plan to become a role model on how to build a community with a strong orientation toward green and sustainable environment. To support this idea, an integrated program was launch with a themeof "FTUI towards Green and Sustainable Society". In this program, several development in waste management and, water and wastewater management and energy saving will be conducted in the FTUI setting. Research on waste management will be focused on solid waste management to encourage 3R (Reduce, reuse, and recycle), and research on water management should prioritize in protecting sustainable water supply in the neighborhood of FTUI campus. Meanwhile research in energysaving will focus in development of smart building as a model for energy efficiency in electricity use. Subsequently all research and result will be socialized/promoted to all FTUI community to encourage public awareness and participation in green and sustainable society.

S 10.8

Share Knowledge to Increase Energy Access – GNESD Energy Access Knowledge Base

Xiao Wang
Global Network on Energy for Sustainable Development (GNESD) facilitated by UNEP, UNEP Risoe Centre
Denmark Technical University, Denmark
xwang@dtu.dk

Lack of reliable, adequate and affordable energy access continues to be of great challenge to developing countries. One of the major obstacles to increasing energy access is the inability for practitioners and policy makers to gain practical and timely knowledge on how to overcome existing barriers to provide modern energy services. The GNESD Energy Access Knowledge Baseprovides users with an informational platform to spread innovative ideas and share successful experiences. Thisknowledge base includes policies, projects or programmes which have led to increased access to energy services for households, communities or small scale businesses.It provides easy access to well-structured and searchable information about energy access initiatives in Asia, Africa and Latin America.
In this ongoing collection of good practices, each case illustrates how a specific demand among the energy poor has been met through provision of sustainable and modern energy solutions.A predefined template ensures the consistency and comparability of the data and information. Different from a simple collection of quantitative data, the GNESD knowledge base attempts to capture the multiple dimensions of energy access by including qualitative analysis ofsocio-economic implications and poverty alleviation impacts. The composite indices adopted help users to properly understand the

underlying context, causes of access change, financial and other resource requirements of each case. It hence contributes to highlighting and indicating the needs of prioritisation, co-operation and capacity building for future up-scaling programmes.

S 11: Electric Power Generation, Transmission and Distribution I
Time: 09:35 – 12:10
Room Assignment: Oriental Palm II

S 11.1 **Analysis of Switching Transient Overvoltages and Protection Techniques for the Energization of the Connected 115 kV Underground and Submarine Cables**

P. Thararak, P. Jirapong and P. Jan-ngoen
Department of Electrical Engineering, Faculty of Engineering
Chiang Mai University, Chiang Mai, 50200, Thailand
pppanidaaa@gmail.com

In this paper, switching overvoltages analysis based on the statistical study approach according to IEC 6007 Insulation Co-ordination are analyzed for the energization of the connected 115 kV underground and submarine cables from Khanom power plant to Samui Island substation. Comparative analysis of protection schemes including metal oxide surge arresters and controlled switching are analyzed for controlling switching overvoltages during cable energization. The digital computer simulations are made using PSCAD/EMTDC software. Test results show that the overvoltage values at the sending and receiving ends from the cable energization without surge arresters and controlled switching of circuit breaker can reach up to 1.6 – 2.0 p.u.. In addition, the switching overvoltages can be mitigated by the provision of surge arresters at the two line terminations. Additional limitation of these overvoltages, controlled switching involving individual closing of each phase in the circuit breaker at the optimal point-of-wave can be used.

S 11.2 Student Award Entry **A Phase Shifted PWM Technique for Common-mode Voltage Reduction in Five Level H-bridge Cascaded Inverter**

N.L.H. Bang, N.V. Nho, N.K.T. Tam and N.M. Dung
Department of Electrical Electronics Engineering
Ho Chi Minh City University of Technology, Vietnam
nlebang@gmail.com

In electric drive applications, the conventional carrier based and space vector pulse width modulation (PWM) which schemes for two-level inverter topology generate large common-mode voltages, this leads to the phenomenon of bearing current. These current spikes can cause electromagnetic interference (EMI) and reduction in the life expectancy of the motor. Cascade multilevel inverters can reduce voltage stress on power switches; generate smaller common-mode voltages and output voltages with low distortion. Phase shifted PWM is a compatible solution for H-bridge cascaded inverters. In this paper, we will present a simple and flexible phase shifted PWM technique for common-mode voltage reduction of a five level H-bridge cascade inverter topology. Simulation results are presented for validation and comparison with other techniques.

S 11.3 Restructuring of a Low Voltage Distribution System into a High Voltage Distribution System -For an Improved Voltage and Power Loss Profile

K. Spandana and Varsha Reddy. A
Department of Electrical Engineering, Osmania University
Hyderabad, Andhra Pradesh, India – 500007
spandu_kammari@yahoo.co.in

The main objective of presenting this paper is to enlighten the importance of restructuring of an existing Low Voltage Distribution System (LVDS) into High Voltage Distribution System (HVDS) which has a better voltage and loss profile and high quality of supply. In India, the average transmission and distribution losses have been officially indicated as 25% of the electricity generated, because of the fact of usage of long lengths of Low Voltage (LV) distribution lines. In HVDS these long length LV lines are replaced by High Voltage (HV) lines up to the Distribution Transformer (DTR) and then a small length LV line is extended to the consumers end. Due to the usage of long lengths of HV lines, there is no scope for unauthorized power pilferage unlike in LVDS. A large rated distribution transformer in LVDS is replaced by many number of small rated distribution transformers in HVDS. Adequate investment in efficient working of transmission and distribution systems in developing economies with high growth of electricity demand is an important objective. Hence to overcome all these problems, implementation of HVDS is considered as the best move to enhance the performance of a distribution system.

S 11.4 Analysis of Impacts of SVC on Voltage Collapse Mechanism and Maximum Loadability

Dinh Thuc Duong and Kjetil Uhlen
Department of Electric Power Engineering
Norwegian University of Science and Technology, Norway
thuc.duong@ntnu.no

Static var compensators (SVC) have been widely used to enhance voltage stability and power transfer. Dynamic control of large SVCs are able to maintain constant voltage over a wide range of operation. Allocation and size of SVCs are normally determined by off-line model analysis. However, under various operating conditions, e.g. change of system topology, redispatch of generation, load variation, etc., the SVC has different effects on maximum loadability and voltage stability. This can lead to voltage collapse at normal operating voltage when maximum loadability has been reached. Under this circumstance, classical undervoltage protection will fail to detect the problem. By addressing this issue, this paper scrutinizes the impact of SVC capacity on voltage collapse and the mechanism behind. The analysis results in a method to identify the maximum loadability in real time, which can be used as an indicator for online voltage stability monitoring. Finally, the methodology is validated by dynamic simulations in PSS/E.

S 11.5 Student Award Entry

Simulation and Experiment of Hybrid Modulation Strategy with Common-mode Voltage Reduction for Seven-Level Hybrid Cascaded Inverter

N.L.H. Bang, N.V. Nho, N.K.T. Tam and N.M. Dung
Department of Electrical Electronics Engineering
Ho Chi Minh City University of Technology, Vietnam
nlebang@gmail.com

Since the development of renewable energy like solar, wind power, the multi-level topologies proved to be more able to apply and control the renewable energy systems. Although, the multi-level inverter generate a common-mode voltage less than the two-level inverter. The common-mode voltage problem still researchers study and solve. This paper will be presented a simple and flexible technique to reduce common-mode voltage for a seven level hybrid cascaded inverter topology. This multilevel inverter topology was established based on five levels H-bridge cascaded inverter. Within, two separated DC sources had the value ratio correlative E/2E. This method also reduces the switching loss and simple to implement in a common processor. Simulation results in Matlab/simulink and experimental results with R-L load will be reported for validation.

S 11.6

Impacts of PMUs in DistributionNetworks with High Penetration of Distributed Generation

Subas Ratna Tuladhar and Jai Govind Singh
Energy Field of Study, School of Environment, Resources and Development
Asian Institute of Technology, Pathumthani 12120, Thailand
Subas.Ratna.Tuladhar@ait.ac.th

Due to growing concern over energy security and environmental impactsdue to fossil fuel, there is much emphasis for greater utilization of distributed resources in power system.However, high penetration levels of distributed generation (DG) in the distribution network can change its state from a simple, quasi-steady-state radial network to a complex, multi-source network with faster dynamics. This will present a number of challenges to the utilities in thecontrol and protection of the distribution network. In such situation, faster and more accurate monitoring of the system becomes essential, which in turn, will justify the implementation of phasor measurement units (PMUs) in the distribution network. PMUs will also play an important role implementing new techniques for distribution network control and protection.

S 11.7

Proposed Implementation Methodology for a Hybrid Energy Management System with Renewable Source Integration

Sardar Farhan Ali Cheema[1], Rana Farhan Akram[1] and Muhammad Aqeel Aslam[1]
Department of Electrical and Power Engineering, PNEC-NUST, Karachi, Pakistan.
sardar.cheema@pnec.nust.edu.pk

Due to environmental conditions and the particular pattern of economic development, masses from all across the world have turned towards different types of energy sources for meeting their energy demands. But the lack of integration in between these sources is an important factor to be taken into consideration. In this study the incorporation of different energy sources on a single node is discussed. It presents a system such as, that different energy sources would come to a common junction and a single output originates from it so as to select the most economical source of energy i.e. having the

least operating cost. The results of the proposed system demonstrate that the developed product would be a proficient device, providing a very economical solution on one hand and increasing the scope of renewable sources of energy on the other.

S 11.8 **Impact of High Solar Rooftop PV Penetration on Voltage Profiles in Distribution System**

Rung Punyachai[1], Weerakorn Ongsakul[1] and Uwe Schmidt[2]
[1]Asian Institute of Technology, Thailand
[2] Institute of Electrical Power Systems and High Voltage Engineering, Technische Universität Dresden, Germany
st114449@ait.ac.th

This paper provides an assessment on voltage profiles of a distribution system in the presence of high level of solar rooftop PV penetration. Each household solar rooftop PV power generation is calculated by PVWATTs online calculation tool. Load profile of South-West Chiang Mai City of the Provincial Electricity Authority (PEA) of Thailand is selected for the simulation. Simulation results indicate the maximum allowable PV installation per household in which voltage level do not exceed standard operating limits. Finally, sensitivity analysis of feeder length, transformer short circuit resistance and solar rooftop-PV inverter operating power factor are shown.

S 12: Bioenergy and Biofuels
Time: 09:35 – 12:10
Room Assignment: Oriental Palm III

S 12.1 **Environmental and Social Impacts of Jatropha-Based Biodiesel: A Case Study in Thailand**

Pornpimon Boonkum[1], Makoto Nohtomi[1], Jitti Mungkalasiri[2], Wanwisa Thanangkano[2], Katsuya Nagata[1], and Hiroshi Onoda[1]
[1]The Graduate School of Environment and Energy Engineering, Waseda University Shinjuku, Tokyo 1690051 Japan
[2]The National Metal and Materials Technology Center, Pathumthani, 10120 Thailand
bpornpimon@fuji.waseda.jp

Thailand, with its abundant agricultural resources, is a well positioned to deploy biofuels such as ethanol and biodiesel. To enhance the self-dependence on the energy and economy in rural areas, the government has implemented the “Alternative Energy Development Plan: AEDP 2012-2021”, aiming to increase the amount of alternative and renewable energy utilization. To ensure the sustainability of the biodiesel production not only research on high efficient production technology improvement is need, but also studies on the impacts from promoting the non-food feedstock such as Jatropha. This study aims to evaluate environmental and social impacts of Jatropha-based biodiesel production by using the Life Cycle Assessment (LCA) concept. The scope of this study is defined as “cradle-to-gate” which includesJatropha cultivation, harvesting, oil extraction and biodiesel production. Inventory data used in this study was developed byan on-site interview and consultation with Jatropha farmers and experts throughout the three provinces in the northern part of Thailand. The environmental impacts were analyzed by the modified LCA methodology called Environmental Load Point (ELP), formulated by the Nagata Laboratory of Waseda University. The weighting factor used in ELP developed by taking Thailand as a case study. The assessment of social impacts of

Jatropha biodiesel systems referred to criteria indicated in the Global Bioenergy Partnership Sustainability Indicator for Bioenergy. The results show the environmental impacts of the Jatropha biodiesel production from a localized environmental viewpoint. The social impacts are focused on results of the change in income and job creation in the local community due to the establishment of biodiesel production system. These can be useful for the policy maker to promote the advantages of non-food biodiesel and enhance the cultivation areas and production plant to the rural in further.

S 12.2 Biodiesel Purification: Comparison and Optimization of Common Washing Processes

D.Y.C. Leung
University of Hong Kong, Hong Kong, China
ycleung@hku.hk

Biodiesel, a low-emission renewable fuel and one of the best substitutes for petro-diesel fuel, has attracted great public interest over the past decade. Biodiesel is a mixture of methyl esters with long-chain fatty acids which are commonly obtained through transesterification reaction. Once the reaction is completed, two major products are formed: the ester content (biodiesel) and glycerol. Both of them are contaminated with unreacted alcohol, residual catalyst and soaps that may be generated during the transesterification step. Other impurities may also exist, depending on the nature of the original oil. Although the glycerol phase tends to contain more contaminants than the biodiesel phase, a significant amount of contaminants is still present in the biodiesel after separation of these two phases. Moreover, according to EN biodiesel standard, the most comprehensive biodiesel standard so far, the ester content (biodiesel) must be at least 96.5%. Crude biodiesel needs to be purified before being used as a qualified fuel for diesel engines. The purification process, generally called washing process, serves the purpose of washing out the remnants of contaminants from the crude biodiesel. An efficient and cost-effective washing process is an important step in purifying biodiesel to meet international standards for biodiesel fuel. In the present study, five commonly used washing methods, i.e. cold deionized water washing, hot deionized water washing, phosphoric acid washing, ultrasonic assisted washing, and magnesol powder washing were examined. The FAME yield of the final product, energy consumption and economic costs of these different methods were compared. The influence of the washing cycle for each washing method on biodiesel quality was also studied to determine their optimal washing cycles. The comparison indicated that at the optimal number of washing cycle, the FAME yield of the final product using the hot deionized water washing method was highest, but its energy consumption was also the highest. The ultrasonic assisted washing method was considered to be the best for biodiesel purification, when energy consumption and operation costs are considered.

S 12.3 Large Scale Transport Energy Production from Microalgae in Persian Gulf Knowledge Island

Nasrin Moazami, Reza Ranjbar and Alireza Ashori
Iranian Research Organization for Science and Technology, Iran
moazami@irost.org

Out of hundreds of microalgal strains reported, only very few of them are capable for production of high content of lipid. Therefore, the key technical challenges include identifying the strains with the highest growth rates and oil contents with adequate composition, which were the main aims of this work. From 147 Microalgae screened for

high biomass and oil productivity, the *Nannochloropsis* sp. PTCC 6016, which attained 52% lipid content, was selected for large scale cultivation in Persian Gulf Knowledge Island. *Nannochloropsis* strain PTCC 6016 belong to Eustigmatophyceae (*Phylum Heterokontophyta*) isolated from Mangrove forest area of Qheshm Island and Persian Gulf (Iran) in 2008. The strain PTCC 6016 was an average biomass productivity of 2.83 g/L/day and 52% lipid content. The biomass productivity and the oil production potential could be projected to be more than 200 tons biomass and 100000L Oil per hectare per year, in an outdoor algal culture (300 day/year) in the Persian Gulf climate.

S 12.4 Development of a Generic Methodology for Assessment of Microalgae Cultivation Potential Using GIS

Karabee Das and P. Abdul Salam
Energy Field of Study, Asian Institute of Technology, Thailand
karabedas@gmail.com

Biofuels have gained the esteem of being an important component of the renewable energy matrices in the international level. In most cases, it is the second generation biofuel which is derived from the lignocellulose agriculture and forest residue which threatens the environment like land use changes. Microalgae has been considered as an energy crop which has huge potential for biofuel production. It has the capacity for carbon dioxide fixation and detoxification of wastewater from the industries and it does not compete with the primary needs of the human being i.e. land, food and water. Many studies have been carried out to assess the technological aspects of biofuel production from the microalgae. This study reviews and develop a generic methodology for the inspection and assessment of microalgae cultivation potential in a particular site using Geographic Information System (GIS).

S 12.5 Comparison the Water Footprint of Oil Palm Plantation in Surat Thani and Rayong provinces of Thailand

Jittraporn Jaimung, Achara Ussawarujikulchai and Kanchana Nakhapakorn
Faculty of Environment and Resource Studies, Mahidol University
Salaya, Phutthamonthon, Nakhon Pathom 73170, Thailand
achara.uss@mahidol.ac.th

The objective of this study was to compare the water footprint of oil palm plantation as a source for production of alternative energy as biodiesel in Surat Thani and Rayong province of Thailand by using water footprint concept. The results showed that the water footprint of oil palm in Surat Thani province was 619.9 m^3/ton while the water footprint of oil palm in Rayong province was 803.2 m^3/ton. The suitable climate for oil palm plantation in Surat Thani province provided the higher yield, more over the water footprint of oil palm in Surat Thani is less than Rayong province. In addition, the irrigation water used in the oil palm plantation in Rayong province is limited due to the utilized sharing of water in industrial and tourism sectors. Thus, it is necessary to find the measures to reduce the water footprint of oil palm plantation by increasing the yield. This can be achieved by improving oil palm through breeding, development and management of irrigation system and adding natural fertilizers to increase fertility in the soil. Additionally, reducing the use of chemical fertilizers during plantation should be performed to reduce the grey water footprint.

S 12.6 Bioenergy Education and Training for the Youth - Does it Matter for the Sustainability of Bioenergy?

Pradipta Halder
School of Forest Sciences, University of Eastern Finland
Joensuu 80101, Finland
pradipta.halder@uef.fi

In order to understand young students' perceptions of bioenergy and the social environment of their learning about bioenergy, a survey was conducted among 1903 school students of 15 years age in Finland, Slovakia, Taiwan, and Turkey. The results showed that the students were critical of bioenergy especially the issues related to energy production from forest biomass. Most of the students did not have any discussions related to bioenergy in their schools and at homes. The majority of the students perceived that there would be no possibility to learn about bioenergy in their schools. Media appeared as a source of information on bioenergy to a large number of the respondents. The study suggests improving young students' perceptions of bioenergy. This can lead to social sustainability of the bioenergy projects by reducing conflicts. The STS (science, technology and society) approach for teaching bioenergy related topics for school students would be highly relevant.

S 12.7 Cost and Benefit Analysis of Bio Energy Alternatives in India

Trupti Mishra
Indian Institute of Technology Bombay, India
truptimishra@iitb.ac.in

As a move towards sustainable low carbon growth, there are number of mitigation measures like energy efficiency, fuel switch, technologies and demand management which have been identified to reduce green house gas emission. The major reduction opportunities of GHGs involve improving the efficiency with which the energy is used and the transition towards alternative sources of energy. The sustainable use of bio energy presents an opportunity to address climate change by reducing fossil based carbon dioxide emissions. Biomass energy sources include: agricultural crops and residues; dedicated energy crops; forestry products and residues; residues and by-products from food, feed, fiber, wood, and materials processing plants, cheese whey; post-consumer residues and wastes, such as fats, greases, oils, construction and demolition wood debris and other urban wood waste, municipal solid wastes and wastewater, and landfill gases. In this backdrop, the present study aims to assess the various bio energy alternatives in India through a cost benefit analysis. Specifically the study will address the cost and benefit associated with bio energy options in urban transport from economic and social perspectives; would help the policy makers to formulate the strategies in term of green energy for low carbon growth.

S 12.8 **Investigation on Optimum Blend Ratio and Microwave Pretreatment Condition of Primary and Secondary Sludge from Sewage Treatment Plants (STP) to Enhance Biogas Production in an Anaerobic Digester**

Sivansankari R. , Kumaran P. and Saifuddin Normanbhay
Center of Renewable Energy, University Tenaga Nasional
Selangor, Malaysia
sivasankari@uniten.edu.my

In this paper, findings of an investigation to determine optimum ratio of primary and secondary sludge and microwave pre-treatment of the combined sludge ratio is reported. In the first experimental works, anaerobic digestion of primary and secondary sewage sludge at ratio of 100:0, 90:10, 70:30, 50:50, 30:70, 0:100 respectively, was carried out. Results have indicated that the highest amount of biogas was generated by the 100% primary sludge. The current practice at the STP employs 70:30 sludge mix ratio. Using microwave, the 70:30 sludge mixture was subjected to pretreatment (MW) at 5 minutes and 15 minutes of continuous and intermittent irradiation prior to anaerobic digestion and compared to samples without pretreatment. The continuously MW pretreated sludge for 15 minutes generated 25% more biogas than the non-pretreated sludge. The outcome of this work suggest, pretreating 100% primary sludge with MW irradiation may prove to be an attractive option to be explored for enhancement biogas production in STP's. The excess biogas produced can be used to generate more electricity hence proving to be techno-economically viable for power production.

S 13: Green Transport
Time: 13:10 – 16:10
Room Assignment: Marine I Ballroom

S 13.1 **Comparative Analyses of Low Carbon Measures in the Transport Sector: the Cases of Thailand and Sri Lanka**

S. Selvakkumaran and B. Limmeechokchai
Sirindhorn International Institute of Technology, Thammasat University
bundit@siit.tu.ac.th

The transport sectors of Thailand and Sri Lanka are analysed in terms of their characteristics and low carbon measures possible. The low carbon society (LCS) scenario of Thailand includes fuel efficiency improvement, modal shift and advanced technologies such as hybrid, in its counter-measures (CMs), and LCS achieves a cumulative mitigation of 21.8% from 2010 to 2050. The Sri Lankan transport sector is a very simple one, which is dominated by motorcycles and three-wheelers in its active fleet. The total expected energy consumption in the 2050 BAU is 5,404 ktoe and the corresponding emissions are 16,600 kton-CO_2. Unlike the Thai transport sector, the Sri Lankan transport sector depends only on gasoline, diesel and very little amount of LPG and also faces heavy taxation in personal passenger vehicle purchases. Thus, the stage of evolution of the transport landscape is much less, thus leading to many challenges in its design of CMs.

S 13.2 Student Award Entry

Analysis of Low Carbon Society in Thai Transport Sector – The AIM/Enduse Modeling Approach

S. Selvakkumaran[1], B. Limmeechokchai[1], T. Masui[2], T. Hanaoka[2] and Y. Matsuoka[3]
[1]Sirindhorn International Institute of Technology (SIIT), Thammasat University Pathumthani, Thailand
[2]National Institute of Environmental Studies (NIES), Japan
[3]University of Kyoto, Japan
sujeetha.selvakkumaran@gmail.com

Thailand's road transportation sector has been modeled using AIM/Enduse, for the BAU case and LCS, Emission Tax (ET) and Emission Reduction Target (ERT) scenarios. The counter-measures modeled are modal shift, travel demand management (TDM), advanced technologies such as hybrid vehicles and fuel switching to biofuels. Results of analyses show that the LCS scenario has the highest mitigation, with a cumulative mitigation of 28% from the BAU scenario. Whilst ET and ERT scenarios show considerable mitigation, they do not lead to a change in the sustainability of the transport system in Thailand. The LCS scenario achieves this mitigation through a change in the way the population meets the travel demand, where as in the ET and ERT scenarios, most of the mitigation is through fuel switching and TDM. In the LCS scenario, in 2050 the majority of the passenger transport is provided for by public transport modes, unlike in the ET and ERT scenarios.

S 13.3

Sustainable Low Carbon Transport Scenarios for India

P.R. Shukla[1], Subhash Dhar[2], Shivika Mittal[1]
[1]Indian Institute of Management, Ahmedabad, India
[2]UNEP Riso Centre, Denmark
shukla@iimahd.ernet.in

Transport sector's fuel mix which is dominated by the fossil fuel imposes multiple external costs vis-à-vis energy security, air quality and climate change. In this study, alternate future scenarios are designed to explore the transitions of national transport system (till 2050). Several policy options are delineated that would facilitate the sustainable low carbon transformation of India's transport sector. The long term energy and emission trajectory of India's transport sector is assessed under alternate scenarios using the integrated assessment modelling framework. Co-benefits like energy security and local air quality that can be accrued by mainstreaming climate change polices into national sustainable development goals and sectoral plans are also estimated. There is no silver bullet that would enable the transition towards low carbon transport. An optimal mix of policies that includes fuel economy standards, modal shifts and cleaner energy supply is required to align climate and sustainable development goals in the long-term.

S 13.4 Student Award Entry

Technical and Environmental Impact of Electric Vehicles in Distribution Networks

Jun Su, Charalampos E. Marmaras, Erotokritos S. Xydas
Cardiff School of Engineering, Cardiff University
Cardiff, CF24 3AA United Kingdom
junsu1989@gmail.com

Against the background of raising CO_2emissions, there is a great interest in electric vehicles (EVs) as replacement for internal combustion engine vehicles (ICEVs). This paperassessesthe CO_2 reduction in the UK result from EVs for years to 2030 based on

two factors: future carbon density of different power generationmix in the UK driven by energy policy; and projected EV penetrations; in order to illustrate theimportant role that EVs play in the UK commitment emissions reduction targets.The battery charging of EVs will adds an extra burden on distribution networks, which may cause peak demand, voltage drop, cable thermal overloads and increase in loss. The technical impacts of EVs charging in 2030 are analyzed at residential distribution level. The possible solutions includingdemand side participation is considered to evaluate large scale integration of EVs.

S 13.5 Determining Key Predictors Influencing Intention to Use Electric Vehicles in Malaysia

Yew-Ngin Sang[1, 2] and Hussain Ali Bekhet[1]
[1]Graduate Business School, College of Graduate Studies
Universiti Tenaga Nasional (UNITEN), Putrajaya, Malaysia
[2]Institute of Energy & Policy Research, Universiti Tenaga Nasional (UNITEN), Putrajaya, Malaysia
eugenesyn@hotmail.com

The purpose of this paper is to conduct an investigation into the key factors influencing the intention to use electric vehicles in Malaysia. An empirical study using a survey questionnaire distributed to a judgment sampling of 350 drivers within Selangor and Federal Territories (Kuala Lumpur and Putrajaya). A research model based on the framework of Theory of Planned Behavior was proposed to realize the objective of the study. Linear regression-stepwise technique was used to test the research hypotheses of this study. The result indicated that the intention to use electric vehicles in Malaysia can be explained by environmental concern, consumer knowledge, psychological benefits and demographics. This paper is a useful source of information on the consumer intention for automotive players planning to market electric vehicles in Malaysia. It offers practical guidelines for formulation of marketing strategies that will address the real wants and needs of their future clients. Policy makers should address the appropriate intervention and policy to encourage the growth of electric vehicles in Malaysia as part of the strategy to increase energy efficiency and to reduce emissions and the reliance on fossil fuel within the transportation sector. Future study should be expanded to others cities to improve representation of respondents within Malaysia and more factors that might influence the intention to use to be further explored

S 13.6 The Energy Management Control Strategy for Electric Vehicle Applications

A. Wangsupphaphol, N.R.N. Idris, A.Jusoh, N.D.Muhamad and Low Wen Yao
Faculty of Electrical Engineering, Universiti Teknologi Malaysia
81310 Skudai, Johor, Malaysia
areeceic@yahoo.com

This paper presents the control system of energy management for electric vehicle (EV) applications, based on the actual speed of the vehicle and the terminal voltage of supercapacitors (SCs). The cascade control of voltage and current were implemented on SCs for tracking the energy during acceleration and braking. The performances of SCs concerning the dynamic power were examined. A reliable power system composed of Lithium-ion Batteries (LBs) and SCswas selected. AC drive was simplified by a DC drive system, simulated using fully driven acceleration cycle and also during

braking condition. The actual vehicle dynamic and tractive loads were modeled for the motor driving load. The energy consumption of pure Battery Electric Vehicle (BEV) and the proposed Batteries-SCs Hybrid Electric Vehicle (BHEV) were then compared for the driving cycle. The driving power portions, bus voltage regulations, andSCs actual voltage and current were also investigated. Numerical simulations using MATLAB had proven the effectiveness of the proposed system over the BEV.

S 13.7 Student Award Entry

Optimal Placement of EV Fast Charging Stations Considering the Impact on Electrical Distribution and Traffic Condition

Prakornchai Phonrattanasak and Nopbhorn Leeprechanon
Department of Electrical and Computer Engineering, Thammasat University
Pathumthani, Thailand
nopbhorn@engr.tu.ac.th

The battery of an electric vehicle (EV) needs to be recharged when it is exhausted. So charging stations must be extensively installed to sufficiently serve a number of electric vehicles, especially in residential areas. Since electric charging stations will be used simultaneously by many EVs, they should be optimally placed in areas of dense traffic for minimum total cost of the fast charging station and minimum total loss of distribution network. In this paper, number of fast charging stations in a residential area is calculated and an optimization model of fast charging station planning is proposed to minimize these objectives subject to distribution line constrains and traffic condition. Ant colony optimization (ACO) is employed to solve the problem. An IEEE 69-bus system in a residential area is used to verify the proposed technique. The results show that ACO method found the best location of fast charging station on residential power distribution with minimum total cost or loss while satisfying many technical and geographical constraints.

S 13.8

Green Energy and Sustainable Urban Transport Transition: a Co-benefits Assessment for Ahmedabad, India

P. Chokshi[1], P.R. Shukla[1], M. Pathak[2] and K. Bhaskar[1]
[1]Indian Institute of Management – Ahmedabad
Vastrapur, Ahmedabad 380009, India
[2]CEPT University, Ahmedabad, India
pchokshi@iimahd.ernet.in

India is witnessing a rapid surge in urban mobility demand as a result of its increasing population, rapid urbanization, rising income levels and the growth and spread of cities. The growth in urban travel demand is majorly driven by cities as LDV sales continue to increase at 26% and the share of two- and four-wheelers in the vehicle mix is increasing in cities. Such a pattern would have vital implications for local air quality, GHG emissions and energy security in future. It is thus important to move towards a sustainable urban transport pathway, especially in cities, which account for major proportion of the urban transport demand. By implementing various national as well as local GHG mitigation strategies, important co-benefits such as air quality improvement, energy security and GHG mitigation can be gained. City level actions would play a major role and the present study looks at the long term energy and environmental pathways for Ahmedabad city, India. Two scenarios: i) Business-as-usual and ii) a Green Energy and Sustainable Transport, are assessed using the AIM Extended Snapshot for the urban transport sector in Ahmedabad till 2050. The results reveal that there would be important local co-benefits (improvement in air quality) and national level co-benefits

(energy security, GHG mitigation) gained if green and sustainable urban transport solutions get implemented across cities.

S 14: Power and Heat
Time: 13:10 – 16:10
Room Assignment: Oriental Palm I

S 14.1

Design of Strategic Information in the Deregulated Indian Power Market: an agent-based Approach

Vivek Mohan[1], Nimal Madhu[1], Weerakorn Ongsakul[1], Jai Govind Singh[1], and Reshma Suresh M P
Energy Field of Study, School of Environment, Resources and Development
Asian Institute of Technology, Pathumthani, Thailand
st115364@ait.ac.th

This paper primarily focuses on formulating an agent based model covering the financial and transactional aspects of deregulated Indian power markets which goes in hand with the legal system of the regulator. It proposes an information system which helps the agents of a power market to take decisions in making better bids and participate in the day ahead markets. A price forecasting engine based on ANN, whose input is adapted using Rough set theory is implemented for Genco and Distco.

S 14.2 Student Award Entry

An Experimental Investigation of a Co-generation Energy System Using a Tubular SOFC: A Renewable Energy Solution for Power and Heat

K.R. Ullah[1], R.K. Akikur[1], H.W. Ping[1], Member, IEEE, R. Saidur[1, 2], S.A. Hajimolana[3], M. A. Hussain[3]
[1]UM Power Energy Dedicated Advanced Centre (UMPEDAC), University of Malaya, 50603 Kuala Lumpur, Malaysia.
[2] Department of Mechanical Engineering, University of Malaya, Kuala Lumpur, Malaysia
[3]Department of Chemical Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia.
ruhuaustee@gmail.com

This study analyzed the technical and economical viability of producing biogas from food waste at Naresuan University for electricity generation. Samples were collected to analyze physical and chemical composition in order to assess its suitability for biogas production. The effects of particle size on biogas quantity and quality were evaluated. Further, the amount of power that can be produced and economic evaluation were calculated. The results showed food waste had high carbon oxygen demand (COD), biological oxygen demand (BOD) and moisture content (MC) of 278,388 mg/kg, 103,889 mg/kg and 77.1% respectively which are suitable for biogas production. It further showed that smaller particle size of food waste produced more biogas than bigger sizes. Higher potential for biogas production of 11m^3/day from the 333 kg of food wastes that are produced daily were observed with the power of 15.66 kW. The high net present value (NPV), cost benefit ratio (BCR) and short payback period (PBP) values of 229,755.29 Baht, 1.05 and 4 years respectively showed viable economic analysis.

S 14.3 Study of the Characteristics of Cellular Premixed Flames on Ceramic Porous Board for $CH_4/C_2H_6/CO_2$ Mixtures

Kaewpradap A[1], Pimtawong T.[1], Tongtrong P.[1], Jugjai S.[1], Kadowaki S[2]
[1]Department of Mechanical Engineering, King Mongkut's University of Technology Thonburi, Thailand
[2] Department of System Safety, Nagaoka University of Technology Kamitomioka, Nagaoka 940-2188, Japan
amornrat.kae@kmutt.ac.th

This research is to study the characteristics of cellular premixed flames that are investigated on ceramic porous board with $CH_4/C_2H_6/CO_2$ mixtures (main compositions of natural gas in Thailand). Cellular flames are the phenomena caused by intrinsic instability induced by thermal expansion and of diffusive thermal instability due to preferential diffusion of mass versus heat. In lean combustion premixed flames, diffusive-thermal instability has a great influence on the flame shape, unsteady behavior, diffusive-thermal instability and thermal instability. To study the characteristics of cellular premixed flames, experimental apparatus consisted of mixing tube, ceramic porous board size, were designed. In this study, the shape and fluctuation of cellular premixed flames on a flat burner were also investigated. As the obtained results, the equivalence ratio for cellular premixed flames of $CH_4/C_2H_6/CO_2$ mixtures is 0.88-0.95. The results were shown that the size of cells and fluctuation from designed experiment as the instability intensity and elucidated the characteristics of air $CH_4/C_2H_6/CO_2$ flames.

S 14.4 Turbulent Convection in a Solar Air Heater Channel with Baffles/Winglets

S. Skullong[1], S. Tamna[2] and P. Promvonge[3]
[1]Department of Mechanical Engineering, Faculty of Engineering at Si Racha Kasetsart University, Sri Racha Campus, 199 Sukhumvit Rd., Si Racha, Chonburi, 20230, Thailand.
[2]Faculty of Engineering, Thai-Nichi Institute of Technology, Bangkok 10250, Thailand
[3]Department of Mechanical Engineering, Faculty of Engineering
King Mongkut's Institute of Technology Ladkrabang, Bangkok, 10520, Thailand
sfengsps@src.ku.ac.th

The paper presents a study on heat transfer, friction loss and thermal performance behaviors in a solar air heater channel fitted with baffle turbulator (BT) or triangular-winglet vortex generator (WVG) at various winglet/baffle to channel-height or blockage ratios (BR=b/H=0.1, 0.15 and 0.2). The BT and the WVG were placed only on the upper wall/absorber plate of the test channel at a single axial pitch ratio ($PR=P_l/H=4$). The investigation is performed for the Reynolds number ranging from 5400 to 23,000. The upper wall of the channel is uniformly heated as a constant heat flux while the rests are covered with thermal insulations to reduce heat loss to surroundings. The BT and the WVG were, respectively, mounted with the attack angle of 90° and 60° relative to main flow direction. The experimental results indicate that the absorber plate with the WVGs provides considerable improvement of the heat transfer rate over the smooth channel around 4.29 to 4.33 times for BR=0.2. The use of the WVG placed on the absorber plate leads to the highest heat transfer rate, friction factor and thermal performance in comparison with the BT and the smooth channel. The WVG at BR=0.2 provides the maximum thermal performance up to 1.61. Thus, because of stronger vortex flow, the WVG at largest BR becomes influential upon the heat transfer and thermal performance enhancement.

S 14.5 Heat Transfer and Flow Friction Behaviours in a Channel with Multiple 30° V-Ribs

C. Khanoknaiyakarn[1], W. Jedsadaratanachai[2] and P. Promvonge[2]
[1] Faculty of Engineering and Technology, King Mongkut's Institute of Technology North Bangkok Rayong, Rayong 21120, Thailand
[2] Department of Mechanical Engineering, Faculty of Engineering King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
k.chitakorn@hotmail.com

The paper presents an experimental study on heat transfer and flow friction characteristics in a rectangular channel fitted with periodically rectangular V-ribs. The multiple V-rib turbulators are tested in the channel having an aspect ratio (width to height ratio), AR=10 and height, H= 30 mm, with three rib-to-channel height ratios (e/H=0.2, 0.3, and 0.4), two rib-pitch to channel-height ratios (PR=P_l/H= 3 and 4) and a single attack angle (α=30°). The upper plate of channel is uniformly heated at a constant heat-flux. The experiment has been conducted by varying airflow velocity in order to obtain the Reynolds number range from 5000 to 24,000. The experimental results show a significant effect of the presence of the ribs on the heat transfer rate and pressure drop over the smooth channel. The measured data indicates that the V-rib turbulators with e/H = 0.4 and PR =3 yields the highest heat transfer rate and friction loss. All the V-rib turbulators perform much higher than the smooth channel with no rib.

S 14.6 Optimization of Operating Parameters to Maximize the Curent Density without Dehydration at the Anode Membrane Interface of a PEM Fuel Cell using Taguchi Method

S.S. Lingeswara Rao, A. Shaija and S. Jayaraj
Department of Mechanical Engineering, National Institute of Technology Calicut Kerala, India-673601
Salumuri_phd11@nitc.ac.in

A mathematical model was developed to investigate the membrane dehydration which appears at the anode side of the membrane by varying various operating parameters like fuel cell operating temperature, anode humidification temperature and anode stoichiometry. Taguchi optimization methodology is then combined with this model to determine the optimal combination of the operating parameters to maximize the current density without membrane dehydration. The sensitivity of each parameter is then analyzed by employing analysis of variance (ANOVA). The results show that higher fuel cell temperature and anode humidification temperature are favorable and also that these two operating parameters are the most significant parameters in the ratio of 86.47% and 11.47%, respectively to get the maximum current draw without membrane dehydration at the anode side. This analysis is more useful where fuel cell operates under high current density, particularly in automotive applications.

S 14.7 Parametric Study on Geographic Factors for Napier Grass Plantation in Thailand

M. Fakkao[1], C. Phianchurat[1], B. Hammachukitatikul[2], N. Limjeerajarus[1]
[1]Research Center of Advanced Energy Technology, Faculty of Engineering
Thai-Nichi Institute of Technology, Bangkok, Thailand
[2]Faculty of Engineering, Thai-Nichi Institute of Engineering, Bangkok, Thailand :
nuttapol@tni.ac.th

According to Thailand's Renewable and Alternative Energy Development Plan for 25 percent in 10 years (AEDP 2012-2021), Napier grass plays an important role as a renewable energy resource for future power generation of the country (up to 3,000 MW by 2021). To achieve this target, a large amount of Napier grass yield is required and so does the enormous area of the plantation. This research aims to study the influence of geographic factors on the dry matter yield of the Napier Grass plantation and to identify most influencing factors that should be taken into consideration for locating a suitable plantation site. The study was done based on the 55 sets of data collected at different 8 pilot plantation sites throughout Thailand using multiple regression analysis. At the 95 % confidence level, pH, soil drainage, and precipitation were found to be the most three important factors on the Napier grass yield, respectively.

S 14.8 Thermal Characteristics in Turbulent Channel Flows with V-Baffle Vortex Generators

Y. Kaewkohkiat[1], W. Jedsadaratanachai[1], P. Eiamsa-ard[2], P. Promvonge[1] and S. Eiamsa-ard[3]
[1]King Mongkut's Institute of Technology Ladkrabang
[2]Phetchaburi Rajabhat University, Petchaburi
[3]Mahanakorn University of Technology, Bangkok
smith@mut.ac.th

Experimental work has been performed to examine the effects of V-baffle vortex generators on the heat transfer and friction characteristics in a channel under a constant heat flux boundary condition. In the experiments, V-baffles at different pitch ratios (PR=P/e = 4.0, 6.0 and 8.0) were carried out. Measurements were carried out for a channel of one aspect ratio, AR = W/H = 4.0 and duct height, H = 40 mm with baffle height, e = 8 mm. Experiments were conducted for the Reynolds number range of 6000 to 22,000. The distributions of temperature and local Nusselt number on bottom channel wall were observed with thermochromic liquid crystal (TLC) sheet. Isothermal friction factors were also taken and presented. The obtained results demonstrate that heat transfer increases with the increase of Reynolds number, whereas friction factor (f) shows the opposite trend. Experimental results also show that the channels with V-baffle at the highest pitch ratio (PR = 8.0) provide highest heat transfer than others.

S 14.9 Study of a Concentrating Solar Collector Integrated in the Roof

J.L. Canaletti, C. Cristofari, G. Notton, J. Panighi
University of Corsica, G. Peri Scientific Research Center, UMR CNRS 6134 - Vignola, Sanguinaires road - F20000 Ajaccio, France
canaletti@univ-corse.fr

The work conducted in this study is to evaluate the efficiency of two different concentrating solar collector models integrated in the roof and to measure the influence of glass roof tiles on efficiency. The collectors presented here aim to improve the deficiency of conventional flat plate collectors during cold period that fail to deliver a

sufficient temperature to fill up the storage tank at a temperature above 60°C for at least 10 minutes per day to limit the growth of bacteria and prevent frequently start and stop of the auxiliary heater. From the M. Touchais collector model we have studied and measured the different efficiency between a longitudinal version and a compact version which have the same input solar radiation area. The result shows that the long model is better than the wide model because it is less sensible to the effect of the solar azimuth and the heat transfer is more efficient with a higher fluid velocity for the same flow rate. The use of glass roof tiles reduces the efficiency of the concentration because it diffuses the incident solar radiation. It also reduces the difference of efficiency between the large model and the long one. A Modelling of this system will help to determine the optimal length.

S 15: Electric Power Generation, Transmission and Distribution II
Time: 13:10 – 16:10
Room Assignment: Oriental Palm II

S 15.1 **Benefits Associated with Distributed Generation to Remove Transmission Overloads**

A.K. Singh and S.K. Parida
Indian Institute of Technology, Patna, India
aks.kings@gmail.com

This paper presents an optimal allocation method for distributed generations (DGs) for market-based power systems considering congestion relief and voltage stability. The sensitivities of the overloaded lines to bus injections are considered for ranking the load buses. The new generations for these load buses are then computed by genetic algorithm (GA) considering to maximize the system performance by reducing the system losses and increasing the voltage profile of the various buses. Their impacts on various market issues are also studied in this work.

S 15.2 **Optimal Placement of Vehicle-to-Grid Charging Station in Distribution System using Particle Swarm Optimization with Time Varying Acceleration Coefficient**

Jukkrapun Prasomthong[1], Weerakorn Ongsakul[1], Jan Meyer[2]
[1]Asian Institute of Technology, Thailand
[2] Institute of Electrical Power Systems and High Voltage Engineering, Technische Universität Dresden, Germany
Jukkrapun.Prasomthong@ait.asia

This paper proposes optimal placement of vehicle to grid (V2G) charging station in a distribution system by using Particle Swarm Optimization with time varying coefficient (PSO-TVAC). While Electric Vehicles (EVs) will be additional load to the distribution system, utilities can use V2G to maximize total benefit including peak power providing, reliability improvement, and power loss reduction within system operating constraints. Charging stations are simulated as loads when they are charging EVs and as distributed generation when they are discharging to the grid. The optimal placement of V2G charging stations and sizes are determined at peak period. Test results on the nine bus test system render a higher total benefit than GA, Basic PSO, and PSO-TVIW.

S 15.3 **Robust Optimization-Based AC Optimal Power Flow Considering Wind and Solar Power Uncertainty**

Titipong Samakpong, Weerakorn Ongsakul and Jirawadee Polprasert
Asian Institute of Technology, Thailand
Titipong.Samakpong@ait.asia

In this paper, robust optimization based AC optimal power flow (ROPF) considering wind and solar power uncertainty is proposed. ROPF is used to determine optimal power dispatch and locational marginal prices in a day-ahead market while limiting the risk of dispatch cost variation. ROPF is tested on PJM 5-bus system integrating wind and solar PV generation. Simulation results indicate that ROPF results in a lower expected dispatch cost at the same risk preference level than a stochastic nonlinear programming (SNP) approach. Accordingly, it is potentially useful for day-ahead market operator in policy and decision making.

S 15.4 **Potential of Smart Grid in Thailand: a Development of WADE Smart Grid Model**

Songkran Pisanupoj, Weerakorn Ongsakul, Jai Govind Singh
Asian Institute of Technology, Thailand
songkran.pisanupoj@ait.asia

A World Alliance Decentralized Energy (WADE) model is a widely used economic model considering decentralized energy impacts. As our existing power grid is developed into a smart grid, an improved smart grid model is developed. By adding load dynamics effects, the model can properly represent load behaviors. The Pattaya city of Thailand is chosen as a pilot smart grid project due to a high load density and wide variety of load profiles. Two scenarios have been developed to demonstrate the benefits of the smart grid. Using the newly developed smart grid model, peak load reduction and energy savings benefits are obtained. Test results indicate the quantifiable benefits of smart grid which is very beneficial for policy and decision makers.

S 15.5 **Chaotic based PSO with Time Varying Acceleration Coefficients for Security Constrained Optimal Power Flow Problem**

Jirawadee Polprasert and Weerakorn Ongsakul
Asian Institute of Technology, Thailand
st105596@ait.ac.th

This paper proposes a chaotic based particle swarm optimization with time-varying acceleration coefficients (CPSO-TVAC) for solving security constrained optimal power flow (OPF) problem. The proposed CPSO-TVAC is an improved PSO mixing chaotic sequences and crossover operation to enhance the search ability to the global optimum solution. The proposed CPSO-TVAC based optimal power flow is used to minimize the total generation fuel cost satisfying power balance flow equations, real and reactive power generation limits, generator bus voltage limits, tap setting transformer limits, and security voltage and transmission line loading constraints. Test results on the IEEE 30-bus and 118-bus systems indicate that the proposed CPSO-TVAC method renders a lower total generation cost in a faster convergence rate than other heuristic methods, which is favorable for online implementation.

S 15.6 **Synchronization Control and Droop Control of Microgrid Operation**

Pornchai Chaweewat[1], Jai Govind Singh[1], Weerakorn Ongsakul[1] and Anurag K. Srivastava[2]
[1]Asian Institute of Technology, Thailand
[2]School of Electrical and Computer Science, Washington State University, Pullman, Washington, USA
chaweewat.p@gmail.com

This paper proposes the synchronization control and droop control of microgrid (MG) operation in an islanding mode. The MG consists of a low voltage distribution system, diesel generator, solar PV plant and battery energy storage (BES). The solar PV plant and BES are connected to the MG through voltage source inverters and step up transformers. Synchronous controller is used in the solar PV plant and BES to minimize power imbalance between DG in MG. Droop controller is used to compensate reactive power from BES. The BES can be used for reliability improvement when fault occurs in the MG. Finally, the results are useful for efficient operation of the Mae Sariang MG system.

S 15.7 **Improving of Uncertain Power Generation of Rooftop Solar PV Using Battery Storage**

Anchuleeporn Chersin[1], Weerakorn Ongsakul[1], Joydeep Mitra[2]
[1]Asian Institute of Technology
[2]Michigan State University

As the distribution grid increasingly integrate rooftop solar PV, their power generation outputs are uncertain due to the solar radiation, panel temperature, passing cloud, and *v-i* characteristic operating level. Therefore, PV grid connected system would require a supplementary source to ensure more stable PV power generation, particularly during cloudy periods. In this paper, the battery storage energy management strategy (BS-EMS) is investigated to decrease the effect of sudden power generation variation of rooftop solar PV. The balance of power between rooftop PV and battery storage is studied by dynamic control of the BS converter to maintain stable output power at the point of common coupling (PCC). Simulation results for a 24 hour period indicate the performance of battery storage system capable of smoothing out grid connected solar PV generation under various conditions.

S 15.8 **Voltage Stability Assessment of DFIG Wind Turbine in Different Control Modes**

Chanokwan Veerasathian[1], Weerakorn Ongsakul[1], Joydeep Mitra[2]
[1]Asian Institute of Technology
[2]Michigan State University

Integrating wind power generation has direct impacts on a distribution network such as power quality, reliability, loss, and voltage profile problems. Thus, a high penetration level of wind power generation is a significant challenge to the traditional system operation on voltage stability. In this paper, a method to evaluate voltage stability of doubly-fed induction generator (DFIG) wind turbines for fixed voltage control and power factor control modes is proposed. The study considers on load tap changers (OLTC) and over excitation limiter (OEL) along with static and dynamic load. A small distribution network of Provincial Electricity Authority (PEA) of Thailand is used for real time

simulation. The impact of different control modes of DFIG is compared. Test results indicate that the operation of DFIG with the interaction between OLTC and OEL equipment has a considerable impact on voltage stability.

S 15.9 Investigation of Step, Touch and Surface Potentials of 11 kV/66 kV Substations

M.A. Salam, S.P. Ang, W. Voon, M. Rafiuddin and M. Aridoon
Institute Technology Brunei, Brunei Darussalam
masalam@ieee.org

This paper presents the measurement and the simulation of soil resistivity and ground resistance of three 11 kV/66 kV substations in Brunei Darussalam. Both the soil resistivity and the ground resistance are measured using a Fluke meter 1625. The soil resistivity is measured using the F. Wenner four-pole equal distance method, while the ground resistance is measured using the stakeless method. With the measured parameters, the step, the touch and the surface potentials of the three substations are assessed using the CYME GRD software.

S 16: Bioenergy and Biofuels II

Time: 13:10 – 16:10
Room Assignment: Oriental Palm III

S 16.1 Techno-Economic Evaluation of Biogas Production from Food Waste for Electricity Generation

Regina Kulugomba, Sahataya Thongsan and Sarayooth Vivuidth
School of Renewable Energy Technologies (SERT), Naresuan University
Phitsanulok, 65000, Thailand
reginakulugomba@yahoo.co.uk

This study analyzed the technical and economical viability of producing biogas from food waste at Naresuan University for electricity generation. Samples were collected to analyze physical and chemical composition in order to assess its suitability for biogas production. The effects of particle size on biogas quantity and quality were evaluated. Further, the amount of power that can be produced and economic evaluation were calculated. The results showed food waste had high carbon oxygen demand (COD), biological oxygen demand (BOD) and moisture content (MC) of 278,388 mg/kg, 103,889 mg/kg and 77.1% respectively which are suitable for biogas production. It further showed that smaller particle size of food waste produced more biogas than bigger sizes. Higher potential for biogas production of 11m^3/day from the 333 kg of food wastes that are produced daily were observed with the power of 15.66 kW. The high net present value (NPV), cost benefit ratio (BCR) and short payback period (PBP) values of 229,755.29 Baht, 1.05 and 4 years respectively showed viable economic analysis.

S 16.2 **Solid Concentration Influence on Biogas Yield from Food Waste in an Anaerobic Batch Digester**

B. Deepanraj, V. Sivasubramanian, S. Jayaraj
National Institute of Technology Calicut, Kerala-673601, India
babudeepan@gmail.com

Food waste contains a substantially large amount of organic matter, which can be digested anaerobically to produce biogas. In this present study, biogas yield of food waste was evaluated in a laboratory scale anaerobic batch reactor. The effect of solid concentrations (5, 7.5, 10, 12.5 and 15%) on the yield of biogas was investigated at mesophilic temperature condition for a hydraulic retention time of 30 days. The volumetric yield of biogas was noted at regular intervals (24hrs) using water displacement method. The food wastes used in this experiment were subjected to characterization studies before and after digestion. The experimental results show that substrate 7.5% of total solid concentration produce higher biogas yield compared to other solid concentrations.

S 16.3 **Production of Thermoelectric Power from the Infectious Waste of Hospitals of Lahore**

Mohammad Rafiq Khan and Zainab Ali
Center of Policy and Environment, Lahore School of Economics
19 Km Burki Road Lahore, Pakistan
drrafiq@lahoreschool.edu.pk

The current energy crises has hard pressed humanity to look for alternative energy resources, make use of available resources in a sustainable manner and minimize wastage. This problem can only be solved by interdisciplinary experts equipped with skills of both technology and economics. The work reported here was projected to study techno-economic disposal of infectious waste produced by the hospitals of Lahore being incinerated to liberate air pollutants and waste heat energy that can be harnessed to produce electricity. The primary data was collected by our research group from five model hospitals of Lahore and sites of incineration. The quantity of infectious waste was assessed as 793 metric ton/annum on the basis of which the potential of production of electricity was determined. Five cost of land inclusive and two exclusive alternative projects were framed on the basis of 2008 price and evaluated. All alternatives turned out as non-feasible except one that excluded land cost. Due to a rapid increase in electricity price triggered at end of 2008 and multiplied 2.5 times in 2012, two projects based on 2008 and 2012 price were designed and evaluated. Former qualified all criteria of acceptability and latter even promised unexpected profit to the entrepreneur.

S 16.4 **SWOT Analysis of Renewable Energy**

Bahadir Aydin
War College Academy, Istanbul, Turkey
badir82@hotmail.com

Being one of the most important elements of social evolution, energy has a vital role for a sustainable economy and development. Energy has great importance to level up the welfare. With this importance countries having rich resources can apply energy as a political tool. While needs of energy is increasing, sources to respond this need is very limited. So countries seek for alternative resources to meet their needs. Renewable energy sources have firstly taken into consideration. Being clean and belonging to

countries own sources, renewable energy resources have been widely applied during the last decades. But renewable energy can't meet all the expectation of energy needs. In this respect, energy efficiency can be seen as an alternative. Energy efficiency can minimize energy consumption without degrading standard of living, lessening quality of products and without increasing energy bills. In this article energy resources, SWOT analysis of renewable sources and energy efficiency topics are mainly discussed in order to describe future of energy.

S 16.5 **A Feasibility Study of Renewable Energy and Carbon Emission Reduction in Iskandar Malaysia**

S.T. Tan, W.S. Ho, H. Hashim and C.T. Lee
Universiti Teknologi Malaysia
81310 Johor Bahru, Malaysia
haslenda@cheme.utm.my

Malaysia is currently a net energy exporter with high energy dependency on fossil fuel. Concerns about energy security, the fluctuation of fuel price and climate change are driving significant of renewable energy (RE), a prominent resource for global electricity generation towards sustainable development. This paper presents a comprehensive feasibility analysis on potential RE in Iskandar Malaysia (IM), the third largest metropolis and the most developed region in the Southern Peninsula of Malaysia. Five major RE resource are considered in this study: biogas, solar, biomass, and municipal solid waste (MSW) and mini hydro. The potential RE generation in year 2025 from different source are analysed. Investigation on the potential of carbon reduction is calculated with consideration of fossil fuel displacement and GHG avoidances. Apart from environmental indicator, economic potential on RE included investment cost and carbon reduction cost are evaluated.

S 16.6 **Solar still Coupled with a Modified Biomass Cook Stove – an Experimental Study**

K. Sampathkumar
Tamilnadu College of Engineering, Coimbatore, Tamilnadu, India
ksktce@gmail.com

In this study, the experimental performance of a single slope solar still coupled with a modified biomass cook stove was investigated. Solar still shows potential for water desalination due to its simplicity and low cost; however the yield is low. Biomass fuels are used by nearly half the world's population on a daily basis for cooking. Modified biomass cook stoves is a promising option to reduce the negative impacts of cooking with traditional open fires and supply hot water to solar still for productive enhancement. The biomass cook stove was designed in such a way that to supply hot water to solar still without affecting the basic cooking operation. A single slope active solar still (ASS) integrated with an modified biomass cook stove was fabricated with an area of 1 m^2 and tested in the composite climate of Coimbatore, Tamilnadu, India, The higher water temperature was achieved by the active solar still compared to the passive solar still due to the additional thermal energy supplied by the modified biomass cook stove. The daily yields obtained from the solar stills were 3.2 kg/m^2day and 8.2 kg/m^2day for PSS and ASS, respectively, at a water depth of 0.05 m. Finally, the economic analysis shows a lowest payback period of less than a year, when the active system is used.

S 16.7 **Pre-Treatment of Sewage Sludge to Enhance Biogas Production to Generate Green Energy for Reduction of Carbon Footprint in Sewage Treatment Plant (STP)**

Hephzibah David, Kumaran Palanisamy, Saifuddin Normanbhay
Center of Renewable Energy, University Tenaga Nasional, Malaysia
hephzibah@uniten.edu.my

This work elucidates the effects of pre-treatment of sewage sludge for enhancement of biogas production to generate green energy and reduction of carbon footprint in STPs. Microwave pre-treatment has been adopted for this study. Experiment works have been designed and conducted to examine the effectiveness on the disintegration of sewage sludge and biogas production of continuous and intermittent batch microwave pre-treatment at 80 W for 5 minutes and 15 minutes. The quantity of biogas produced with and without pre-treatment has been evaluated and compared whereby the continuous microwave pre-treated for 5 minutes and 15 minutes enhances the anaerobic digestibility rate and biogas production by 38.5% and 11.9% respectively compared to intermittently pre-treated sewage sludge sample which only increases by 15.4% and 4.8%. The additional quantity of biogas has shown to be able to increase potential green energy to 45% from current 7% which can offset the energy usage generated by fossil fuels and reduces the CO_2 emission to generate energy from fossil fuels. The replacement of green energy has potential to reduce annual CO_2 emission by 4,329.6 ton for a modern mechanized STP for 250,000 population equivalent in urban setting.

S 16.8 **Catalytic Gasification of Empty Palm Fruit Bunch (EPFB) over Mixed Metal Oxide Catalysts for Hydrogen Production**

Yun Hin Taufiq-Yap
University Putra Malaysia
taufiq@upm.edu.my

Declining fossil fuel reserves and current energy scarcity spurred the idea of utilizing biomass which is renewable energy source into fuel production. Gasification is one of the most promising techniques for biomass conversion to produce hydrogen. Malaysia is one of the largest producers of palm oil. Currently, oil palm plantations in Malaysia generates 73.74 million tones of biomass waste per year are sustaining biomass feedstock for energy production [1,2]. In this study, we mainly focus on developing new mixed metal oxides catalysts from combination of CaO, Ni and promoters such as La2O3, K2O, CoO and Fe2O3. The catalysts were synthesized using wet impregnation method and characterized by XRD, BET and TGA. Biomass and catalyst were premixed with a ratio of 2:1 and gasification was carried out in a flow of oxygen (5 % in helium) from ambient temperature to 900 ºC and maintained for 1 h. From the result, maximum hydrogen gas was produced mainly from water gas shift ($CO + H2O \rightarrow CO2 + H2$) and methane reforming ($CH4 + H2O \rightarrow CO + 3H2$) reactions. An interesting phenomenon notified, where hydrogen production is inversely proportional to CO2 production. This is due to the exothermic reaction of CO2 captured by CaO ($CaO + CO2 \rightarrow CaCO3$) that shift equilibrium towards H2 production. Furthermore, addition of Ni into CaO catalyst elevates H2 content in the product. Moreover, the incorporation of metal oxide promoters believed to play a vital role in prolonging the water shift gas reaction and CO2 absorption.

FIELD VISIT SITES

A. PTT Gas Separation Plant

Map Ta Phut, Amphur Muang, Rayong Province

The construction of gas separation plants in Thailand followed the utilization of natural gas as fuel in replacement of imported crude oil. PTT, a state-owned gas company responsible for national energy, constructed the pipeline from the production fields in the Gulf of Thailand to come ashore at Mab Ta Phut, Amphur Muang, Rayong Province. The pipeline was laid further to Bangpakong and South Bangkok Power Plants of Electricity Generating Authority of Thailand to bring gas to be used as fuel for power generation.

The gas from the Gulf of Thailand consists of various valuable hydrocarbon components which can be extracted into many products instead of using as fuel only. The gases can be separated before sent to the power plants which play key roles in industry development in the Eastern Seaboard and along the pipeline route especially the petrochemical industry as well as other related industries.

PTT requested for endorsement from the Cabinet to construct two units of gas separation plants at Mab Ta Phut, Amphur Muang, Rayong Province. Initially, PTT constructed the first unit which required a budget of 7,360 million baht. The first gas separation plant has a processing capacity of 350 million cubic feet per day (MMscfd). The construction began in 1982 and completed in 1984. Coming on stream in 1985, the plant was graciously presided over by His Majesty the King in the opening ceremony on April 18, 1985.

PTT is the largest gas separation operator in Thailand. It runs six gas separation plants to separate various hydrocarbons from the natural gas which in turn maximizes value of the gas from the Gulf of Thailand. The Gas Separation Plant Units 1-3, 5 and 6 are located in Tambon (Sub-district) Mab Ta Phut, Amphur (District) Mueng, Rayong Province and the fourth Unit in Amphur Khanom, Nakhon Sri Thammarat Province.

Presently, PTT's gas separation plants have a nameplate capacity of 2,660 million cubic feet per day (MMSCFD). The first Unit's capacity is 350 MMSCFD; the Second and the Third Units (including increment from the ethane separation plant) have a capacity of 750 MMSCFD. As for the Fourth Unit, its capacity is 230 MMSCFD, while the Fifth and the Sixth Units have a capacity of 530 and 800 MMSCFD, respectively. The last plant, the Sixth Unit has a capacity to process 800 MMSCFD. Due to continuous effort to improve efficiency of the gas separation plants, a combined processing capacity of every unit in 2012 is 2,740 MMSCFD.

B. BLCP Power Station

Map Ta Phut, Amphur Muang, Rayong Province

BLCP Power Station completed its construction activities in 2007. The site is located in the Map Ta Phut Industrial Estate Phase 2 under the 30-year-long term lease contract signed by June 30, 2000 with the Industrial Estate Authority of Thailand (IEAT). In line with other heavy industrial plants in the nearby location, the plant is also required to comply with all terms and conditions as stipulated by the lease contract, and to meet all environmental compliance as stipulated in various permits or licenses, granted by the authority. The plant is now well equipped with all modern-design equipments under proven technology. Priority is given to ensure that the plant must fully comply with all environmental requirements, as well to get acceptance from all surrounding communities. Its fuel source is a top-grade bituminous coal to be imported from Australia. The total generating capacity is 1,434 Megawatts. The business vision is to become a role model of coal-fired power plants in Thailand.

The power station is a privately-own company. The company has been incorporated in accordance with the national policy for greater access and participation of private sector in the electricity generation business under the scheme of the Independent Power Producer; or commonly known as IPP Program. The national policy was supported and adopted by the country's cabinet resolution made in 1994 in order to reduce the country's financial burden, to lessen government dominance, and to promote greater competition among electricity generators.

BLCP Power Station is scheduled to commence its Commercial Operation dates (CODs) for the first unit of 717 MW on October 1, 2006, and the second unit of the same capacity on February 1, 2007.

- It is apparent that the Station could live up its commitment, thanks to the progress of construction and commissioning activities. The COD timetable is also nicely fitted into the country's Power Development Plan (PDP) to ensure the system stability and to keep the reserve margin within the country's target policy level.
- Being a coal-fired power plant, the Station would be a low cost producer as measured by its cost per unit vis-á-vis other types of power stations throughout the country. Based upon historical price movements of coal and other fuels in the global energy market, it is expected that the Station's low fuel cost should lower blended cost, and provide greater stability into the country's overall cost structure of total electricity generation.

In addition, the Station may help to reduce the magnitude of domestic electricity retail price hike amid the current upbeat of global energy market. Lastly, the Station may help to support the country's fuel diversification policy in the future.

C. PEA Control Center, Central Area 2
Muang District, Chonburi Province

The Provincal Electricity Authority Area 2 (central) Chonburi Province is located at 47/1 Moo 3 Samed Sub-district, Muang District, Chonburi Province 20000. It provides power supply and services to the five provinces of Chonburi, Chachoengsao, Rayong, Chantaburi and Trat.

About the Provincial Electricity Authority (PEA)

The Provincial Electricity Authority is a government enterprise under the Ministry of Interior, established under 1960 Act by the Royal Decree executed on 20th September 1960. Then published in the Government Gazette on 27th September 1960. The authority's responsibility is primarily concerned with the generation, distribution, sales and provision of electric energy services to the business and industrial sectors as well as to the general public in provincial areas, with the exception of Bangkok, Nonthaburi and Samut Prakran provinces. The PEA has expanded electricity supply to all areas covered 73 provinces, approximately 510,000 km2, accounting for 99% of the country's total area. In order to upgrade the quality of life of people and support other developments in rural area, PEA has developed and applied modern technology to electricity supply and distribution dispatching system for improving efficient, reliability and quality of service.

In accordance with the Government's plan and policy on the privatization, the PEA has drawn up an action plan for restructuring the organization and then has applied the Quality Standard Management System to its total work areas which has been certified by ISO 9002 in 2001. All of these solutions create the satisfaction and confidence to the customers in using the PEA's electricity and service.

PEA's three major objectives are:

To continue to improve its provision and distribution services of electric energy for customers: to achieve the highest possible level of sufficiency, efficiency and reliability in power distribution commensurate with safety practices; to meet the timely need of customers; and to keep pace with changing circumstances.

1. To optimize its business and operations in order to be more profitable and thereby achieve sufficient revenues to facilitate further development.
2. To develop its organizational structure, man power and resources management in order to achieve the highest level of efficiency and effectiveness.
3. To develop its organizational structure, man power and resources management in order to achieve the highest level of efficiency and effectiveness.

D. Saha Cogeneration Power Plant
Sri Racha, Chonburi Province

Nature of Business

Sahacogen (Chonburi) Public Company Limited is a Small Power Producer (SPP) producing and distributing electricity and steam. The first power plant is a natural gas-fired cogeneration combined cycle type, located in Sriracha Saha Group Industrial Park, Nongkharm, Sriracha, Chonburi province, is capable of producing electricity since 1999. The Company supplies of 90 megawatts of electricity to the Electricity Generating Authority of Thailand (EGAT), and supplies electricity and steam to Saha Pattana Inter-Holding PCL, the sole distributor of electricity and steam to factories in Sriracha Saha Group Industrial Park. The steam distributed by Sahacogen Power Plant is produced by a highly efficient process, and suitable for substituting for the steam generated by boilers that use fuel oil, not only saving cost for the factories but also reducing green house gas that causes global warming. As a result, there has been the continuity of business expansion in the industrial park. The Company, therefore, has increased the capacity of generating electricity at the natural gas-fired cogeneration plant by 40% to be capable of producing 174 megawatts of electricity and 81 tons of steam per hour currently.

With regards to business development, the company has placed significant interest in participations of communities and social to receive mutual benefits. The Company has focused on renewable energy development project to replace fossil energy source which is increasingly expensive and likely a major part of expediting the global warming. Therefore subsidiary companies were established complying with the Company's policy namely Sahacogen Green Co., Ltd. and Sahagreen Forest Co.,Ltd.

Mission

1. To produce and distribute high quality and reliable energy to meet the requirements and satisfactions of customers
2. To enhance capability and potentiality by continually development
3. To earnestly respond to social, partners, and employees by management in compliance with the good governance
4. To efficiently and effectively operate with the awareness of safety, occupational health and environment

E. Thai Future Energy Co. Ltd.
Ban Bueng, Chonburi Province

The company produces energy from solar power. Its published capacity reached up to 30.2 MW and operates on a 2.6 billion baht capital investment.

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The International Conference and Utility Exhibition (ICUE 2014) on: Green Energy for Sustainable Development is a venue to exchange research ideas, experiences, technical, social, financial, economic and policy issues covering greening energy utilization. It is a platform for energy professionals, policy makers, engineers, researchers, members of the academe and energy business sector, to share research findings, technological innovations and transformative emerging technologies to tackle burning issues in energy utilization with an aim to help achieve low-carbon societies for a more sustainable development.

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Regional Energy Resources Information Center (RERIC)
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P.O. Box 4, Klong Luang
Pathumthani 12120 Thailand
E-mail: icue@ait.ac.th
Tel: (66 2) 524 6216,
(66 2) 524 5413 (Direct)
Fax: (66 2) 524 5439 (Direct)

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