



**PEA - AIT International Conference on**

# **ENERGY AND SUSTAINABLE DEVELOPMENT: ISSUES AND STRATEGIES (ESD 2010)**

**2-4 June 2010**

**The Empress Hotel and Convention Center, Chiang Mai, Thailand**



**การไฟฟ้าส่วนภูมิภาค**  
PROVINCIAL ELECTRICITY AUTHORITY

**ASIAN INSTITUTE OF TECHNOLOGY**  
(Empowering Asia through post-graduate education)



**PROVINCIAL ELECTRICITY AUTHORITY**  
(Thailand's biggest power distributor)



**PROGRAMS  
AND  
ABSTRACTS**



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## **RATIONALE OF THE CONFERENCE**

Sustainable development is based on three interlinked criteria: environmental protection, social progress and economic development. It is the state of development that seeks to produce sustainable economic growth while ensuring future generations' ability to do the same by not exceeding the regenerative capacity of nature. In other words, it is development with a social awareness that aims economic development without sacrificing the environment. To achieve sustainability there is a need for holistic responses to global issues such as urbanization and energy overconsumption.

We all know that energy fuels development. Without it progress cannot be achieved, basic human requirements will not be met, infrastructures will not be there, and trading markets will falter. As the global population grows and energy demand increases, we all need to use energy more efficiently in less expensive ways. We also need to look out for more ways to reduce our dependence on fossil fuels and improve our capability to harness cleaner technologies, alternative, and renewable forms of energy. A report recently released by policy network REN21 gives many reasons to be optimistic. It reported that in 2008, production of renewable energy increased by 16% (from 240 GW in 2007 to 280 GW in 2008) and the share of solar grew to 15% (145 GW of thermal energy), while biodiesel and ethanol grew even faster at 34 %. These growths can be attributed to a positive global trend that sees more governments adopting policies and targets for renewables as we now have around 73 countries having binding targets for renewables. But certainly, more needs to be done. The targets of the Kyoto Protocol (viewed as the mechanism to encourage countries to use energy and develop in more sustainable ways) are still far from being achieved. Realistically it is still a very long road filled with many challenges, but we should deal with it optimistically as we are in an ocean full of ideas just waiting to be discovered and with opportunities ready to be reaped.

After the success of three previous international conferences on ELECTRIC SUPPLY INDUSTRY IN TRANSITION: Issues and Prospects for Asia in January 2004, ENERGY FOR SUSTAINABLE DEVELOPMENT: Issues and Prospects for Asia in March 2006, and ENERGY SECURITY AND CLIMATE CHANGE: Issues, Strategies and Options in August 2008, this conference (ESD 2010) offers a broader but timely theme to allow more people to interact and share research findings. This conference will create an interesting international forum for researchers and practitioners to exchange new ideas and practical experiences in the area of energy in the context of sustainable development. ESD 2010 aims to strengthen relations between the energy and power sector, research laboratories, universities, funding agencies, developmental organizations and government institutions.

ESD 2010 is collaboration between the Asian Institute of Technology (AIT) and the Provincial Electricity Authority (PEA) Thailand, the country's leading power distributor. On year 2010, AIT will be on its 51<sup>st</sup> year of empowering Asia through education and research, while PEA will also be celebrating its 50<sup>th</sup> year of providing reliable electricity, power and energy services to the general public, business and industrial sectors of Thailand.

## ORGANIZERS

Regional Energy Resources and Information Center (RERIC)

Energy Field of Study, Asian Institute of Technology (AIT)

Provincial Electricity Authority, Thailand (PEA)

## ORGANIZING COMMITTEE

### *Chairpersons:*

**Professor Said Irandoust**

President

Asian Institute of Technology, Thailand

**Mr. Adisorn Kiatchokewiwat**

Governor

Provincial Electricity Authority, Thailand

### *Members:*

**Prof. Worsak Kanok-Nukulchai**

Vice President

Resource Development, AIT

**Mr. Pongsakorn Tontivanichanon**

Deputy Governor

Planning and System Development, PEA

**Dr. Weerakorn Ongsakul**

Conference Director and Dean

SERD, AIT

**Mr. Weerachai Koykul**

Deputy Governor

Network Operation, PEA

**Prof. S. Kumar**

Conference Coordinator

Energy FoS, SERD, AIT

**Mr. Samruej Sumanaphan**

Deputy Governor

Regulated Retail Business Region 1, PEA

**Dr. P. Abdul Salam**

Technical Program Co-Organizer

Energy FoS, SERD, AIT

**Mr. Suttidej Suttisom**

Deputy Governor

Human Resource Development, PEA

**Dr. Charles O.P. Marpaung**

Technical Program Co-Organizer

Energy FoS, SERD, AIT

**Dr. Jai Govind Singh**

Technical Program Co-Organizer

Energy FoS, SERD, AIT

### *Secretariat:*

**Maria Kathrina B. Gratuito**

Co-Coordinator, AIT

**Mrs. Jurailuk Chotiwana**

Co-Coordinator, PEA

**Parichart Khammeerak**

Member, AIT

**Mrs. Witchuda Suphabvanich**

Member, PEA

**Mrs. Darawan Promkasikon**

Member, PEA

**Ms. Pawika Pum-In**

Member, PEA

## **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.

### **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)

### **Key Facts and Figures**

- 2300+ Students from 47 + Countries/Territories
- 16000+ Alumni from 80 Countries/Territories
- 24000+ Short-term Trainees from 70+ Countries/Territories
- 130 World Class Faculty from 20+ Countries
- 499 Research and Support Staff from about 30 Countries
- About 400 Sponsored Research Projects
- 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

## THE PROVINCIAL ELECTRICITY AUTHORITY (PEA)



The Provincial Electricity Authority (PEA) is a government enterprise under the Ministry of Interior. It was established 50 years ago by a Royal Decree executed on September 20, 1960 and then published in the Government Gazette on September 27, 1960.

### **Objective**

The PEA's three major objectives are:

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

### **Service Area**

The service area of the PEA is approximately 510,000 km<sup>2</sup>, accounting 99 percent of the country. PEA has primary responsibilities in the provision and distribution of electricity and related services to the public, business and industrial sectors in 73 provinces (except Bangkok, Nonthaburi and Samut Prakarn provinces) and the neighboring countries. The PEA has grouped its service area into four (4) regions: North region, Northeast region, Central region, and South region.

There are over 900 PEA sub-offices scattered throughout the country, rendering services to more than 14 million customers through its nationwide electrical system network with state of the art and sophisticated equipment. PEA's service personnel comprise experienced and highly-skilled staff with expertise in both high-power network operation and organizational management.

Now on its 50<sup>th</sup> year, PEA continues to make every effort for excellence to be at par with leading institutions of international standard in doing business in energy services and related services.

## 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 include publishing, networking, consulting, and other information services for energy conservation and renewable energy promotion.

The current RERIC staff are as follows:

Director:	Professor S. Kumar
Research/Information Professional:	Maria Kathrina B. Grauto
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.ser.d.ait.ac.th/eric](http://www.ser.d.ait.ac.th/eric). Annual membership fees to RERIC entitles the members to hard copies of the International Energy Journal (IEJ) as well as access to the online journal system at [www.ericjournal.ait.ac.th](http://www.ericjournal.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*).

## **INTERNATIONAL ADVISORY COMMITTEE**

Dr. David Wood	Faculty of Engineering and Built Environment The University of Newcastle	Australia
Professor Tapan Kumar Saha	School of Information Technology and Electrical Engineering University of Queensland	Australia
Dr. Deepak Sharma	Energy Planning and Policy Program Graduate School of Engineering University of Technology Sydney	Australia
Professor Harry Clarke	Faculty of Law and Management La Trobe University	Australia
Mr. Binu Parthan	Renewable Energy and Efficiency Partnership	Austria
Professor Hans-Jürgen Haubrich	RWTH- Aachen University	Germany
Dr. D.P. Kothari	Vellore Institute of Technology University	India
Professor S.C. Bhattacharya	International Energy Initiative	India
Dr. Leena Srivastava	The Energy and Resources Institute (TERI)	India
Dr. Shobhakar Dhakal	Global Carbon Project	Japan
Professor Shinsuke Kato	Institute of Industrial Science The University of Tokyo	Japan
Professor Keisuke Hanaki	Department of Urban Engineering The University of Tokyo	Japan
Professor Kenji Yamaji	School of Engineering The University of Tokyo	Japan
Professor Wil L. Kling	Technical University of Eindhoven	Netherlands
Professor Thomas B. Johansson	International Institute for Industrial Environmental Economics (IIIEE), University of Lund	Sweden
Professor Ferdinand Banks	Department of Economics Uppsala University	Sweden
Professor R.H.B. Exell	The Joint Graduate School of Energy and Environment (JGSEE) King Mongkots Institute of Technology Thonburi	Thailand
Dr. Govinda R. Timilsina	Development Research Group The World Bank	USA

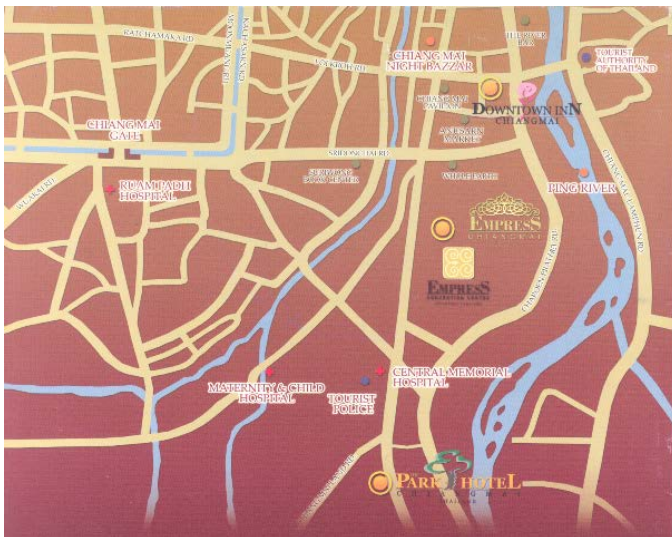


## VENUE

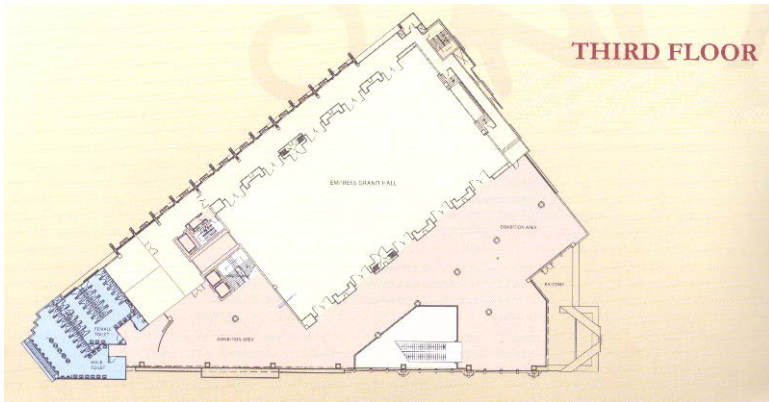
Chiang Mai locals are proud of the city's 700-year history. Chiang Mai is one of the few places in Thailand where it is possible to find in the heart of the city centuries-old chedis and temples next to modern convenience stores and boutique hotels. The old city of Chiang Mai with its fascinating indigenous cultural identity such as diverse dialects, cuisine, architecture, traditional values, festivals, handicrafts and classical dances is a prime location in its own right. In addition, the presence of hill tribes and their wealth of unique cultures enhance Chiang Mai's distinctive diversity.

Chiang Mai is also blessed with pristine natural resources of mountains (dois), waterfalls, and other nature-based tourist attractions. Moreover, visitors from all walks of life can collect handicrafts of silk, silver and wood produced locally as timeless souvenirs.

ESD 2010 will be held at The Empress Hotel and Convention Center, which is located right at the heart of Chiang Mai City, Thailand. The hotel is conveniently located and just a 12-minute drive to the Chiang Mai International Airport and the railway station. It is also just a few minutes walk to the city's famous Night Bazaar.



## ROOM ASSIGNMENTS



**Empress Grand Hall**

Venue for:

- = Opening Ceremony, Keynote Adresses, Closing Ceromony
- = Session 1: Assessment of Energy Use Implication
- = Session 4: Renewable Energy for Sustainable Development
- = Session 7: Power System Planning, Design and Operation
- = Session 10: Smart Grids and Active Distribution Networks



**Chiang Mai 2 and 3 = Chiang Mai A**

Venue for:

- = Session 2: Small Scale Hydro and Solar Systems
- = Session 5: Biofuel Development and Applications
- = Session 8: Potential and Application of Biomass and Biogas
- = Session 11: Energy Use in Rural and Urban Settings
- = Session 13: Energy Efficiency and Heat Transfer 1

**Chiang Mai 4 and 5 = Chiang Mai B**

Venue for:

- = Session 3: Ocean Energy for Sustainable Development
- = Session 6: Wind Power Development
- = Session 9: Emerging and Advance Energy Technology
- = Session 12: End Use Energy Efficiency
- = Session 14: Energy Efficiency and Heat Transfer 2

## **PROGRAM AT A GLANCE**



## KEYNOTE ADDRESS 1



**Dr. Subin Pinkayan** \*

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\* Dr. Subin Pinkayan was born and grew up in Chiang Mai, Thailand. He received a Bachelor's Degree in Engineering with honor from Chulalongkorn University, Master of Engineering from Asian Institute of Technology (AIT), and Ph.D. in Civil Engineering from Colorado State University, Fort Collins, Colorado, USA.

Early in his career, Dr. Subin worked as an engineering consultant with the then Bangkok-based Mekong Committee, the precursor to the current Mekong River Commission. The Mekong Committee brought together the four states in the Mekong Region that were allied to the US, namely Thailand, Laos, South Vietnam and, after 1970, Cambodia. During this period, the Mekong Committee, with the support of the US Bureau of Reclamation and the United Nations Development Programme (UNDP), developed plans for seven dams on the Mekong River mainstream with a combined capacity of 23,300 MW and reservoirs capable of storing more than one third of the river's annual flow. After leaving the Mekong Committee, Dr. Subin was involved in the establishment and is currently serving as the chairman of SEATEC (Southeast Asia Technology Co., Ltd.) in Thailand (now the SEATEC Group of Companies), an environmental and engineering consulting company that has since completed more than 1,000 projects in nine countries throughout the region.

Dr. Subin played prominent roles as Project Director and advisor for several successful irrigation and water resource projects implemented in collaboration with both local and international organizations such as the Royal Irrigation Department (RID), the National Economic and Social Development Board (NESDB), the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), United States Agency for International Development (USAID), etc.

Apart from his active role as professional engineer, he has also held high ranking positions in the government serving as Thailand's Minister of Foreign Affairs, Minister of Commerce, Minister of University Affairs, Deputy Minister of Finance and as member of Parliament of Thailand. As an eminent engineer, he served as Director of International Water Resources Association, Vice President of Thai Consulting Engineers Association of Thailand, Executive Director of Engineering Institute of Thailand, member of the Board of the Council of Engineers of Thailand. Dr. Subin has served in different capacities in leading universities in Thailand. AIT has also benefited from his wealth of experience and wisdom as former member of the AIT Board of Trustees and faculty member.

Dr. Subin is currently active in public affairs and company business – both at home and abroad. He was a recipient of the 1991 Personal Service Award in "National and International Prestige" honored by Colorado State University and also a recipient of the 2003 Outstanding Alumni Award in "Social Achievement Award" honored by Asian Institute of Technology Alumni Association of Thailand.



## KEYNOTE ADDRESS 2



**Professor Hironori Hamanaka<sup>†</sup>**

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<sup>†</sup>Professor Hironori Hamanaka took up the position of chair of IGES Board of Directors in April 2007. He is a Professor at Keio University. Before joining Keio University, he was the Vice-Minister for Global Environmental Affairs at the Ministry of the Environment. He served with the Government of Japan for more than 35 years, mostly in the field of environmental policies, before he left in 2004. Over the last 9 years, he has devoted his administrative career to intergovernmental negotiations in areas including: the Kyoto Protocol and its implementing rules; major agreements in the field of sustainable development, such as the Johannesburg Plan of Implementation agreed at the World Summit on Sustainable Development in 2002; and the development of national policies to implement international agreements, most notably the Kyoto Protocol. Based on his professional career, he was elected and serves as a Co-chair of the Compliance Committee under the Kyoto Protocol and the Chair of its Facilitative Branch.

## KEYNOTE ADDRESS 3



**Professor Saifur Rahman<sup>‡</sup>**

### **The Smart Grid Needs a Smart Utility**

Saifur Rahman, PhD  
Joseph R. Loring Professor & Director  
Virginia Tech Advanced Res. Inst.  
Arlington, VA 22203, USA

#### **Abstract:**

The concept of the smart grid originated from the desire to make the grid - starting from the power station to the end-use appliance - smarter, safer, reliable and more cost-effective using advanced sensors, communication technologies and distributed computing. A smart grid will look more like the Internet, where information about the state of the grid and its components can be exchanged quickly over long distances and diverse networks. It will also allow integration of new sustainable energy sources, such as wind, solar, off-shore electricity, etc. At present there are efforts by many vendors globally to develop technologies which will become building blocks of this grid. At the same time standards are being developed that can make technologies from different vendors interoperable so that many players will be able to participate giving customers a broad choice. But, since much of the data related to the smart grid will reside on the Internet and it will carry personalized information, there are significant concerns about data integrity and privacy. Also, there must be policies and regulations in place that will encourage participation by creating a differential pricing structure for the electricity consumed which will discourage peak load growth. The electric utility will have to be the party that will implement all of these diverse requirements and satisfy the interests of various players – from customers to regulators to equipment providers. And they have to evolve and change their ways of operation to become an intelligent provider of these services. This lecture introduces various aspects of the smart grid - technology, standards, regulations and data security – and highlights the functionalities of the smart electric utility that makes the smart grid possible.

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<sup>‡</sup>Dr. Saifur Rahman is the director of the Advanced Research Institute at Virginia Tech where he is the Joseph Loring Professor of electrical and computer engineering. He also directs the Center for Energy and the Global Environment at the University. He is a Fellow of the IEEE and the editor-in-chief of the IEEE Transactions on Sustainable Energy. In 2010 he is serving as the vice president for New Initiatives and Outreach for the IEEE Power & Energy Society and a member of its governing board. In 2006 he served as the vice president of the IEEE Publications Board, and a member of the IEEE Board of Directors. He is a distinguished lecturer of IEEE.

## KEYNOTE ADDRESS 4



**Dr. Ludovic Lacrosse<sup>§</sup>**

### **Rural Energy for Sustainable Development in the Mekong Region: A particular case of Vietnam**

Ludovic Lacrosse  
EEP Mekong Chief Technical Advisor

#### **Abstract:**

Over the last few years, more and more multinational and bilateral co-operation agencies have been supporting initiatives that aim at promulgating the use of renewable energy in rural areas. The recently launched EEP Mekong programme aims at facilitating access to energy and energy services in the Mekong Region and at reducing greenhouse gas emissions. It covers Cambodia, Laos, Thailand and Vietnam. Recently, EEP Mekong received 163 project proposals for funding. Many projects were RE projects to be implemented in rural areas of the Mekong region. An overview of the programme and of these projects is provided, highlighting the current trends in the region.

A lot of lessons can be learned from the Vietnam - Sweden Rural Energy (VSRE) Programme that has been in operation since 2004 and is expected to be completed mid 2010. Funded by Sida (Sweden), its overall objective is that the rural population of Vietnam has increased access to options for rural energy services that are reliable, affordable, appropriate and sustainable. It is implemented by the Ministry of Industry and Trade in two provinces: Ha Giang (Northern Vietnam) and Quang Nam (Central Vietnam). The key activities and the success factors of the programme are presented, especially those which lead to the implementation of sustainable off-grid renewable energy projects. They include building capacity in policy planning and project development, establishing appropriate institutional models for community services provision and awareness creation on productive use of energy in rural areas of Vietnam.

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<sup>§</sup>Dr Ludovic LACROSSE, (D. Eng, M. Eng (Chem), EMBA) has 27 years of experience in the renewable energy sector (8 years in Europe and 19 years in South-East Asia). He moved to South East Asia in 1991 to become Technical Advisor during the first two phases of the EC-ASEAN COGEN Programme (COGEN 1 & 2), aiming at promoting the use of clean and efficient European biomass energy technologies in ASEAN wood and agro-industries. He then became Programme Co-ordinator of the third phase (COGEN 3). He has a strong experience in Euro-ASEAN economic co-operation. He acted as policy advisor to ASEAN energy policy makers and as business facilitator between European cogeneration equipment suppliers, their local partners and clients in ASEAN. He has been the International Team Leader of the Vietnam-Sweden Rural Energy Programme from 2005 to 2009. He is currently the Chief Technical Advisor of the Energy and Environment Partnership Programme with the Mekong Region financed by the ministry of Foreign Affairs of Finland and the Nordic Development Fund. He is a Director at Full Advantage Co. Ltd and is a member of the UNFCCC Methodology Panel.

## KEYNOTE ADDRESS 5



**Mr. Kasabol Bowonsrikan** \*\*

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\*\*Mr. Kasabol Bowonsrikan is the Services and Energy Management Director joining Schneider Electric Thailand since early 2008, with responsibility for the service operations, the implementation and alignment of department strategy and business orientation.

Mr. Kasabol has more than 20 years of vast and diverse experience in the Sales & Marketing Management, where he held sales and senior management positions from different distinguished companies including the leading role in Energy Efficiency Management field, the core business of Schneider Electric.

He graduated Bachelor Degree from Kasetsart University and followed by MBA from Thammasat University. He enjoys playing golf, swimming and tennis. He is married and having one son.

## PRESENTATION SCHEDULES

### Day 1: 02 June 2010

<b>S 01: Assessment of Energy Use Implications</b>		
Time: 10:00 – 12:00		
Room Assignment: Empress Grand Hall		
Ref. No.	Title, Authors, Affiliation	Country of Origin
<b>S 01.1</b>	<b>Comparative Analysis of Upstream Petroleum Fiscal Systems of Pakistan, Thailand and Other Countries with Medium Ranked Oil Reserves</b> Sara Zahidi <i>COMSATS Institute of Information Technology</i>	Pakistan
<b>S 01.2</b>	<b>Assessing the Fuel Consumption and GHG of Future In-Use Vehicles</b> John B. Heywood <i>Massachusetts Institute of Technology</i>	USA
<b>S 01.3</b>	<b>Life Cycle Cost of Lighting System in Various Groups of End user in Thailand</b> W. Sriamontikul, Nipon Tongasuk, Rawin Jareansuk, B. Hongpeechar, Suttichat Saengsuwan, P. Bhasaputra and W. Pattaraprakorn <i>Thammasat University</i>	Thailand
<b>S 01.4</b>	<b>Estimating the Health Damage Costs of Electricity Generation in Thailand</b> Songsak Sakulniyomporn, Kuskana Kubaha, and Chullapong Chullabodhi <i>King Mongkut's University of Technology Thonburi</i>	Thailand
<b>S 01.5</b>	<b>Climate Policy in China: Balancing Ambition and Ambiguity</b> Eric Zusman <i>Institute for Global Environmental Strategies (IGES)</i>	Japan
<b>S 01.6</b>	<b>Green Energy Financing for Indonesia</b> Koji Fukuda <i>Institute for Global Environmental Strategies (IGES)</i>	Japan

<b>S 02: Small-Scale Hydro and Solar Systems</b>		
Time: 10:00 – 12:00		
Room Assignment: Chiang Mai A		
Ref. No.	Title, Authors, Affiliation	Country of Origin
<b>S 02.1</b>	<b>Reconnaissance Studies of Micro Hydro Potential in Malaysia</b> Ibrahim Hussein and Nathan Raman <i>Universiti Tenaga Nasional</i>	Malaysia
<b>S 02.2</b>	<b>Islanding Operation of Mini-Hydro Generation in Real Distribution Network</b> Thawatchai Tantimaporn, Panida Srikacha, Kesinee Loahacharoensombat, and Phongphat Waraphok <i>Provincial Electricity Authority</i>	Thailand
<b>S 02.3</b>	<b>Building on Local Knowledge, Distribution and Support Networks: Examples of Intervention on Pico-Hydropower in the Lao PDR</b> Mattijs Smits	Australia



<b>S 02.4</b>	<i>University of Sydney</i> <b>Preventive Maintenance Optimization for Excitation System of Bhumbol Hydro Power Plant</b> S. Pansrisu <sup>*</sup> and Suttichai Premrudeepreechacharn <i>Electricity Generation Authority of Thailand (EGAT)</i> <sup>*</sup> <i>Chiang Mai University</i>	Thailand
<b>S 02.5</b>	<b>Statistical Models for Estimating Hourly Diffuse Solar Radiation in Different Regions of Thailand</b> Serm Janjai <sup>*</sup> , Pimporn Phaprom, Rungrat Wattan, Itsara Masiri <i>Silpakorn University</i>	Thailand
<b>S 02.6</b>	<b>Effect of TiO<sub>2</sub> doped with Cu<sub>2</sub>O on photo-electrode for solar-hydrogen system</b> Leo Chau-Kuang Liao <sup>1*</sup> and Hung-Jui Chang <i>Yuan Ze University</i>	Taiwan
<b>S 02.7</b>	<b>Solar Photovoltaic Energy for the Future</b> Marc Lees <i>Schneider Electric(Thailand) Limited</i>	Thailand

<b>S 03: Ocean Energy for Sustainable Development</b>		
Time: 10:00 – 12:00		
Room Assignment: Chiang Mai B		
<b>Ref. No.</b>	<b>Title, Authors, Affiliation</b>	<b>Country of Origin</b>
<b>S 03.1</b>	<b>Study of Ocean Energy in Taiwan</b> Ho-Shong Hou <sup>*</sup> , Jesse Liu <sup>†</sup> <i>National Sun Yat Sen University</i> <sup>†</sup> <i>National Taitung University</i>	Taiwan
<b>S 03.2</b>	<b>Design and Development of Green Electricity Generation System Using Ocean Surface Wave</b> Mohd Farriz Basar, Azhan Ab. Rahman, Asri Din, Muhammad Sharil Yahaya and Zubir Mahmud <i>Universiti Teknikal Malaysia Melaka</i>	Malaysia
<b>S 03.3</b>	<b>Evaluation of Wave Energy Changes in Taiwan</b> Ching-Her Hwang, Chien-Chung Yao, Wen-Chin Lee <i>Chienkuo Technology University</i>	Taiwan
<b>S 03.4</b>	<b>Renewable Energy from the Sea - Organic Rankine Cycle using Ocean Thermal Energy Conversion</b> S.K. Wang and T.C. Hung <i>I – Shou University</i>	Taiwan
<b>S 03.5</b>	<b>Study of Deep Ocean Water (DOW) Cooling Energy and DOW Industry</b> Ho-Shong Hou, Yih-Cheng Hou, and Yen Lee <i>National Taitung University</i>	Taiwan

<b>S 04: Renewable Energy for Sustainable Development</b>		
Time: 13:35 – 15:35		
Room Assignment: Empress Grand Hall		
<b>Ref. No.</b>	<b>Title, Authors, Affiliation</b>	<b>Country of Origin</b>
<b>S 04.1</b>	<b>Integrated Renewable Energy Solutions for Seafood Processing Stations</b> H. Ronde, A. Ranne and E. Pursiheimo <i>Technical Research Centre of Finland VTT</i>	Finland

<b>S 04.2</b>	<b>A Renewable Energy Strategy for Lao PDR</b> Chantho Milattanapheng, Hatsady Sysoulath, Joanta Green, Mahinda Kurukulasuriya <i>National Energy Strategy and Capacity Building Programme, Ministry of Energy and Mines</i>	Lao PDR
<b>S 04.3</b>	<b>Issues and Challenges of Renewable Energy Development: A Malaysian Experience</b> Siti Indati Mustapa, Leong Yow Peng, and Amir Hisham Hashim <i>University Tenaga Nasional</i>	Malaysia
<b>S 04.4</b>	<b>Renewable Energy Mapping at Riau Province: Promoting Energy Diversification For Sustainable Development (a Case Study)</b> Adhy Prayitno, Amir Awaluddin, Anhar <i>University of Riau</i>	Indonesia
<b>S 04.5</b>	<b>Development of Thailand's First Nuclear Power Plant</b> Apisit Patchimpattapong <i>Electricity Generating Authority of Thailand</i>	Thailand
<b>S 04.6</b>	<b>Sustainable Development of Community and Social Impact from Small Scale Gasification Electric Generation System</b> Tirapong Kasirawat, Chotepong Pongsriwat <i>Provincial Electricity Authority (PEA)</i>	Thailand

<b>S 05: Biofuel Development and Applications</b>		
Time: 13:35 – 15:35		
Room Assignment: Chiang Mai A		
<b>Ref. No.</b>	<b>Title, Authors, Affiliation</b>	<b>Country of Origin</b>
<b>S 05.1</b>	<b>Biofuel Development in the Lao PDR: Baseline Assessment and Policy Evaluation</b> Leon Gaillard, Paul Robert and Jakob Rietzler <i>Lao Institute for Renewable Energy</i>	Lao PDR
<b>S 05.2</b>	<b>Bio Oil from Palm Oil Industry Solid Waste</b> Syaiful Bahri, Muhdarina, Edy Saputra, Irene Detrina and Yusnitawati <i>University of Riau</i>	Indonesia
<b>S 05.3</b>	<b>Research on Di-ethyl Ether as an Oxygenated Additive with Biodiesel in CI Engine</b> S.Sivalakshmi and Dr.T.Balusamy <i>Government College of Engineering</i>	India
<b>S 05.4</b>	<b>Transesterification of Waste Chicken Fats for Synthesizing Biodiesel by CaO as Heterogeneous Base Catalyst</b> Amir Awaluddin, Saryono, Adhy Prayitno, T. Ariful Amri <i>University of Riau</i>	Indonesia
<b>S 05.5</b>	<b>Making Biodiesel from Coconut Oil by Reaction Metanolisis Heterogeneous Catalyst</b> Padil, Amir Awaluddin and Slamet Wahyuningsih <i>University of Riau</i>	Indonesia

<b>S 06: Wind Power Development</b>		
Time: 13:35 – 15:35		
Room Assignment: Chiang Mai B		
Ref. No.	Title, Authors, Affiliation	Country of Origin
<b>S 06.1</b>	<b>The First Medium Wind/Diesel Pilot Project in Thailand</b> Supakorn Saengsrithorn, Pairach Kitworawut <i>Provincial Electricity Authority</i>	Thailand
<b>S 06.2</b>	<b>Fabrication and Testing of Composite Sandwich Blades for a Small Wind Power System</b> T.Y. Kam <sup>*</sup> , J.H. Jiang <sup>*</sup> , H.H. Yang <sup>*</sup> , R.R. Chang <sup>+</sup> , F.M. Lai <sup>#</sup> , and Y.C. Tseng <sup>+</sup> <sup>*</sup> <i>National Chiao Tung University</i> <sup>+</sup> <i>Chung Hua University of Science and Technology</i> <sup>#</sup> <i>Da Yeh University</i>	Taiwan
<b>S 06.3</b>	<b>Pumped Hydroelectric Storage Coupling Wind-Solar Resources: A Solution for Increase Ren on Islands Electrical Grid</b> Christian Cristofari <sup>*</sup> , Gilles Notton <sup>*</sup> , Motaz Ezzat <sup>*</sup> , Ludmil Stoyanov <sup>+</sup> , Vladimir Lazarov <sup>+</sup> , Jean Louis Canaletti <sup>†</sup> <sup>*</sup> <i>University of Corsica</i> <sup>+</sup> <i>Technical University of Sofia</i>	France (Bulgaria)
<b>S 06.4</b>	<b>Voltage Stability of Wind Farms Connected to Transmission Network Using VSC-HVDC</b> Dao Trung Hieu, V.K. Ramachandaramurthy, and Min Min Kyaw <i>Universiti Tenaga Nasional</i>	Malaysia
<b>S 06.5</b>	<b>Fault Ride through of Offshore Wind Turbines with Optimum Power Tracking</b> Min Min Kyaw, V. K. Ramachandaramurthy and Dao Trung Hieu <i>Universiti Tenaga Nasional</i>	Malaysia
<b>S 06.6</b>	<b>Sizing Optimization and Analysis of a Stand-Alone WTG System Using Hybrid Energy Storage Technologies</b> Prabodh Bajpai, Sowjan Kumar, N.K. Kishore <i>Indian Institute of Technology Kharagpur</i>	India
<b>S 06.7</b>	<b>Optimum Sizing and Placement of DFIG Wind Turbine for Line Loss Reduction and Voltage Profile Improvement in Distribution System</b> Kitti Leangkrua <i>Provincial Electricity Authority</i>	Thailand

<b>S 07: Power System Planning, Design and Operation</b>		
Time: 15:45 – 17:45		
Room Assignment: Empress Grand Hall		
Ref. No.	Title, Authors, Affiliation	Country of Origin
<b>S 07.1</b>	<b>Portfolio Risk Analysis Based Generation Expansion Planning Considering CO<sub>2</sub> Trading</b> Nguyen Xuan Phuc, Charles Marpaung, Ram M. Shrestha <i>Asian Institute of Technology</i>	Thailand
<b>S 07.2</b>	<b>A Study of Particle Swarm Technique for Renewable Energy Power Systems</b> N. Phuangpornpitak <sup>*</sup> , W. Prommee <sup>+</sup> , S.Tia <sup>#</sup> and W. Phuangpornpitak <sup>^</sup> <sup>*</sup> <i>Kasetsart University, Chalermphrakiat Sakonnakhon Province</i>	Thailand

	<i>Campus</i> *Rajamankala University of Technology Lanna #King Mongkut's University of Technology Thonburi ^Provincial Electricity Authority	
<b>S 07.3</b>	<b>Power System Optimization: Case Study of Sri Lanka</b> Dinesh Rangana Gurusinghe and Weerakorn Ongsakul <i>Asian Institute of Technology</i>	Thailand
<b>S 07.4</b>	<b>Economic Impact of Power Outage in Thailand: Industry Perspectives</b> Siriprapa Panya, Woraratana Pattaraprakorn, Thanet Detmote, Panuwat Teansri and Pornrapeepat Bhasaputra <i>Thammasat University</i>	Thailand
<b>S 07.5</b>	<b>Long-term Peak Load Forecasting Using LM-Feedforward Neural Network for Java-Madura-Bali Interconnection, Indonesia</b> Yusak Tanoto*, Weerakorn Ongsakul <sup>+</sup> , and Charles O.P. Marpaung <sup>+</sup> <i>Petra Christian University;</i> <i>Asian Institute of Technology</i>	Indonesia
<b>S 07.6</b>	<b>Shihmen Sediment Prevention Diversion Tunnel Planning and Design</b> Hoshong Hou*, Mingshun Lee <sup>+</sup> , and Percy Hou <sup>#</sup> <i>National Sun Yat Sen University</i> <i>Ministry of Economic Affairs</i> <i>Fortune Information Systems Corporation</i>	Taiwan
<b>S 07.7</b>	<b>Application of GIS to Distribution Substation Planning: Case Study of Metropolitan Electricity Authority</b> A. Phayomhom <sup>**</sup> , C. Yangyuenbangchan*, C. Thongkulaphat* and S. Sirisumrannukul <sup>+</sup> <i>Metropolitan Electricity Authority</i> <i>King Mongkut's University of Technology North Bangkok</i>	Thailand

### S 08: Potential and Application of Biomass and Biogas

Time: 15:45 – 17:45

Room Assignment: Chiang Mai A

Ref. No.	Title, Authors, Affiliation	Country of Origin
<b>S 08.1</b>	<b>Potential of Thermoelectric Power from Bagasse by Sugar Mills of Pakistan</b> Mohammad Rafiq Khan <i>Lahore School of Economics</i>	Pakistan
<b>S 08.2</b>	<b>The Competitive Economic Potential of Biomass Plantations for Bioenergy Production in Europe</b> Chrystalyn Ivie S. Ramos and Uwe A. Schneider <i>Hamburg University</i>	Germany
<b>S 08.3</b>	<b>Feasible Study of Biogas Energy for Thai Dairy Cooperative from Dairy Cow Manure: The Potential and Economic Analysis</b> Woraratana Pattaraprakorn, Rakpong Saikaew and Pornrapeepat Bhasaputra <i>Thammasat University</i>	Thailand
<b>S 08.4</b>	<b>Production of Thermoelectric Power from Solid Waste of Some Educational Institutions of Lahore</b> Mohammad Rafiq Khan	Pakistan

<b>S 08.5</b>	<i>Lahore School of Economics</i> <b>Direct Coupling of an Updraft Gasifier with a Stirling Engine to Produce Power from Solid Biomass</b> Jeng-Chyan Muti Lin, Sung-Kai Wang, Zhi-An Yan <i>Chinyi University of Technology</i>	Taiwan
<b>S 08.6</b>	<b>Effect of Chemical Treatment on Biogas Production from Bambara Nut (<i>Vigna Subterranea</i>) Chaff and its Blend with Some Wastes</b> Ofoefule, A.U. and Ibeto, C.N. <i>University of Nigeria</i>	Nigeria
<b>S 08.7</b>	<b>Loss Measurement Techniques at Field Level of Three Phase AC Induction Motor</b> I. Daut, K. Anayet, N. Gomesh, M. Asri, Syatirah, M. Muzhar <i>Universiti Malaysia Perlis</i>	Malaysia

### S 09: Emerging and Advance Energy Technology

Time: 15:45 – 17:45

Room Assignment: Chiang Mai B

Ref. No.	Title, Authors, Affiliation	Country of Origin
<b>S 09.1</b>	<b>Chelate Effect on the Synthesis of Carbon Supported Pt Nanoparticles for PEMFC Anodes</b> Shyh-Jiun Liu*, Chia-Hung Huang <sup>†</sup> , and Weng-Sing Hwang <sup>#</sup> , Der-Yuan Lee <sup>^</sup> <i>National University of Tainan</i> <sup>†</sup> <i>Metal Industries Research and Development Centre</i> <sup>#</sup> <i>National Cheng Kung University</i> <sup>^</sup> <i>Chia-Nan University of Pharmacy and Science</i>	Taiwan
<b>S 09.2</b>	<b>The Minimum of Thermal Resistance Design of High Power LED Package</b> David T.W. Lin, Chong-Ching Chang, and Chung-Neng Huang <i>National University of Tainan</i>	Taiwan
<b>S 09.3</b>	<b>Design of TiO<sub>2</sub> Spherical Particles as a Light-scattering Layer in Dye Sensitized Solar Cells</b> Leo Chau-Kuang Liau and Yuan-Chun Chung <i>Yuan Ze University</i>	Taiwan
<b>S 09.4</b>	<b>Technological Development of a PEMFC-Based CHP System</b> Jeng-Chyan Muti Lin, Zhi-An Yan, Sung-Kai Wang <i>Chinyi University of Technology</i>	Taiwan
<b>S 09.5</b>	<b>Advanced Energy Research of College of Engineering at National Tsing Hua University</b> H. Hocheng, C.S. Tan, C.A. Lin, C.H. Lai, M.C. Yip, C.C. Hu and C.N. Liao <i>National Tsing Hua University</i>	Taiwan
<b>S 09.6</b>	<b>Fabrication and Test of Gamma-Type Stirling Engine</b> Shung-Wen Kang, Meng-Yuan Kuo, Jian-You Chen, Wen-An Lu <i>Tamkang University</i>	Taiwan
<b>S 09.7</b>	<b>Assessment of CO<sub>2</sub> Reduced from Utilizing Fuel Cell in Electricity and Heat Generation</b> R. Sae-Low <i>King Mongkut's University of Technology Thonburi</i>	Thailand



## Day 2: 03 June 2010

<b>S 10: Smart Grids and Active Distribution Networks</b>		
Time: 09:45 – 11:45		
Room Assignment: Empress Grand Hall		
Ref. No.	Title, Authors, Affiliation	Country of Origin
<b>S 10.1</b>	<b>Roadmapping the PEA Smart Grids</b> Thongchai Meenual <i>Provincial Electricity Authority</i>	Thailand
<b>S 10.2</b>	<b>Reliability Index Forecast by Fuzzy Principle</b> S. Katithummarugs <sup>*</sup> , A. Apiwattananon <sup>*</sup> , P. Labchareonwong <sup>*</sup> , N. Sirisophonwattana <sup>*</sup> , N. Teera-achariyakul <sup>+</sup> , and D. Rerkpreedapong <sup>+</sup> <i>Provincial Electricity Authority of Thailand</i> <i>*Kasetsart University</i>	Thailand
<b>S 10.3</b>	<b>Optimal Placement of DGs Using MINLP in Deregulated Electricity Market</b> Amit K. Singh and S. K. Parida <i>Indian Institute of Technology Patna</i>	India
<b>S 10.4</b>	<b>Performance of Oman Transmission System with Distributed Generation</b> Omar H. Abdalla, Hilal S. Al-Hadi, and Hisham A. Al-Riyami <i>Oman Electricity Transmission Company</i>	Oman
<b>S 10.5</b>	<b>Loss Minimization and Capacity Saving in Residential Networks - An AIT Case Study</b> Sasidharan Sreedharan <sup>*</sup> , Weerakorn Ongsakul <sup>*</sup> , I Made Wartana <sup>*</sup> , Kittavit Buayai <sup>*</sup> and Nadarajah Mithulananthan <sup>+</sup> <i>Asian Institute of Technology</i> <i>+University of Queensland, Australia</i>	Thailand
<b>S 10.6</b>	<b>Investigation on Photovoltaic/Hydrogen Hybrid System for an Isolated Electrical Grid</b> C. Cristofari, J.L. Canaletti, C. Darras, M. Muselli, P. Poggi, J. Panighi <i>University of Corsica</i>	France
<b>S 10.7</b>	<b>High Speed Data Acquisition System Using FPGA for Detection and Counting of Partial Discharge in High Voltage Underground Cable</b> Emilliano, Chandan Kumar Chakrabarty, Ahmad Basri, Agileswari K. Ramasamy <i>Universiti Tenaga Nasional</i>	Malaysia

<b>S 11: Energy Use in Rural and Urban Settings</b>		
Time: 09:45 – 11:45		
Room Assignment: Chiang Mai A		
Ref. No.	Title, Authors, Affiliation	Country of Origin
<b>S 11.1</b>	<b>Preparation Energy Poverty and Income Poverty Linkages: Indian Experience</b> Garima Jain <i>The Energy and Resources Institute</i>	India
<b>S 11.2</b>	<b>Powerbike to Enhance Hybrid PV-Diesel system for Rural Primary School</b>	Thailand

	Wichit Krueasuk, Arnon Pongchingyam <sup>+</sup> , Wirat Sriamonkitkul <sup>#</sup> , Rittirong Intarajinda <sup>#</sup> , Pornrapeepat Bhasaputra <sup>#</sup> and Woraratana Pattaraprakorn <sup>#</sup> <i>Sripatum University;</i> <sup>+</sup> <i>Rajamangala University of Technology Suvarnabhumi;</i> <sup>#</sup> <i>Thammasat University</i>	
<b>S 11.3</b>	<b>Solar Lantern Rental System: Paying for the service, not the hardware</b> Simon Henshel <sup>*</sup> , Leon Gaillard <sup>+</sup> and Andy Schroeter <sup>*</sup> <i>Sunlabob Renewable Energy Ltd</i> <sup>*</sup> <i>Lao Institute for Renewable Energy</i>	Lao PDR
<b>S 11.4</b>	<b>The Potential of Sustainable Energy in Thammasat University Rangsit Campus</b> S. Saengsuwan, W. Sriamonkitkul, R. Intarachinda, B. Hongpeechar, P. Bhasaputra and W. Pattaraprakorn <i>Thammasat University</i>	Thailand

### S 12: End Use Energy Efficiency

Time: 09:45 – 11:45

Room Assignment: Chiang Mai B

Ref. No.	Title, Authors, Affiliation	Country of Origin
<b>S 12.1</b>	<b>Multi-Scenarios of Effective Demand Side Management in Navanakorn Industrial Promotion Zone</b> Panuwat Teansri, B. Hongpeechar, Rittirong Intarajinda, Pornrapeepat Bhasaputra and W. Pattaraprakorn <i>Thammasat University</i>	Thailand
<b>S 12.2</b>	<b>Result of Road Lighting Energy Saving Project Implementation through the Use of Public Private Partnership Scheme</b> Kamron Hyodhyad and Piyachart Srikaew <i>Provincial Electricity Authority</i>	Thailand
<b>S 12.3</b>	<b>The Strategic Management of Energy Service Company to Enhance the Sustainable Energy Management in Thailand</b> Rittirong Intarajinda, Vivat Chutiprapat, Pornrapeepat Bhasaputra and W. Pattaraprakorn <i>Thammasat University</i>	Thailand
<b>S 12.4</b>	<b>Multi-Criteria Decision Analysis for the Selection of Alternative Options Towards Environmentally Sustainable Transport System in Bangkok, Thailand</b> Chawannat Jaroenkhasemmesuk, Charles O. P. Marpaung, Ram M. Shrestha <i>Asian Institute of Technology</i>	Thailand
<b>S 12.5</b>	<b>PCM Thermal Energy Storage and Cooler Night Temperatures for Pretreatment of Ambient Air Introduced in th Building</b> Adeel Waqas and S. Kumar <i>Asian Institute of Technology</i>	Thailand
<b>S 12.6</b>	<b>Energy Efficiency in Industrial Facilities</b> Amit Chadha <i>Schneider Electric India</i>	India

## Field Trip

## Day 3: 04 June 2010

<b>S 13: Energy Efficiency and Heat Transfer 1</b>		
Time: 10:20 – 12:00		
Room Assignment: Chiang Mai A		
Ref. No.	Title, Authors, Affiliation	Country of Origin
<b>S 13.1</b>	<b>Thermal Enhancement in a Solar Air Heater Channel Using Rectangular Winglet Vortex Generators</b> Nattawoot Depaiwa, Teerapat Chompookham, Pongjet Promvonge <i>King Mongkut's Institute of Technology Ladkrabang</i>	Thailand
<b>S 13.2</b>	<b>Drying Kinetic of Peppercorns in a Rectangular Fluidized-bed with Wavy Surfaces</b> Chinaruk Thianpong, Amnart Boonloi and Pongjet Promvonge <i>King Mongkut's Institute of Technology Ladkrabang</i>	Thailand
<b>S 13.3</b>	<b>Investigation of Buoyancy Air Flow inside Solar Chimney using CFD Technique</b> Praphanpong Somsila, Umphisak Teeboonma, and Wirapan Seehanam <i>Ubonratchathani University</i>	Thailand
<b>S 13.4</b>	<b>Effect of Inlet Water Temperature and Flow Rate on Cooling Efficiency of a Radiant Ceiling System in Taiwan</b> Wei-Hwa Chiang, Jian-Sheng Huang and Yen-Hsiang Huang <i>National Taiwan University of Science and Technology</i>	Taiwan
<b>S 13.5</b>	<b>Energy Efficiency Practices for Green Buildings</b> Jatuwat Varodompun <i>Thammasat University; Schneider Electric (Thailand) Limited</i>	Thailand

<b>S 14: Energy Efficiency and Heat Transfer 2</b>		
Time: 10:20 – 12:00		
Room Assignment: Chiang Mai B		
Ref. No.	Title, Authors, Affiliation	Country of Origin
<b>S 14.1</b>	<b>Laminar Periodic Flow and Heat Transfer in Square Channel with 30° Inclined Baffles</b> S. Kwankaomeng, W. Jedsadaratanachai and P. Promvonge <i>King Mongkut's Institute of Technology Ladkrabang</i>	Thailand
<b>S 14.2</b>	<b>Augmented Heat Transfer in Rectangular Duct with Angled Z-Shaped Ribs</b> Monsak Pimsarn, Parkpoom Sriromreun and Pongjet Promvonge <i>King Mongkut's Institute of Technology Ladkrabang</i>	Thailand
<b>S 14.3</b>	<b>Experimental Study on Heat Transfer and Pressure Drop in a Channel with Triangular V-ribs</b> Dumri Jansangsuk, Chitakorn Khanoknaiyakarn, and Pongjet Promvonge <i>King Mongkut's Institute of Technology Ladkrabang</i>	Thailand
<b>S 14.4</b>	<b>Thermal Characteristics in Square Channel with 45° Staggered Baffle inserts</b> Sutapat Kwankaomeng, Sompol Skullong, Thavee Teschareon and Pongjet Promvonge <i>King Mongkut's Institute of Technology Ladkrabang</i>	Thailand
<b>S 14.5</b>	<b>Active Building Envelope System (ABE): Wind and Solar –</b>	Taiwan

**driven Ventilation, Electricity and Heat Pump**

Bor-Jang Tsai and Chien-Ho Lee

*Chung Hua University*

## DETAILED ABSTRACTS

### S 01: Assessment of Energy Use Implications

Time: 10:00 – 12:00

Room Assignment: Empress Grand Hall

#### S 01.1 **Comparative Analysis of Upstream Petroleum Fiscal Systems of Pakistan, Thailand and Other Countries with Medium Ranked Oil Reserves**

Sara Zahidi

COMSATS Institute of Information Technology, Chak Shahzad, Islamabad, Pakistan.

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*Governments and investors are both interested in the petroleum fiscal systems operating in various countries. Governments aim to attract investors, whereas investors are continually searching for markets which provide the rewards commensurate with the risk they will take. Using fiscal tools, governments can make their upstream petroleum regimes more attractive to investors, by providing greater rewards. Therefore, fiscal tools are important for the management and best exploitation of national oil resources. Although many factors can influence attractiveness of a particular upstream petroleum regime, such as the individual geological attractiveness of a particular prospect, costs of exploration and production or the risk profile of a country or concession, yet, by holding all such factors constant, a model has been built that allows the comparison of various countries in terms of fiscal systems only. The research undertaken compares the current upstream petroleum fiscal systems of countries with closely similar oil reserves to those of Pakistan. Turkey, Cameroon, Congo, and Thailand are the randomly selected countries; however any country with similarly ranked oil reserves could have been selected for comparison. Take Statistics have been used to determine the global competitiveness of upstream petroleum fiscal systems of the five countries.*

#### S 01.2 **Assessing the Fuel Consumption and GHG of Future In-Use Vehicles**

John B. Heywood

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77 Massachusetts Avenue, Cambridge, MA 02139, U.S.A.

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*Over the next several decades, substantial reductions in greenhouse gas emissions from transportation will be required. The targets—an 80% reduction by 2050—are challenging. Thus, we need quantitative methodologies for assessing the impact of changes in vehicle technology and use, and of fuels, on transportation energy consumption and GHG emissions. This paper describes an appropriate methodology for creating plausible future transportation scenarios and assessing their impacts. It focuses on light-duty vehicles (cars and light trucks), in the U.S. and European context. The factors that must be included are: more efficient propulsion systems; vehicle weight changes; performance, size and other vehicle attributes; and now rapidly the deployment of these improved technologies can grow over time. The methodology combines engineering assessments of vehicle performance for the different propulsion and vehicle technologies, a model of the in-use vehicle fleet, and the availability of the various possible fuels. The findings show there is significant potential for reducing petroleum consumption and GHG emissions through improvements in engines, transmissions, vehicle weight reduction, and alternative fuels.*

S 01.3 **Life Cycle Cost of Lighting System in Various Groups of End user in Thailand**

*Nipon Tongasuk, Rawin Jareansuk, Suttichat Saengsuwan and Pornrapeepat Bhasaputra*

Thammasat University, Klong Luang, Pathumthani 12120, Thailand.

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*This paper studies the Life Cycle Cost (LCC) of various lighting systems that are T-8 fluorescent lamps with standard ballast, T-8 fluorescent lamps with low-loss ballast, T-8 fluorescent lamps with electronic ballast and T-5 fluorescent lamps with electronic ballast. The LCC of residential customers, small general service customers, medium general service customers and large general service customers are evaluated by considering initial cost, energy cost, maintenance cost and savage cost for the assessment in Thailand. The analytical results show that T-5 fluorescent lamps with electronic ballast can reduce the LCC of fluorescent lamps up to 3,177, 3,948, 3,619 and 3,382 for residential customers, small general service customers, medium general service customers and large general service customers, respectively. In addition, the LCC of T-5 fluorescent lamps with electronic ballast are less than the LCC of T-8 fluorescent lamps with standard ballast, the LCC of T-8 fluorescent lamps with low-loss ballast, and the LCC of T-8 fluorescent lamps with electronic ballast by 20%, 15% and 9% for small general service customer. According to the information from department of demand side management, EGAT (Electricity Generation Authority of Thailand), 200 million of T-5 fluorescent lamps with electronic ballast can decrease the peak demand up to 2,000 MW and 5 million tons of CO<sub>2</sub> emission. Finally, the sensitivity analysis shows that the most influent factors for LCC is the electricity tariff rate, following by the cost of light bulbs and accessories, and the reverse life time of equipment respectively.*

S 01.4 **Estimating the Health Damage Costs of Electricity Generation in Thailand**

*Songsak Sakulniyomporn, Kuskana Kubaha and Chullapong Chullabodhi*

School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, 126 Pracha-utid Rd., Bangmod, Toongkru, Bangkok 10140, Thailand.

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*Electricity generation is one of the major sources of airborne pollutants which can cause public health degradation. However, evidences for using the health damage costs cannot be found in the literature in order to include the effects in its production costs. In this study, the health damage costs due to Thai electricity generation produced from fossil fuels which operated during the period from 2006 to 2008 were evaluated. Based on the impact pathway approach (IPA), the main airborne pollutants (SO<sub>2</sub>, NO<sub>x</sub>, and PM<sub>10</sub>) were formed in fossil fuel burning stage and emitted directly from stack to the atmosphere. The advections of the pollutants including secondary particulates (sulfate and nitrate aerosols) were simulated using the CALMET/CALPUFF modeling system. Damages to human health resulting from the increment in pollutant concentrations were associated with the exposure-response functions (ERFs) of mortality and morbidity. Finally, costs of such impacts were then estimated. The results showed that more than 300 deaths were annually caused by all considered sources which taken more than 90% of the total damage cost. The largest problem was influenced by oil/gas-fired power plants. As a result, the health damage costs were relatively significant to electricity market price. Taking the damage costs into account will be beneficial to energy and environmental policy implications.*

**S 02: Small-Scale Hydro and Solar Systems**

Time: 10:00 – 12:00

Room Assignment: Chiang Mai A

**S 02.1 Reconnaissance Studies of Micro Hydro Potential in Malaysia**

*Ibrahim Hussein and Nathan Raman*

Department of Mechanical Engineering, Universiti Tenaga Nasional (UNITEN),  
Km 7, Jalan Kajang-Puchong, 43009 Kajang, Selangor, Malaysia

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*Malaysia is blessed with abundant streams and rivers flowing from highland areas, thus promise it with a lot of hydro power potential. To date Malaysia had utilized these potential in the range of large and mini hydropower but very few in the micro hydro range. This paper presents the results of reconnaissance studies carried out to identify the micro hydro potential sites in Malaysia. The reconnaissance studies were conducted with data from the Department of Survey and Mapping Malaysia, (JUPEM) and Metrological Department Malaysia. All the identified streams were located in areas which are accessible and/or showed evidence of settlements. Only streams with high head i.e. above 50m, were considered in this study. From the reconnaissance studies, a total of 149 sites were identified. However, the energy demand for micro hydro was found not significant as most areas in Malaysia are electrified. Still, micro hydro generation may serve as alternative renewable energy source in future amid rising electricity cost.*

**S 02.2 Islanding Operation of Mini-Hydro Generation in Real Distribution Network**

*Thawatchai Tantimaporn, Panida Sriakacha, Kesinee Loahacharoensombat  
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*This paper investigates the islanding operation of mini-hydro generation connected in a Provincial Electricity Authority (PEA) distribution network. A real test system with three mini-hydro generating units was set up to examine their dynamic and steady state performance. Voltage and frequency regulation of the generating units were inspected. Test results show that mini-hydro generating units connected in the distribution network are capable of operating in the islanding mode without sacrificing the system stability. Hence, in the case of supply outage or substation maintenance required to de-energize some equipment, the islanding operation of mini-hydro generating units will have a great opportunity to improve the continuity of service.*

**S 02.3 Building on Local Knowledge, Distribution and Support Networks: Examples of Intervention on Pico-Hydropower in the Lao PDR**

*Mattijs Smits*

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*This article shows the characteristics, use, and interventions of market-driven pico-hydropower turbines in the Lao PDR to emphasise the importance of building on local knowledge, distribution and support networks for rural electrification. Privately owned pico-hydropower (<2 kW) is the most prolific form of off-grid rural electrification in the northern provinces of Laos. Its relatively wide utilisation relies on the extensive network of Chinese and Vietnamese traders and Lao shop owners to distribute the turbines and the spare parts, and on local knowledge of end-users on the choice of the location, installation, use and load management of the systems.*

Despite its comparative advantages over solar home systems, diesel generators, micro-hydropower, and other forms of off-grid rural electrification, there are some issues related to safety, load management, seasonality, and the supply chain. The ongoing interventions by the pico-hydropower team at the Lao Institute for Renewable Energy (LIRE) to overcome these issues are used as an example of an approach that builds upon the local knowledge, distribution and support networks of pico-hydropower in Laos. These include ways to share and disseminate information, the implementation of a 2 kW community pico-hydropower system as a demonstration of best practice for replication, testing turbines and accessories, and policy advocacy.

#### S 02.4 **Preventive Maintenance Optimization for Excitation System of Bhumibol Hydro Power Plant**

*S. Pansrisu\* and S. Premrudeepreechacharn\**

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*Power plant reliability is highly related to the way maintenance tasks on system equipments are performed. From operation record of bhumibol hydro power plant between 2002-2006, the unplanned outage hours (uoh) of power plant are varied. The main factor of uoh is mostly caused by excitation system of power plant. Therefore, the maintenance system of excitation system has to be revised in order to improve of reliability of power plant.*

*This paper proposes a maintenance tools called preventive maintenance optimization(pmo). This approach has improved maintenance related to failure mode of equipment. Since weibull distribution is able to find mean time to failure (mttf), failure rate and reliability with small number of failure data due to limited of information. Therefore, weibull distribution is used as statistical analysis.*

*This paper has applied the pmo with bhumibol power plant unit 1-4. From the simulation results has shown that the maintenance plan from pmo can improve power plant reliability compared with previous shutdown planned for maintenance. In addition, the power plant also can reduce unnecessary planned maintenance. The reliability of system is also increased. This study results are assessed, analyzed and considered as a guide line for maintenance excitation system of other egat's hydro power plant.*

#### S 02.5 **Statistical Models for Estimating Hourly Diffuse Solar Radiation in Different Regions of Thailand**

*Serm Janjai, Pimporn Phaprom, Rungrat Wattan and Itsara Masiri*

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*In this study, four statistical models for estimating diffuse solar radiation from global solar radiation in different regions of Thailand have been developed. In developing the models, a 12-year period of global and diffuse solar radiation measured at four of our solar radiation monitoring stations, situated in different regions of Thailand have been analyzed. The statistical models estimate diffuse fraction from clearness index at the hourly scale. The performance of these models have been compared with that of other models. The models developed in this study performed best for most cases.*



S 02.6

## Effect of TiO<sub>2</sub> Doped with Cu<sub>2</sub>O on Photo-Electrode for Solar-Hydrogen System

Leo Chau-Kuang Liao and Hung-Jui Chang

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Modifications of TiO<sub>2</sub>, with Cu<sub>2</sub>O additive, were investigated and its characteristics, such as sample structure, electronic, and optical properties of the modified TiO<sub>2</sub> composites, were analyzed. The modified TiO<sub>2</sub> samples were prepared from the mix of commercial TiO<sub>2</sub> powder (p25) with Cu<sub>2</sub>O particles. The prepared TiO<sub>2</sub> solutions, coated on substrates, were thermally processed to fabricate TiO<sub>2</sub> films under atmosphere-controlled conditions. Results show that the compositions and structures of the Cu<sub>2</sub>O/TiO<sub>2</sub> samples were altered from the X-ray diffraction (XRD) analysis. The presence of Cu<sub>2</sub>O compositions can influence the electronic properties of the modified TiO<sub>2</sub> films observed by the current-voltage (I-V) data. In addition, the band gaps of the modified TiO<sub>2</sub> samples were changed according to the analysis of UV-vis measurements. The modified TiO<sub>2</sub> samples were further utilized to work as an photoelectrode for the photocatalytic test using a solar-hydrogen system. The feasibility of the Cu<sub>2</sub>O/TiO<sub>2</sub> film used as an photoelectrode of the solar-hydrogen system was discussed.

S 02.7

## Solar Photovoltaic Energy for the Future

Marc Lees

Renewable Energies, Asia-Pacific, Schneider Electric (Thailand) Limited

Climate changes concerns and depleting fossil fuel supplies are pushing the need for the use of more renewable energy production. Government support is driving these new markets through incentives and legislation to ease commercialization of the technology, and design and installation services. Solar photovoltaic power plants have witnessed stunning growth over the last few years but it is still a new market. Technology is proving itself and become more efficient, and social benefits are already apparent in terms of job creation. Schneider Electric as a leading provider of solutions for solar power plants will demonstrate how these technologies can be suitable for building integration, both residential and commercial, and ground-based solar plants.

### S 03: Ocean Energy for Sustainable Development

Time: 10:00 – 12:00

Room Assignment: Chiang Mai B

S 03.1

## Study of Ocean Energy in Taiwan

Ho-Shong Hou\* and Jesse Liu†

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Taiwan east coast are full of ocean energy, especially Ocean Energy Conversion (OTEC). Offshore 3 km away from Hualien coast or Taitung coast will reach 1,000 M to 1,500 M. Their temperatures are around zero to 4 degrees, while surface temperature around 25 to 28 degrees, temperature difference is more than 20 degrees. If ammonia is used as the catalyst, it is easily to generate electric power. Offshore 33 km from Taitung coast and about 5 km from Green Island, there exists 3~4 knots' Kuroshio current. MOEA is currently planning to develop 3 giga watts power. For the convenience to develop the Ocean Energy and Ocean Resources, the planning of an airport and seaport is shown in Figure 1 for future transportation of energy and

Deep Ocean Water (DOW) products.

S 03.2      **Design and Development of Green Electricity Generation System  
Using Ocean Surface Wave**

*Mohd Farriz Basar, Azhan Ab. Rahman, Asri Din,  
Muhammad Sharil Yahaya and Zubir Mahmud*

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*Once the non-renewable energy such as petroleum, coal, gas and nuclear have been used, it cannot be restored. Many countries in the world are heavily dependent on the non-renewable energy and polluting sources to generate electricity. This would cause the greenhouse gas emissions and would have adverse effects on the country due to the climate changes. Generally, 75% of earth is covered by the ocean and for that reason; converting the surface wave energy into electricity essentially is a form of renewable energy available on the earth. Thus, this paper describes the design and development of green electricity generation system using surface wave power for small-scale applications. The generation system is presented by the handy floating box that consists of neodymium iron boron permanent magnets, 1,000 turns of solenoid wires and voltage multiplier system. As oceans waves moves along the floating device, the solenoid rocks back and forth the permanent magnet and hence the relative motion produces electrical power. From the experimental works, it gives a significant result and shows a positive indicator on the effort to harnessing this clean energy.*

S 03.3      **Evaluation of Wave Energy Changes in Taiwan**

*Ching-Her Hwang, Chien-Chung Yao and Wen-Chin Lee*

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R.O.C

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*The aim of this paper is to identify the magnitude of the wave climate change, investigate the trend as well as the rate of the change. Due to the lack of long-term wave observations around Taiwan, numerical simulations are carried out to obtain a near 30 years wave database for the statistical analysis. The results demonstrate strong inter-annual variations of the wave climate. The wave energy and wave slope decreased. Started from 2003 to 2006, significant trend of increase of wave energy (250%) and slope (30%) are identified. Wave propagation directions also features significant shift from Eastward propagation direction more to the north.*

S 03.4      **Renewable Energy from the Sea - Organic Rankine Cycle using  
Ocean Thermal Energy Conversion**

*S.K. Wang and T.C. Hung*

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*Rankine cycles using refrigerant- and benzene-series fluids as working fluids in converting low-grade energy from renewable energy resources such as solar energy and ocean thermal energy were investigated in this study. The main purpose is to verify the feasibility of utilizing ocean energy (i.e., ocean thermal energy conversion, OTEC) which can also be combined with solar energy in an organic Rankine Cycle (ORC) to generate electricity. Parameters under investigation were turbine inlet temperature, turbine inlet pressure, condenser exit temperature, turbine exit quality, overall irreversibility, and system efficiency. Results indicate that wet fluids with very steep saturated vapor curves in T-s diagram have a better overall performance in*

energy conversion efficiencies than that of dry fluids. It can also be shown that all the working fluids have a similar behavior of the efficiency-condenser exit temperature relationship. Furthermore, an appropriate combination of solar energy and an ORC system with a higher turbine inlet temperature and a lower condenser temperature (as operated deeply under sea level) would provide an economically feasible and environment-friendly renewable energy conversion system.

### S 03.5 **Study of Deep Ocean Water (DOW) Cooling Energy and DOW Industry**

Ho-Shong Hou, Yih-Cheng Hou and Yen Lee  
Life Science Institute, National Taitung University, Taiwan  
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Sea Water Air Conditioning (SWAC) takes advantage of available deep cold seawater to make the chilled water in one and more building to become cool. The design of a basic seawater air conditioning system is presented in this research. These basic components can be optimized for each special location, climate and building. DOW Industry is devoted to temperature control refined organic agriculture, cultivate fishery and cooling system. Multi-purpose Development of Deep Ocean Water is described in this paper.

## **S 04: Renewable Energy for Sustainable Development**

Time: 13:35 – 15:35

Room Assignment: Empress Grand Hall

### S 04.1 **Integrated Renewable Energy Solutions for Seafood Processing Stations**

H. Ronde, A. Ranne and E. Pursiheimo  
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The ENERFISH project aims to demonstrate a new poly-generation application with renewable energy sources for the fishery industry. The distributed energy system utilizes cleaning waste of a fish processing plant to produce biodiesel. The biodiesel is used to produce the locally needed cooling/freezing and heating energy. In addition, a power surplus is generated for the electricity network or local industrial use. The research contribution focuses on optimisation, simulation, validation and planning of piloted concepts. A energy integration auditing and optimisation tools are being developed to carry out feasibility studies for the fishery industry. The advanced CO<sub>2</sub> based freezing/cooling system requires optimization and control system planning of special high-pressure equipments. The final biodiesel will be tested in appropriate engines. With a view to marketing possibilities the demonstration will take place in Vietnam. In the demonstration case, the main product of the fish processing plant is catfish fillet (about 40 t/d). The fat content of 22 per cent in the fish cleaning waste results in a production of biodiesel of about 13 t/d. A part of the biodiesel is used to produce electricity for the locally needed cooling/freezing (0.3 MW) and heating (1,3 MW) energy. In addition, a power surplus (0.8 MW) is generated for the local industrial use. Fish farming and processing plants in Vietnam produce frozen fish fillet with capacity from some tonnes per day to dozens tonnes/day. One third of fresh fish is yielded as fillet and the rest of fish is treated as fish cleaning wastes. There are some alternatives for utilisation of fish cleaning wastes, one of them is biodiesel and energy production at the own factory. The energy demand at the fish processing factory is dominated by cooling and freezing facilities. 80 % of electricity consumed at the factory is supplied for cooling/freezing compressors, and the cold energy of low temperatures is needed in freezing and cold storage facilities of fillet. Cooling energy of about zero degrees is needed for space cooling of production

halls. The specific electricity consumption is about 400 kWh per tonne fresh fish, or 1400 kWh per tonne fish fillet. The electricity load is typically very steady over a day and a year in the Vietnamese conditions. From the energy viewpoint the fish processing plant is energy self-sufficient, when the fish waste oil is processed in a biodiesel processor and further converted to electricity. In addition to this, a part of biodiesel can be sold to the fuel market. The fish processing factory producing fish fillet of 40 ton/day consumes electricity average at a power of 2 MW. 11 ton/day biodiesel is needed for that power production and a surplus biodiesel of 2 ton/day is available for fuel market. At the same time, diesel engine plant generates heat energy at a capacity of 2,6 MW, which is also available. The other end in possibilities of poly-generation is to generate all biodiesel, 13 ton/day, to the fuel market. In Vietnam, electricity and diesel fuel prices are very low being for electricity average 42,6 €/MWh for industry customers, and diesel fuel costs 400 €/ton. This results in shutdown of private electricity production (except during electricity blackout), even if cogeneration heat could be utilized. And the markets for biodiesel should be found outside Vietnam. According to the calculations and assumptions presented in this report, biodiesel production from fish cleaning wastes is profitable, and the payback period of the investment seems to be very short. However, more information on the technical and economical performances related to the operation and equipments are needed.

S 04.2

### **A Renewable Energy Strategy for Lao PDR**

*Chantho Milattanapheng, Hatsady Sysoulath, Joanta Green and Mahinda Kurukulasuriya*

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*Abstract is unavailable.*

S 04.3

### **Issues and Challenges of Renewable Energy Development: A Malaysian Experience**

*Siti Indati Mustapa, Leong Yow Peng and Amir Hisham Hashim*

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*As we are facing energy resource shortages around the world, there is an urgent need to develop a more sustainable energy system to cater for growth. The use of renewable energy (RE) sources is one of the feasible options. Malaysia is amply endowed with RE sources and is environment-friendly in nature. However the RE capacities are grossly under-utilized, particularly from biomass and solar energy. The Malaysian Government recognizes the potential of RE as an alternative to ensure the sustainability of energy resources. Thus, the green technology policy was launched to promote the utilization of low carbon energy and technology of which RE has been identified as the promising green energy option. In addition to current RE incentives, concerted efforts are underway to embark on programs to promote the green technology market in Malaysia. This paper will identify the key issues and challenges of RE development in Malaysia and explore the merits of establishing Green Technology Policy in order to adopt a green economy for sustainable future in Malaysia. This paper will look in detail at the barriers of RE proliferation, broad strategies and action plans which will be a catalyst for RE penetration in power generation in Malaysia.*

S 04.4

### **Renewable Energy Mapping at Riau Province: Promoting Energy Diversification For Sustainable Development (a Case Study)**

*Adhy Prayitno\*, Amir Awaluddin\* and Anhar#*

\* Technology and Energy Study Centre, The University of Riau Research Institution, Kampus Bina Widya, Jl. Soebrantas KM12.5 Sp Baru, Pekanbaru 28293, Indonesia.

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*Mapping of renewable energy sources has been done. It inspires to figuring out an escalation of energy demand at rural and remote area by promoting Energy Diversification Programs (EDP). Biomass, solar, wind and hydro are four renewable energy resources enable people to provide energy by their own. The mapping describes three zones based on the dominant of the resources. Upstream of tributary zone at which the hydropower may supply energy for running micro hydro power plant. Agriculture and plantation zone produces plenty of biomass for steam turbine power plant. Estuary and coast line zone is the open area where solar radiation and wind speed are potentially able to be harnessed for producing electricity. Promoting energy diversification based on mapping data followed by implementing appropriate technology may give much benefit for sustainable development. A small scale hybrid model power plant is introduced.*

S 04.5

### **Development of Thailand's First Nuclear Power Plant**

*Apisit Patchimpattapong*

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*Strengthening energy security, mitigating global warming and being competitive in global markets are among reasons Thailand is developing nuclear power program. Based on the current Thailand Power Development Plan there will be 5 units of a 1,000 MWe nuclear power plant commercialized from 2020 to 2028. Nuclear power will contribute no greater than 10% of Thailand electricity generation. Currently, Electricity Generating Authority of Thailand (EGAT), government owned utility, is conducting nuclear power plant feasibility study. Major tasks include reactor technology and supplier selection, site survey and selection, and human resources development planning. Since this is Thailand's first nuclear power plant, infrastructure assessment and establishment planning, e.g. nuclear law and regulatory body, and public education and participation, are also crucial to the success of the program. All these will be in the readiness report to submit to the Thai Cabinet for approval next year. According to the Nuclear Power Infrastructure Establishment Plan, a roadmap for launching nuclear power program in Thailand, nuclear power project will be implemented during 2011-2013, construction will start in 2014, and Thailand's first nuclear power plant will be complete for commercial operation in 2020.*

S 04.6

### **Sustainable Development of Community and Social Impact from Small Scale Gasification Electric Generation System**

*Tirapong Kasirawat, Chotepong Pongsriwat*

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*Thailand has widely cultivated a corn, covering the area equal to 11,200 million square meters of Thailand, which gives the corncob more than 1.1 million ton. Normally, Agricultural waste management process are done by natural fermentation or burning in the community area,*

furthermore, CO<sub>2</sub> emission and air pollution are also occurred in the area. Hence, PEA (Provincial Electricity Authority) has set up the renewable energy policy about the renewable energy project to sustain the community to construct their own small power plant connected with PEA grid. This project give too many benefits such as high reliability of power system, electrical loss reduction, moreover, the community can reduce the environmental problems as well as the social impact. Finally, the energy security stability for both demand side and supply side can be completely fulfilled by lessen the energy import, encourage the energy conservation and efficiency including with sustainable development to Thailand

## S 05: Biofuel Development and Applications

Time: 13:35 – 15:35

Room Assignment: Chiang Mai A

### S 05.1 **Biofuel Development in the Lao PDR: Baseline Assessment and Policy Evaluation**

Leon Gaillard, Paul Robert and Jakob Rietzler

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Since 2006, the government of the Lao PDR has strongly promoted biofuel development, on the basis of national energy security concerns, and interests for rural development. As a result, many farmers were encouraged to cultivate *jatropha* as a biofuel feedstock through government campaigns and private sector investment. For most, the return on their investment has been woefully low; a domestic biofuel sector has failed to materialise, largely due to (i) negligible feedstock supply and poor yields, (ii) inadequate market development, and (iii) a lack of investment in biofuel processing capacity. Despite these limitations, the Lao government has set an ambitious target of offsetting 10% of petroleum fuel consumption with biofuel by the year 2020. In order to address the likelihood and requirements of reaching such a goal, this paper presents a baseline assessment of the embryonic biofuel sector in the Lao PDR, and formulates a comparison between national expectations and targets with the current scale of investment by public and private sectors. A simple analysis of market chains for domestic biofuel production and consumption in the Lao PDR is established as a basis to evaluate the merits of biofuel for the Lao PDR, in the context of national development goals.

### S 05.2

#### **Bio Oil from Palm Oil Industry Solid Waste**

Syaiful Bahri\*, Muhdarina\*, Edy Saputra\*, Irene Detrina\* and Yusnitawati\*

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Fossil fuel is the most important energy resources for human life whilst its production tend to decrease in recent year, hence it is needed an alternative renewable energy resources for replacement. Many researches were developed to investigate an alternative energy resource. The conversion of biomass to bio oil is one of the prospective alternative energy resources. This research used palm solid wastes from palm oil industry which consist of tree, stem and empty bunch as a sample material. Pyrolysis is a method selected. The process was conducted in a stainless steel tube reactor having diameter and length of 3.81 and 60 cm respectively, at temperature range of 450-600°C under flow of nitrogen. The best result of 58.75 % bio oil is achieved at run 600°C for the sample of the tree having diameter of -2+6 mesh. Analysis of the product conducted using a gas chromatograph HP 5890 II. Many compounds such as ethanol,



benzene, toluene and xylen were identified among the product of bio oil produced.

### S 05.3 **Research on Di-ethyl Ether as an Oxygenated Additive with Biodiesel in CI Engine**

S.Sivalakshmi and Dr.T.Balusamy

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*Increased environmental concerns and depletion of fossil fuel resources necessitate the search for a viable alternative fuel for diesel engines. Biofuels are renewable, can supplement fossil fuels, reduce green house gas emissions and mitigate their adverse effects on the climate resulting from global warming. However, further reduction in engine emission becomes one of major tasks in engine development. One promising approach to solve this problem is to add the oxygenated fuels in biodiesel. In this research work, an attempt has been made to analyze the effect of diethyl ether as an additive at different proportions with biodiesel in a single cylinder, four stroke naturally aspirated, computerized diesel engine (5hp @ 1500rpm). The measured performance parameters are brake thermal efficiency, brake specific fuel consumption and engine exhaust emission of CO, CO<sub>2</sub>, HC, NO<sub>x</sub> and smoke intensity. Significant improvements in performance parameters and exhaust emissions have been observed by the addition of diethyl ether blends with biodiesel.*

### S 05.4 **Transesterification of Waste Chicken Fats for Synthesizing Biodiesel by CaO as Heterogeneous Base Catalyst**

Amir Awaluddin, Saryono, Adhy Prayitno and T. Ariful Amir

University of Riau, Indonesia

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*High consumption of chicken in Indonesia leads to a considerable amount of chicken skin as a waste. The utilization of this chicken skins as possible biodiesel feedstock was therefore investigated. The transesterification between this chicken fats and methanol was conducted using calcium oxide as solid catalyst. The variables affecting the yield of biodiesel during transesterification, such molar ratio of methanol to oil, reaction time, reaction temperature, catalyst concentration were investigated. With 1 % catalyst, when the transesterification was carried out at molar ratio of methanol to oil of 6:1, reaction time of 1.5 hours, reaction temperature of 50 °C, yield of 75.4% was achieved. The fuels properties, namely, kinematic viscosity, specific gravity, flash point, cetane number, water content and iodine number are found within the limit of Indonesian National standard for Biodiesel.*

### S 05.5 **Making Biodiesel from Coconut Oil by Reaction Metanolisis Heterogeneous Catalyst**

Padil\*, Amir Awaluddin\* and Slamet Wahyuningsih\*

\* Chemical Engineering Department, Faculty of Engineering, University of Riau, Kampus Bina Widya Jl. Raya Soebrantas Km 12,5, Pekanbaru, Kode Pos 2829, Indonesia.

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*Biodiesel is one of alternative energies. Biodiesel can be made from coconut oil and is referred to as cocodiesel. This research studies the optimum condition of cocodiesel production by methanolysis reaction between coconut oil and methanol using heterogen catalyst of calcium carbonate (CaCO<sub>3</sub>) is calcined for 1.5 hours at 900°C. In order to get optimum condition, several*

experimental parameters are applied such as catalyst concentration 1-3 %-wt and molar ratio of methanol/coconut oil 4:1-12:1. The optimum condition obtained from this experimental as follow: catalyst concentration was 2%, molar ratio of methanol/coconut oil was 8:1 at 60°C, produced the highest conversion of cocodiesel 75.02%. The cocodiesel meet the requirement of Standar Nasional Indonesia (SNI) specifications, where the density was 860 kg/m<sup>3</sup>, kinematic viscosity was 2.44 mm<sup>2</sup>/s, flash point was 110°C, water content was 0.039%-v, setana number was 65.94, acid number was 0.049 mg KOH/g and iod number was 6.35 gr Iod/100 gr. Based on data analysis, the product has a qualification as diesel fuel.

## S 06: Wind Power Development

Time: 13:35 – 15:35

Room Assignment: Chiang Mai B

S 06.1

### The First Medium Wind/Diesel Pilot Project in Thailand

Supakorn Saengsrithorn and Pairach Kitworawut

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Since 2005, the people in Koh Tao (Tao Island) has electrified from diesel generation for 24 hours a day. The total installed capacity of diesel generator (DEG) is 6 MW but they cannot supply electricity at rated output because of the life time of each DEG. The average of rated output of DEG can be supplied to load is around 60% of rated output. In 2009, the maximum load at Koh Tao was 3.2 MW and minimum load was 1.4 MW. The energy reserve of DEGs is 400 kW. At this island it has a problem of power quality especially in high season of travelling because the electric energy demand is rapidly growth. Other problem is loss of profit of Provincial Electricity Authority (PEA) because PEA provides and supply electricity to load. The electricity tariff at this island is around 3.5 baht/kWh (0.11 \$US/kWh) which is same rate with mainland but the capital cost of electricity is around 8 baht/kWh (0.24 \$US/kWh). PEA loses money about 6.5 million baht (0.2 M.USD) per month. PEA attempts to reduce loss of profit and improve the power quality by using wind energy which measured the potential more than two years. The 1 x 250 kW wind turbine has installed at mountain range of Chalok Baan Kao.

S 06.2

### Fabrication and Testing of Composite Sandwich Blades for a Small Wind Power System

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The development process of a small composite wind turbine blade with efficiency over 0.3 for a 1kW wind power system is presented. The wind blade composed of glass/epoxy skin and foam core was designed in accordance with IEC standards to sustain the wind pressure of 50m/s. The wind blade was fabricated via the VRTM approach in which the foam core wrapped by glass fabric was placed in a steel mold, epoxy resin was injected into the mold to cover the skin of the blade, and the inner part of the mold was vacuumed during the resin injection process. The cured wind blade was subjected to static, dynamic, and fatigue tests to validate the reliability of the blade. The blades were used to fabricate a 1kW wind power system for long term endurance and efficiency testing. The performance of the wind power system has been found acceptable.



S 06.3 **Pumped Hydroelectric Storage Coupling Wind-Solar Resources: A  
Solution for Increase Ren on Islands Electrical Grid**

Christian Cristofari\*, Gilles Nottori\*, Motaz Ezzat\*, Ludmil Stoyanov\*\*\*,  
Vladimir Lazarov\* and Jean Louis Canaletti\*

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*The energy problem of islands differs from those in mainland countries because islands need to manage their own energy supplies. The islands are good test beds for the utilization of renewable energy production and storage technologies. We present the main problems related to the electrical production in small islands and by the utilization of renewable energy plants; the necessity to integrate some energy storages is shown and various storage means are classified. At last, the hydro pumping storage will be presented as a good solution for participating to the increase of the penetration rate of renewable energies, particularly in island electrical grid.*

S 06.4 **Voltage Stability of Wind Farms Connected to Transmission Network  
Using VSC-HVDC**

Dao Trung Hieu, V.K. Ramachandaramurthy and Min Min Kyaw

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*Voltage stability of a 200 MW wind farm using VSC HVDC link is investigated in this paper. During wind speed fluctuations, the voltage at wind farm side should be regulated with minimized power losses. This paper emphasis on voltages control strategy which is implemented in VSC-HVDC converters to obtain variable speed operation, voltage stabilization in wind farm network and transmission network respectively. Simulations using PSCAD/EMTDC are performed to study the behavior of wind farm, transmission voltage and dc voltage of HVDC systems for changes in wind speed and for different type of faults. The simulation results prove that the voltage control strategy proposed is able to improve voltage stability of wind farms.*

S 06.5 **Fault Ride through of Offshore Wind Turbines with Optimum Power  
Tracking**

Min Min Kyaw, V. K. Ramachandaramurthy and Dao Trung Hieu

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*Due to the advantage of double fed induction generator's (DFIG) controllable ability, DFIG has become a popular offshore wind turbine. The significant increase in the number of wind generation challenges wind turbine operators to supply reliable power and extract optimum power from the wind. Hence, the fault ride through (FRT) capability of wind turbine together with the optimum power tracking becomes essential. In this paper, a method is proposed to track the optimum power and ensure that the double fed induction generator (DFIG) wind turbine will continue to operate during severe power system grid faults. Extensive simulation is performed using PSCAD/EMTDC software by applying severe three phase fault. The results show that the proposed method is able to track the optimum power and ensure that the wind turbine rides through fault, and that the DFIG output voltage fulfills the grid code requirements.*

S 06.6

### **Sizing Optimization and Analysis of a Stand-Alone WTG System Using Hybrid Energy Storage Technologies**

Prabodh Bajpai, Sowjan Kumar and N.K. Kishore

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*Decentralized distributed generation technologies based on renewable energy resources such as Solar PhotoVoltaic (SPV)/ Wind Turbine Generators (WTG) address the major issues concerned with conventional diesel generators to a large extent and are therefore considered as emerging alternate power solutions to stand alone applications. Three stand alone WTG power systems using different energy storage technologies, i.e. WTG-Battery system, WTG-Fuel Cell (FC) system and WTG-FC-Battery system are optimized and compared in this paper. The analysis of such hybrid systems feeding a standalone load of 45.6 kWh/day energy consumption with a 2.3 kW peak power demand is carried out using Hybrid Optimization Model for Electrical Renewable (HOMER) software. Based on simulation results, it was found that WTG-FC-Battery hybrid system is most economic solution compare to either single storage system. Cost sensitivity analysis with wind speed is also performed in this paper.*

S 06.7

### **Optimum Sizing and Placement of DFIG Wind Turbine for Line Loss Reduction and Voltage Profile Improvement in Distribution System**

Kitti Leangkrua

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*In recent years, the number of small size wind farms used as DG source located within the distribution system is rapidly increasing. From advantage of power electronics, wind farm made up with doubly fed induction generators (DFIG). The most important benefit of DFIG is supply the continuous reactive power source to support system voltage control due to reactive power control capability of DFIG. This report studies on use of particle swarm optimization (PSO) technique to find wind farm optimal power output for distribution system losses reduction and voltage profiles improvement in distribution system. Finally, the distribution system is used as a test case to evaluate the algorithm*

## **S 07: Power System Planning, Design and Operation**

Time: 15:45 – 17:45

Room Assignment: Empress Grand Hall

S 07.1

### **Portfolio Risk Analysis Based Generation Expansion Planning Considering CO<sub>2</sub> Trading**

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*This paper presents a new generation expansion model that considers the fluctuation of fuel prices and effects of CO<sub>2</sub> trading. This model is applied to Viet Nam power sector during 2013-2030. This model finds out the efficient curve containing all feasible technology mixes. Each feasible mix represented by a value of risk-aversion factor has different value of risk, revenue from CO<sub>2</sub> trading and present value of total cost (PVTC). The result shows that the higher the PVTC, the lower the volatility of fuel cost and the higher the revenue from CO<sub>2</sub> trading. In the case of Viet Nam, if the investor selects high value of risk-aversion factor, renewables, such as*

solar and wind, will become attractive. Furthermore, coal will be the dominant technology that replaces gas and oil.

### S 07.2 **A Study of Particle Swarm Technique for Renewable Energy Power Systems**

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*Renewable power system is an innovative option for electricity generation as it is a clean energy resource. Noting the climate change becomes an important issue the whole world is currently facing, the ever-increasing price of petroleum products (now about US\$ 80 a barrel) and the reduction in cost of renewable energy power systems, opportunities for renewable energy systems to address electricity generation seems to be increasing. However, to achieve commercialization and widespread use, an efficient energy management strategy of system needs to be addressed. Recently, particle swarm optimization (PSO) has been successfully applied to the various fields of power system including economic dispatch problems. This paper presents the survey of PSO in solving optimization problems in electric power systems. The introductory sections provide the new way to implement renewable energy power system using particle swarm technique. Subsequent sections cover recent trends of PSO development in renewable energy power systems. This technique would be useful to determine the powerful energy management strategy so as to meet the required load demand at minimum operating cost while satisfying system equality and inequality constraints.*

### S 07.3 **Power System Optimization: Case Study of Sri Lanka**

Dinesh Rangana Gurusinghe and Weerakorn Ongsakul

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*The purpose of this research is study of long-term generation expansion plan (2010-2020) of power system - Sri Lanka, analysis of technical & economical constraints of existing, committed, and candidate plants of the system and formulation of a suitable mathematical model for the optimization problem for the base case (Year 2012). In this research, all power plants are categorized into three groups namely, must run or continuous run, hydro, and thermal plants and of each category is addressed separately. Must run plants committed throughout the time horizon while committed status of hydro plants depend upon the availability of water, which should satisfy a set of hydrology constraints. Thermal plants are committed to supply remaining power demand after committing both must run and hydro plants. As the optimal generation level does not depend only upon generator parameters, but also the transmission network configuration, which is also included in this research. The results shows significance of the research model and it can be applied to whatever case where relevant system data are available.*

S 07.4 **Economic Impact of Power Outage in Thailand: Industry Perspectives**

Sirirapa Panya, Woraratana Pattaraprakorn, Thanet Detmote,

Panuwat Teansri and Pornrapeepat Bhasaputra

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*This paper estimates the outage cost of industries in Thailand. The information of planned outage costs and unplanned outage costs is obtained from surveyed sample of 800 industries in the Provincial Electricity Authority (PEA) service area. The analytical results show that the average unplanned outage costs in Central region, South region, Northeast region, and North region of Thailand are 1,634,117.02 Baht/year, 1,167,333.33 Baht/year, 1,043,197.67 Baht/year and 218,310.81 Baht/year, respectively. In addition, the average planned outage costs are lower than the unplanned outage cost about 60-90%. Moreover, the annual average duration and annual average frequency outage from customer survey are 128.40 minutes/year and 5.46 events/year, respectively. Furthermore, the results in this study indicate that the economic impact of unplanned outage costs is higher than the results of previous study in all PEA service areas although the actual system performances in term of system average outage frequency index (SAIFI) and system average outage duration index (SAIDI) have been continuously improved. Not only economic growth and high technology equipment of industries affect to the increasing of outage cost, but the internal factors of industries such as process characteristic, recovery time, machines and equipment, emergency power supply also involve to the outage costs.*

S 07.5 **Long-term Peak Load Forecasting Using LM-Feedforward Neural Network for Java-Madura-Bali Interconnection, Indonesia**

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*This paper presents the application of artificial neural network (ANN) based on multi-layered feedforward backpropagation for long-term peak load forecasting (LTPF). A four-layered network using Levenberg-Marquardt (LM) learning algorithm is proposed to forecast annual peak load of Java-Madura-Bali interconnection, Indonesia, for the period of 2009-2018 considering 11 regional factors encompass economic, electricity statistics, and weather thought to affect the load demand. The proposed network structure is first trained over the past 11 years (1995-2005) to forecast annual peak load of 2006-2008. Afterwards, the justified network structure is trained over the past 14 years (1995-2008) to forecast annual peak load of 2009-2018. Several simulations involve changes in historical actual peak load target and variation on projected regional economic growth are carried out to observe the network adaptability. Results are then compared with that achieved by the multiple regression model and projection made by utility. In this case, forecasting result exhibited by the proposed network is the closest to actual values of 2006-2009 among others taken the average error of 0.2%. Likewise, its forecasting differences for 2010-2018 are less than 7% compared to others. In term of network adaptability, outputs generated by the network are well adjusted to the projected inputs variation.*

S 07.6

## **Shihmen Sediment Prevention Diversion Tunnel Planning and Design**

*Hoshong Hou\**, *Mingshun Lee\** and *Percy Hou*<sup>#</sup>

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*Shihmen reservoir was started in May 1963. The main purposes of Shihmen reservoir are for agriculture, power supply, flood control and tourism. Shihme Asn dam is an earth dam. Its crown height is 133m above mean sea level, with length 360 m, watershed 763.4 km<sup>2</sup>, and maximum volume 309 million cms. Turbidity in Shihmen dam was severely affected by typhoons Aere (2004) and Masa (2005). Increased deposition after Aere was 28 million cms. Turbidity at Shihmen Canal Inlet is 3000 NTU (Nephelometry Turbidity Unit). Sediment sluicing strategies for downstream channel are demanded. Therefore, diversionary sediment preventing channel is planned in the upstream of Shihmen reservoir. Finally, turbid flow in tunnel channel is bypassed and diverted its flow down to downstream.*

S 07.7

## **Application of GIS to Distribution Substation Planning: Case Study of Metropolitan Electricity Authority**

*A. Phayomhom*<sup>\*\*</sup>, *C. Yangyuenbangchan*<sup>\*</sup>, *C. Thongkulaphat*<sup>\*</sup> and *S.*

*Sirisumrannukul*<sup>\*</sup>

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*This paper proposes an application of Geographic Information System (GIS) to distribution substation planning for distribution systems of Metropolitan Electricity Authority (MEA). The main objective is to serve future load growth and to increase the reliability of the distribution systems. GIS is extensively used in the planning process as it contains comprehensive topological information of electrical equipment from transmission substations, distribution substations, power transformers, and distribution transformers to revenue meters at customers' sites. It also gives the number of customers in each feeder and power demand in small areas. With this information, it is possible for MEA to have accurate and reliable results with effective investment. In addition, the system reliability in specified area can be evaluated.*

### **S 08: Potential and Application of Biomass and Biogas**

Time: 15:45 – 17:45

Room Assignment: Chiang Mai A

S 08.1

## **Potential of Thermoelectric Power from Bagasse by Sugar Mills of Pakistan**

*Mohammad Rafiq Khan*

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*Potential of thermoelectric power from bagasse by sugar mills of Pakistan was studied to explore whether a significant quantity of electricity could be produced from the biomass of this waste left as surplus after its use to fulfill mill's in-house requirements. The data concerning the production and disposal of bagasse and indigenous production of electricity for mill use by its incineration were collected from 8 sugar mills as models through successive visits/telephones*

and interviews of managements. The data from some mills were also collected via e-mail and telephone. The production data at Pakistan level was collected from Pakistan Sugar Mills Association by interviewing its office holders. The results indicated that there is a significant potential of production of thermoelectric power from biomass of bagasse surplus in sugar mills. Assuming that the mills run twenty four hourly for 100 days a year, the total production of bagasse on the basis of cane crushed in 2008-09 was 17,835,000/m ton per annum or 7,431 m ton per hour. When averaged on the basis of the cane crushed over the last three years, it turned out to be 16,603,370 m ton per annum and 6,918 m ton per hour and if on recent five years, it come out to be 13,569,180 m ton per annum and 5,654 m ton per hour. The electricity produced for these three scenarios would be 1,304mw/hr, 1,236mw/hr and 992mw/hr. The current production of electricity by sugar mills on the basis of average from models is 478mw/hr. Thus there is an extra potential of production of electricity by sugar mills 826 mw/hr, 736mw/hr and 514mw/hr in these scenarios. The interviewees also claimed that there was a potential of production of electricity amounting to 1,600mw/hr by sugar mills of Pakistan from molasses a by-product of sugar industry through biogas technology. This leads to an overall potential of 2,426mw/hr, 2,336mw/hr and 2114mw/hr respectively. The results look quite encouraging as these can be used in policy framework to be developed for controlling energy crises in Pakistan and can be reproduced all over the globe to help in overcoming energy crises at large.

## S 08.2 **The Competitive Economic Potential of Biomass Plantations for Bioenergy Production in Europe**

*Chrystalyn Ivie S. Ramos and Uwe A. Schneider*  
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*Energy from biomass is one strategy that has received extensive attention to engage the global concerns in conventional energy insecurity and climate change, which have motivated the search for and utilization of alternative energy sources. This endeavor has been strengthened by energy and environmental policies and related targets in different nations worldwide. Reliable knowledge of competitive economic biomass potentials for energy in Europe is essential for both policy and industry in Europe to design efficient policies for the development of the renewable energy sector. This paper exhibits simulation results from the European Forest and Agricultural Sector Optimization Model (EUFASOM). The research assesses the viability of biomass energy plantations for electricity, heat and biofuel production combining economic and ecological perspectives within a welfare maximization approach. Particularly, EUFASOM is used to analyze the competition for land of different European agricultural land use options to determine the economically competitive portion of the technical potentials of biomass energy plantations. Furthermore, the model addresses the impacts of bioenergy production in Europe under different environmental policy scenarios. Results show that the implementation of bioenergy policies in Europe such as energy targets or price incentives incurs substantial economic limitations because of competition between different land use options. Restrictions aimed at avoiding negative environmental impacts of indirect land use change further decrease the economic potential of bioenergy.*

## S 08.3 **Feasible Study of Biogas Energy for Thai Dairy Cooperative from Dairy Cow Manure: The Potential and Economic Analysis**

*Woraratana Pattaraprakorn, Rakpong Saikaew and Pornrapeepat Bhasaputra*  
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*The objective of this study is to estimate the potential of energy from dairy cow manure for the dairy cooperatives in Thailand. According to the information from the Cooperative Promotion Department, there are 118 cooperatives with 25,757 dairy farmers and 364,745 dairy cows. In*



addition, the dairy cow cooperatives, farmer numbers and cow numbers are divided by regions and the potential of energy is presented in various forms. The highest number of cow by region is found in the Central region with 262,805 dairy cows. The highest number of cow is found in the dairy cooperative in the Central region with 71,952 dairy cows. The highest energy potential is in the Central region with 1,202,656 MJ/day of LPG equivalent. Using the model from a previous successful study in Lamphayaklang Reform Land Dairy Cooperative, the analytical results of finances index, the net present values (NPV), is propose to evaluate the feasible of biogas plant establishment. The results show that the NPV from total Thai dairy cooperatives is about 953,261,057.50 Baht and the NPV of the Central region is 686,840,867.50 Baht that the number of dairy cow cooperatives is 40.68% of total number of dairy cow cooperatives in Thailand. Finally, this paper provides an overview of the potential energy from biogas plant that could use as the renewable energy under the sustainable energy concept.

S 08.4                    **Production of Thermoelectric Power from Solid Waste of Some Educational Institutions of Lahore**

*Mohammad Rafiq Khan*

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*This research article integrates the work undertaken in sustainable development context by Lahore School of Economics to study feasibility of production of thermoelectric power by incineration of biomass of solid waste of Lahore School of Economics (LSE), Lahore University of Management Sciences (LUMS), Kinnaird College (KC) and Government College University Lahore (GCUL). The researchers collected requisite data concerning production and disposal of solid waste from scheduled institutions and that concerning the production of electricity from solid waste such as bagasse from Pattoki Sugar Mill. The data were used to design different projects which were subsequently appraised to determine their B/C Ratio, NPV by discounted cash flow techniques and payback period by conventional method. The appraisal of basic projects indicated that the projection was not feasible for scheduled institutions except Government College University Lahore which qualified the criteria of feasibility. Factors that rendered projects non-feasible were the cost of land and insufficient amount of solid waste. The projects could be pulled towards feasibility by changing these parameters. Thus the appraisal provides a solid base for working out strategies to exploit this source at institution to global level to overcome the ongoing energy crises. This policy paper attempts to answer, "How to work out these strategies?".*

S 08.5                    **Direct Coupling of an Updraft Gasifier with a Stirling Engine to Produce Power from Solid Biomass**

*Lin, Jeng-Chyan Muti, Wang, Sung-Kai, Yan and Zhi-An*

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*The current study proposes a small scale solid biomass powering system to explore the viability of direct coupling of an updraft fixed bed gasifier with a Stirling engine. The modified updraft fixed bed gasifier employs an embedded combustor inside the gasifier to fully combust the syngas generated by the gasifier. The flue gas produced by the syngas combustion inside the combustion tube is piped directly to the heater head of the Stirling engine. The engine will then extract and convert the heat contained in the flue gas into electricity automatically. Output depends on heat input and the heat input is proportional to the flow rate and temperature of the flue gas.*

S 08.6

### **Effect of Chemical Treatment on Biogas Production from Bambara Nut (*Vigna Subterranea*) Chaff and its Blend with Some Wastes**

Ofoefule, A.U. and Ibetto, C.N.

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*A comparative study of the effect of chemical treatment on biogas production from Bambara nut (*Vigna Subterranea*) chaff and the chaff blended with; cow dung (BNC:CD), swine dung (BNC:SD), field grass (BNC:FG), and cassava peels (BNC:CP) in the ratio 1:1, all treated with KOH (50% w/v) was investigated. The different variants from the treated wastes were charged into 50L metal prototype biodigesters in the ratio 3:1 water to waste. They were all subjected to anaerobic digestion under a 65 day retention period and temperature range of 25°C-41°C. Results obtained showed that BNC had a cumulative gas yield of  $186.9 \pm 2.6 \text{ dm}^3/\text{TMS}$  (Total mass of slurry) with the flash point on the 5<sup>th</sup> day even though the flammability discontinued on the 9<sup>th</sup> day. Blending and chemical treatment increased the cumulative gas yields and sustained onset of gas flammability of the cow dung and field grass blends with the BNC: CD having cumulative gas yield of  $223.80 \pm 2.7 \text{ dm}^3/\text{TMS}$  and flash point on the 26<sup>th</sup> day while BNC: FG had  $207.70 \pm 2.0 \text{ dm}^3/\text{TMS}$  and flash point on the 56<sup>th</sup> day. However, there was no observed positive effect of the treatment on BNC: SD and BNC: CP with cumulative gas yields of  $130.80 \pm 2.3 \text{ dm}^3/\text{TMS}$  and  $132.30 \pm 2.5 \text{ dm}^3/\text{TMS}$  respectively and with both systems not producing flammable biogas throughout the retention period. Results of mineral ions content showed that while most of the minerals were found in reasonable levels within the limits required,  $\text{Ca}^{2+}$  exceeded the limit and was actually at a level capable of inhibiting biogas production. Overall results showed that Bambara nut chaff is a highly unstable waste which blending and chemical treatment did not improve tremendously.*

S 08.7

### **Loss Measurement Techniques at Field Level of Three Phase AC Induction Motor**

I. Daut, K. Anayet, N. Gomesh, M. Asri, Syatirah, M. Muzhar

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*This paper describes the loss measurements techniques at the field level for AC induction motor. The standard requirements is the conventional no-load test to measure the "rotational losses" (sum of the core, friction and windage losses) and stator copper loss. Based on the no-load test several parameters such as the no load resistance, reactance, impedances as well as the per-phase magnetizing current and per-phase core loss current is obtained. Practical setup for loss measurements presented in this study.*



**S 09: Emerging and Advance Energy Technology**

Time: 15:45 – 17:45

Room Assignment: Chiang Mai B

**S 09.1 Chelate Effect on the Synthesis of Carbon Supported Pt Nanoparticles for PEMFC Anodes**

Shyh-Jiun Liur\*, Chia-Hung Huang<sup>†</sup>, Weng-Sing Hwang<sup>#</sup> and Der-Yuan Lee<sup>^</sup>

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*Colloidal suspensions of spherical crystalline Pt nanoparticles with a narrow size distribution were synthesized using a microwave synthesis process. Analogous Pt-complexes (Pt(dien)<sup>2+</sup>, Pt(trien)<sup>2+</sup>, and Pt(en)<sub>2</sub><sup>2+</sup>, where dien = diethylenetriamine, trien = triethylenetetraamine, en = ethylenediamine) were deposited onto Vulcan XC-72 carbon powder to obtain Pt/C-x catalysts (x = 3, 4, and 22 represents the coordination number of the chelating agent). The Pt/C-x catalysts were evaluated under PEMFC conditions. X-ray diffraction and transmission electron microscopy were used to characterize the Pt/C-x catalysts. It was found that the Pt nanoparticles were uniform in size and highly dispersed on the carbon black supports. The chelating agents were expected to improve the growth of Pt particle size as well as the dispersion of Pt nanoparticles. In the PEMFC experiments, the mass-specific current density and mass-specific power density of the catalysts were as high as that of the commercial 20wt % Pt/C-ETEK catalyst.*

**S 09.2 The Minimum of Thermal Resistance Design of High Power LED Package**

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*The aim of this article attempts to explore the optimal design of the high power LED package related the thermal resistance. To achieve the optimal design of the size of the slug inside the LED package is our purpose to improve the heat dissipation. The simplified conjugate-gradient method (SCGM) is adopted to combine with the finite element method to optimize the shape of the slug inside the LED package. The results show that the shape of the slug changing directly affects the temperature profile inside the LED. The heat generated from die can be removed more by the change of the slug. It is obvious that the proposed method is effective on thermal optimization of the LED package. It may give rise to a new insight and more innovative possibilities in the development of the new generation LED.*

S 09.3 **Design of TiO<sub>2</sub> Spherical Particles as a Light-scattering Layer in Dye Sensitized Solar Cells**

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*A thin layer of spherical TiO<sub>2</sub> particles was designed and fabricated as a light-scattering layer in the electrode device of dye-sensitized solar cells (DSCs) to improve the power conversion efficiency. The spherical TiO<sub>2</sub> particles were synthesized and prepared (300 nm) uniformly using a sol-gel method. The solution sample of these spherical particles, and these particles mixed with the other type of sol-gel TiO<sub>2</sub> particles (30 nm), was coated on top of a P25-TiO<sub>2</sub> sample as a modified electrode. The multi-layer TiO<sub>2</sub> electrodes were immersed in dye solution to adsorb dye (N719) and further assembled to be DSCs. The transmittance of this multi-layer TiO<sub>2</sub> electrode was tested and showed a low transmittance in the visible light region. From the solar simulator measurements, the performance of the modified DSC device was improved, compared with one using the electrode without this light-scattering layer. The efficiency of the modified DSCs increased relatively about 12% higher due to the presence of the spherical TiO<sub>2</sub> layer. The contribution of the relatively higher efficiency attributed to the light-scattering layer which increases the photo-current value ( $I_{sc}$ ). The modified TiO<sub>2</sub> electrode can be applied in the DSC design to improve its performance.*

S 09.4 **Technological Development of a PEMFC-Based CHP System**

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*Hydrogen fed PEMFC has to overcome high installation and operation cost before being adopted as a distributed power candidate. Cogeneration of power and heat is a good approach to increase hydrogen energy utilization rate. A micro PEMFC-based power and heat cogeneration system is proposed and established in the current study to investigate system's technological and economical feasibility. This CHP system composes of a 2.5 kW fuel cell stack, hydrogen supply system, air supply system, water and heat management system and heat recovery system. The control strategies to automate the system operation are realized by a PAC system. Detailed measurement of the system is also constructed along with a web-based HMI platform to facilitate experiments and demonstration. Preliminary testing of the CHP system showed good performance of heat and power outputs. System combined efficiency is measured at about 73%.*

S 09.5 **Advanced Energy Research of College of Engineering at National Tsing Hua University**

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*The advanced energy research is vital on national strategic level of Taiwan and pursued by College of Engineering of National Tsing Hua University, top tier higher education and research institution in the country. The current paper introduces the major research in this regard and crowned by the grant of National Energy Project recently approved. The solar and wind energy are adopted for the innovative "Air Power City" utilizing compressed air energy of zero-emission to substitute the common petrochemical energy from gasoline. Wind turbines and sterling engines are examined to convert the wind power and solar power to mechanical energy. For solar energy, film deposit by sputtering with a quaternary CIGS compound target is studied to*

meet the requirement for mass production, large deposition area and high throughput for commercial purposes. A vertical type of small wind turbine blades integrates the specialties to develop key components of composite material wind turbine as well as the high performance converter. The effective system integration is explored to reduce the overall cost and enhance performance. The next-generation electrochemical supercapacitors more advanced than the EDLCs in both energy and power densities are being developed utilizing double-layer and faradaic capacitances. Enhancement of energy efficiency by recycling energy waste is often practiced for the high-temperature industrial waste heat, while the low-temperature waste heat is hardly reused but dumped into the environment. Thermoelectric generator (TEG) converts heat into electricity when a temperature difference exists across the TEG module, and is considered perfectly suitable for low-temperature waste heat harvesting. A prototype generating 300 watts at 12 volts with a temperature difference of 150 °C will be demonstrated. Finally, the CO<sub>2</sub> reduction is endeavored including the capture by chemical absorption, physical adsorption, chemical looping process, and conversion of CO<sub>2</sub> into energy products.

S 09.6

### **Fabrication and Test of Gamma-Type Stirling Engine**

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In this investigation, a gamma-configuration Stirling engine is designed and constructed. The single and twin power cylinder engines are tested with air at atmospheric pressure by using an electric heater as a heat source. The engine is tested with heater input of 156.3W, 187.6W, and 223.2W. Variations of engine torque, shaft power and brake thermal efficiency with engine speed and engine performance at various heat inputs are presented. The results indicate that at the maximum heater input of 223.2 W, the heater temperature for single power cylinder and twin power cylinder are 612 °C and 574 °C. The two engines produce a maximum torque of 0.13 Nm at 405 rpm and 0.15 Nm at 412 rpm; a maximum shaft power of 5.73 W at 456 rpm and 6.47 W at 412 rpm; a maximum brake thermal efficiency of 2.57 % at 456 rpm and 2.9 % at 412 rpm, respectively.

S 09.7

### **Assessment of CO<sub>2</sub> Reduced from Utilizing Fuel Cell in Electricity and Heat Generation**

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This study aims to analyze the calculation of CO<sub>2</sub> released from utilizing high temperature fuel cell in electricity and heat generation. This calculation is based on clean development mechanism (CDM). The effects of related variables and optimal utilization to reduce CO<sub>2</sub> have been examined. Based on the assumption of the study, the calculation shows that the amount of CO<sub>2</sub> released from fuel cell electricity and heat generation reaches 1876 tCO<sub>2</sub>/MW. For the economical study, the optimal capital for utilizing fuel cell in electricity and heat generation has been examined. Moreover, the operations with and without carbon credit trading of reduced CO<sub>2</sub> have been compared and analyzed. The study shows that carbon credit trading leads to high capital. It is also found that maximum capital of all case studies is not more than 29 million baht/MW; IRR is equal to 5% without CDM and the project lasts 10 years.

## S 10: Smart Grids and Active Distribution Networks

Time: 09:45 – 11:45

Room Assignment: Empress Grand Hall

S 10.1

### Roadmapping the PEA Smart Grids

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Provincial Electricity Authority (PEA) has engaged in the development of Smart Grids. Smart Grids is the future of electric power system and electricity supply businesses. A development process of Smart Grids is continuous and collaborative and involves several stakeholders. A clear picture of Smart Grids enables all stakeholders to accelerate the development process. Roadmapping is a way of imaging and expecting a series of future pictures at different points of time. This paper shows the application of roadmapping in visualizing the PEA Smart Grids.

S 10.2

### Reliability Index Forecast by Fuzzy Principle

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This paper proposes the reliability index forecast of the feeders in the central area of Provincial Electricity Authority (PEA), during 2002 – 2009. The failure rate distribution of each protective device (Breaker, Recloser and Fuse) is assumed by Weibull distribution. In addition, fuzzy set is introduced to describe the uncertainty of those failure rates by combining each failure rate of protective devices which effect to a load point. Finally, the incoming year System Average Interruption Frequency Index (SAIFI) of each feeder can be calculated by fuzzy principle base on the evaluated failure rates and number of customers at that load point.

S 10.3

### Optimal Placement of DGs Using MINLP in Deregulated Electricity Market

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Distributed generators (DGs) are small generating units connected directly to the distribution networks. As distribution networks are interconnected with the transmission networks, the impact of these DGs to enhance the reliability of the whole system can be observed. System loadability, total power loss in the system and total cost of the system are some of the important aspects in planning the DGs throughout the network. In this work, optimal sites for placement of DGs have been identified by using mixed integer nonlinear programming (MINLP) approach. The optimal sites are the different distribution networks connected to the transmission system under consideration. Also, the sizing of the DGs is taken into consideration, while enhancing the reliability in terms of system loadability, total power loss in the system and total cost of the system. The approach includes three optimal power flow (OPF) problem formulations, in which the objectives are to maximize the system loadability, and minimize the total power loss in the system and total cost of the system subjected to the constraints of power balance equations, power flow limits in each transmission line, voltage limits at every bus. In these problem

formulations one binary vector is introduced that indicates the site of the DG location at various load serving nodes. The results are illustrated on Standard 5-bus test system and IEEE 24-bus Reliability Test System (RTS).

#### S 10.4 **Performance of Oman Transmission System with Distributed Generation**

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The paper presents simulation studies of installing distributed generation (DG) at a number of grid stations in the main transmission system of Oman. The diesel-engine driven generator units are required on a temporary basis to aid in meeting the peak demand. A digital model is developed to simulate the system including power plants, transmission system, loads and the proposed DG. The simulation studies are performed by using the DlgSILENT software package. The objective of the studies is to demonstrate effects of the DG in improving system performance in terms of voltage profile, line and transformer loadings, and transmission losses. The results include comparison of the contribution of individual generation at each site and the case with all proposed distributed generators installed.

#### S 10.5 **Loss Minimization and Capacity Saving in Residential Networks - An AIT Case Study**

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This paper opens up a novel technique of end-user based energy saving and loss reduction technique evolved from a energy audit study conducted in the residential dormitories of Asian Institute of Technology (AIT) Bangkok, Thailand. An automatically switched capacitor was connected to some of the residential socket plugs of each dormitory and analyzed the capacity saving and loss minimization. This study focused on the healthy conclusion that a substation and a DG of 500 kVA could able to be eliminated in terms of the capacity investment and there was also a marginal saving in the institute monthly electricity bill payment to the Provisional Electricity Authority of Thailand due to the reduction in network losses.

#### S 10.6 **Investigation on Photovoltaic/Hydrogen Hybrid System for an Isolated Electrical Grid**

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The object of the study is to reduce the daily load peaks on an insular electric network (corsica island, france) using with help to renewable energy systems. the methodology is based on an energy balance between a pv array, an electrolyzer and fuel cells (50 kw) supplying a seasonal load profile built from electrical network load peaks. this load is supplied firstly by the pv array and the fuel cell produces complementary power when the pv system is deficient. an electrolyzer, using unconsumed pv energy produces hydrogen for the fuel cell. in the present work, at the beginning of the operation, the hydrogen stock is sufficient to satisfy a given

number of days corresponding to the system autonomy (loss of load probability = 0). solar and ambient temperature data were measured at our laboratory weather station in ajaccio (41°55' n, 8°48' e, 70 m altitude). hourly data are available for the years 1998 to 2004. the originality of this approach was to determine a whole methodology allowing to obtain quickly sizing curves for a pv/h2 hybrid system supplying a given load (remote sites and/or grid connection).

S 10.7 **High Speed Data Acquisition System Using FPGA for Detection and Counting of Partial Discharge in High Voltage Underground Cable**

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*The FPGA (Field Programmable Gate Array) technology is widely used today for signal processing and control owing to its fast digital processing capabilities. Using this, a test-bed high-speed data acquisition system that combines a commercial FPGA board (ML405) with the ADC in PIC micro-controller 16F877A that has 8 bit in resolution, sampling rate of 20 MS/s and bandwidth of 10 MHz for counting very high speed transient signals has been developed and successfully tested in the lab. This system enables direct measurement and counting of the transient signals at 50-100 ns pulse width at a sampling frequency 20MHz. All the results are shown to proof the concept for detecting partial discharge with pulse width of 5 ns in high power underground cables. The advantage of this system is that it can easily be deployed and count simulated Partial Discharge signal without the use of an oscilloscope and PC. The work in this paper comprises of using VHDL programming in FPGA to capture and discriminate the high-speed transient signals that has been digitized by the ADC in PIC micro-controller. Several features such as counting and discrimination between pulses are integrated in the system are also shown. This concept will be used in the future to detect real partial discharge generated in high power underground cables in the field.*

**S 11: Energy Use in Rural and Urban Settings**

Time: 09:45 – 11:45

Room Assignment: Chiang Mai A

S 11.1 **Preparation Energy Poverty and Income Poverty Linkages: Indian Experience**

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*The Millennium Development Goals (MDGs) are the international community's commitment to halving poverty in world's poorest countries by 2015. World Summit for Sustainable Development in Johannesburg in 2002 recognized the access of energy services as a prerequisite to achievement of all MDGs. Provision of energy services is important for almost all aspects of human welfare, including access to water, agricultural productivity, health care, education, job creation, and environmental sustainability. Yet, worldwide about 2.4 billions people still lack access to safe and reliable energy and about 1.6 billion people do not have access to electricity. 'Energy poor' having lack of access to clean and modern energy sources such as Liquefied Petroleum Gas for cooking and electricity for lighting tend to spend a large portion of their income and time on acquiring energy fuels. Higher financial burden faced by 'income poor' in meeting their energy needs acts as a deterrent to upward movement of people*



on the energy ladder towards high priced clean fuels and thus aggravating the problem of energy poverty. This establishes the two way linkages between the two, wherein income poverty leads to energy poverty and energy poverty further acts as a hindrance to improvements in income level and thus creating a vicious circle. India faces acute energy poverty as about 89% of rural and about 24% of urban households depend on polluting sources of energy such as firewood, chips and dung cake for meeting their cooking needs. Also, access to electricity is just limited to about 56% of total households. Energy poverty has far reaching adverse social and economic impacts. It is surprising to note that despite lacking access to clean fuels, people with lowest income spend more than 12% of their total expenditure on energy fuels. The energy consumption patterns of poor people tend to aggravate their income poverty. With the above background, this paper discusses the problem of energy poverty in Indian context and its adverse social and economic impact and highlights its linkage with income poverty. The paper also analyses the measures taken to address energy poverty keeping in view its linkage with income poverty and recommends the regulatory and policy measures as a way forward for addressing the problem.

### S 11.2 **Powerbike to Enhance Hybrid PV-Diesel system for rural primary school**

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The education policy of Thai Government to explanation a free education to all Thai citizens under the primary school. This is a good policy gave an equivalent to Thai citizen to get a basic need of education in all regional in Thailand which most of citizen are agriculture families and located in rural area. The infrastructure in the metropolis is great support by the government agencies, the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA). In the other hand, there are many rural area of Thailand, are no electricity supplied include all education schools in that area. In this paper is enhanced security of electrical supply for rural area with had hybrid PV-Diesel as a main electrical supply to primary school by integrated powerbike station. According to the unreliable of the hybrid PV-diesel supplied in the rural school area. The powerbike station is designed to enhance the electrical assurance with energy recovery and sustainable electrical energy at Tanpuyinsang Ingkuranon Primary School in Ban Phu Fa, Bo Kluea District, Nan Province. The powerbike stations were enhanced the hybrid PV-diesel under risk management concept and optimal energy management schedule. The experimental results demonstrate the optimal schedule can reduce diesel fuel about 144 liters or 5,244.48 MJ per year which is 40% of energy cost and improved students healthy and environmental.

### S 11.3 **Solar Lantern Rental System: Paying for the service, not the hardware**

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This paper is a concept note on Sunlabob's latest innovation to tackle the challenge of rural electrification using renewable energy sources in developing countries. A technical and operational description is given of a rechargeable battery lantern and solar charging station rental scheme. Sunlabob has developed a package based upon a village entrepreneur operating a solar charging station on a rental basis. The entrepreneur charges portable lanterns,

and circulates them among village households in return for a fee collected for each recharge. The revenue covers the costs of operating the system on a commercial basis. For households, the recharging fee is a regular small expense, qualitatively comparable to buying kerosene at the village outlet. Sunlabob's experience has shown that technical expertise is essential but it needs to be combined with a robust operational and financial model offering economic sustainability, for rural electrification programmes to be successful and have long-lasting benefits for populations in developing countries. Involvement of local populations is also decisive, both for a smooth transition and for good management and maintenance of the renewable energy solutions proposed.

#### S 11.4 **The Potential of Sustainable Energy in Thammasat University Rangsit Campus**

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*The potential of sustainable energy in Thammasat University, Rangsit campus is studied in term of energy efficiency and environmental aspect. The achieved national regulations for buildings in Thailand, such as building code and green building, are the guideline to set up the optimal energy policy for academic campus. In addition, the evaluation of energy efficient and environmental friendly buildings is used to evaluated the scores of the 12 selected buildings in Rangsit campus by 9 categories that are Building Site, Planning and Architecture Work, Building Envelop, Air Conditioning System, Lighting System, Natural System and Alternative Energy, Sanitation System, Materials and Construction and Planning Techniques and Strategies in Energy Saving/ Environmental Conservation. Furthermore, the standard measures for energy conservation from the successive projects of the Energy Ministry are proposed to enhance the energy management in the Rangsit campus. The analytical results show that the energy consumption can be reduced up to 5% with the conservative sustainable energy concept. Finally, the key points to achieve the sustainable energy for academic campus are concluded.*

#### **S 12: End Use Energy Efficiency**

Time: 09:45 – 11:45

Room Assignment: Chiang Mai B

#### S 12.1 **Multi-Scenarios of Effective Demand Side Management in Navanakorn Industrial Promotion Zone**

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*This paper studies the multi-scenarios of effective demand side management by implementing energy conservation programs in 51 designated factories according the Energy Conservation Promotion Act No. 2 B.E. 2550 (2007). In addition, 5% of peak demand reduction is estimated from the industries in Navanakorn industrial promotion zone that use to evaluate the effect of energy conservation programs and to investigate the limit of substation capacity. Moreover, the optimal management of diversity factor is indicated base on the estimated peak demand reduction by energy conservation programs and the annual demand growth of 3 substations. The surveyed results show that the peak demand can be reduced up to 1.97 MW with implementing energy conservation programs which mostly come from electronic ballast replacement measure. However, the analytical results of energy conservation project analysis show that the energy efficiency improvement is still a high potential for Navanakorn industrial promotion zone. Furthermore, the simulation results of multi-scenarios demand side*



management with the energy conservation programs illustrate that the substations can be supplied industries in Navanakorn industrial promotion zone until 2016 with 96.15% of total transformer capacity in case 5% of peak demand reduction from fully implemented energy conservation programs is achieved. Finally, the effective demand side management programs of the designated factories are the opportunity to extend the new substation.

S 12.2 **Result of Road Lighting Energy Saving Project Implementation through the Use of Public Private Partnership Scheme**

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*This paper is to summarize the result of road lighting energy saving project carried out by Provincial Electricity Authority (PEA) through the use of Public Private Partnership (PPP) scheme. Energy saving using power reducing equipments for high pressure sodium (HPS) road lighting has been installed to alleviate the use. The result has been satisfactory with saving energy of about 25-30%. Investment cost leads to a large financing burden to PEA. Monitoring, maintenance and management systems have been strongly needed. Large number of road lighting is significant barrier to extend the project throughout the country. PPP scheme associated with Energy Service Company (ESCO) is a new approach to cope with these difficulties. Universities were adopted in dealing with this PPP project. Investment cost, financial charge and other expense were provided by the universities. Amount of actually saved energy stream would be paid to those universities until its investment costs have been fully recovered along the project contracting period. The result shows that the implementing scheme tends to be a sustainable project development. Moreover, the basis of financial scheme is able to be applied to other energy saving projects.*

S 12.3 **The Strategic Management of Energy Service Company to Enhance the Sustainable Energy Management in Thailand**

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*Thailand imports a large portion of crude oil which equals to 12 % of GDP in 2008 for driving the growth of Thailand economy. Several countermeasures are developed from various fields of responsibility in order to provide the sufficient and sustainable energy policy. This paper reviews the development of energy service company (ESCO) in Thailand which is expected to be an important player for the policy of energy conservation and efficiency. In addition, the strategic management of ESCO under the roles of Thai government, private organizations and ESCOs are also analyzed with the current countermeasures and the future trend measures by considering three options of energy performance contracting (EPC). The results of analysis show that the strategic management of ESCO mainly depends on the directive of Thai government especially the enforcement of law and regulation. The ESCO with guaranteed saving contract will be dominant player if the law and regulation are effective enforced in the future. Moreover, the ESCO with shared saving contract will be the highest feasibility under the fully supported financial; however, the participation of the ESCO with consultant contract will decrease with significant level. Finally, the strategic management of ESCOs in Thailand is presented.*

S 12.4

### **Multi-Criteria Decision Analysis for the Selection of Alternative Options Towards Environmentally Sustainable Transport System in Bangkok, Thailand**

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*The demand for energy in the transport sector in Bangkok, Thailand has increased rapidly during the last few years. Accordingly, this sector becomes one of the main source of GHG and other harmful emissions. The GHG and other harmful emissions would affect the urban quality and detrimental to global environment. Various alternatives need to be done towards environmentally sustainable transport system in Bangkok. There are seven alternative options that have been identified to be introduced to the transport system in Bangkok, i.e., car pool subsidy, promoting bicycle transport, electric railway expansion, small efficient vehicle promotion, road management for efficient transportation, taxi improvement, and bus line improvement. This study develops a model to examine the seven alternative options based on the adaptability criteria to find which option is the best to be introduced to the transport system in Bangkok. The results show that electric railway expansion would be the most potential in contributing towards environmentally sustainable transport system in Bangkok, and then followed by small efficient vehicle promotion, and bicycle transportation. This study also develops a model to examine the barriers of implementing the seven alternative options. The results show that bus line improvement has the least barriers to implement, and then followed by taxi management. The results also show that car pool subsidy has the highest barriers and then followed by bicycle transportation.*

S 12.5

### **PCM Thermal Energy Storage and Cooler Night Temperatures for Pretreatment of Ambient Air Introduced in the Building**

*Adeel Waqas and S. Kumar*  
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*Storage of cooler night temperatures using Phase Change Material (PCM) energy storage technique, for cooling of ambient air during hot day times can be an alternate of current cooling techniques in building sector. Such technique can be helpful in the reduction of electricity consumption by building sector and consequently reduced green house gas (GHG) emissions. Latent heat storage technique is preferred over other storage techniques due to its high energy storage density and ability of storing heat/coolness at certain constant temperature. This study presents the storage of cooler night temperatures for achieving comfort temperatures during day times in hot and dry climatic conditions. The results clearly indicate the feasibility of PCM based systems to provide comfort during the hot day time during summer season. Effect of phase change temperature of the storage material on the performance of storage unit is studied. It has been found that, when storage material phase change temperature is equal to the comfort temperature of hottest summer month; performance of storage unit is maximized for all the summer months.*

S 12.6

### **Energy Efficiency in Industrial Facilities**

*Amit Chadha*  
Schneider Electric India

*The industrial sector contributes for 45% of the Thailand electrical energy consumption. Energy consumption in industries presents high potential for energy savings, but the way the energy usage is interlocked into the process needs to be understood in order to minimize waste*

energy. Schneider Electric shows that energy auditing of the facility and a systems analysis approach is the first step to implementing energy efficiency measures.

### S 13: Energy Efficiency and Heat Transfer 1

Time: 10:20 – 12:00

Room Assignment: Chiang Mai A

S 13.1

#### **Thermal Enhancement in a Solar Air Heater Channel Using Rectangular Winglet Vortex Generators**

Nattawoot Depaiwa, Teerapat Chompookham and Pongjet Promvonge  
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The forced convection heat transfer and friction loss behaviors for turbulent airflow through a constant heat flux channel solar air heater with rectangular winglet vortex generator (WVG) are experimentally investigated in this work. The rectangular winglet pairs are considered with two different arrangements by pointing upstream (PU) and pointing downstream (PD) of the flow. Ten pairs of the WVGs with various attack angles ( $\alpha$ ) of  $60^\circ$ ,  $45^\circ$  and  $30^\circ$  are mounted on the test duct entrance wall to create longitudinal vortex flows over the tested channel. Measurements are carried out for the rectangular channel air heater of aspect ratio,  $AR = 10$  and height,  $H = 30$  mm with the WVG height,  $b/H = 0.4$  and a transverse pitch ratio,  $P/H = 1$ . The flow rate is in terms of Reynolds numbers based on the inlet hydraulic diameter of the channel ranging from 5000 to 23,000. The experimental results show that the solar air heater channel with rectangular WVG provides significantly higher heat transfer rate and friction loss than the smooth wall channel. The use of larger attack angle value leads to higher heat transfer rate and friction loss than that of lower one. The PD-WVGs performs higher heat transfer rate and friction loss than the PU one for similar operating conditions. In comparison, the largest attack angle ( $\alpha = 60^\circ$ ) of the PD-WVGs yields the highest increase in Nusselt number and friction factor while the lowest attack angle ( $\alpha = 30^\circ$ ) of the PU-WVGs shows the best thermal performance.

S 13.2

#### **Drying Kinetic of Peppercorns in a Rectangular Fluidized-bed with Wavy Surfaces**

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The paper presents the comparative study of drying peppercorns in a rectangular fluidized-bed and a rectangular fluidized-bed with wavy surfaces. This experimental work has been carried out in two different drying bed configurations: rectangular bed and rectangular bed with wavy surface (called "wavy surface bed"). The wavy surface bed is used to produce a stronger turbulence flow inside. For each run of both beds, inlet hot air at  $80^\circ\text{C}$  is used for drying peppercorns with initial moisture content at about 82.5% w.b. The inlet air velocity is adjusted to be  $1.0U_{mf}$ ,  $1.1U_{mf}$  and  $1.3U_{mf}$  ( $U_{mf}$ = minimum fluidization velocity of peppercorns) as desired. Drying time and weight of peppercorns are measured in 5 minute intervals for 120 minutes for each run. The experimental results show that in the rectangular bed, the peppercorns show low oscillating and it becomes dense bed. This causes low heat transfer rate between peppercorns and hot air leading to slower mass transfer of moisture in the peppercorns. In the wavy surface bed, the peppercorns has high fluctuations due to unsymmetrical flow in the bed creating a sustainable oscillating flow with stronger turbulence of hot air and it causes dilute bed, resulting in higher heat and mass transfer in peppercorns. Closer examination reveals that for a similar

*operating condition, the rectangular wavy surface bed performs better than the rectangular bed.*

### **S 13.3 Investigation of Buoyancy Air Flow inside Solar Chimney using CFD Technique**

*Praphanpong Somsila, Umphisak Teeboonma and Wirapan Seehanam*

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*A solar chimney is a way of improving the natural ventilation of buildings by using convection of air heated by passive solar energy. It results in air flows because of the difference of the density varied with vertical direction. Therefore, the objective of this study was to investigate the ventilation efficiency of solar chimney using experimental and computation fluid dynamics (CFD) methods. In the simulation, models of buoyancy force and radiation heat transfer were applied to compute air flow inside the chimney. The influence of heat flux in a range of 400-800 W/m<sup>2</sup> and 1 to 2 m height of solar chimney on the ventilation efficiency was investigated. It was found that the ventilation efficiency and air flow rate are increased with increasing the heat flux and height of solar chimney. In addition, CFD simulation shows good agreement with experimental results.*

### **S 13.4 Effect of Inlet Water Temperature and Flow Rate on Cooling Efficiency of a Radiant Ceiling System in Taiwan**

*Wei-Hwa Chiang, Jian-Sheng Huang and Yen-Hsiang Huang*

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*This study is to test the cooling capacity of radiant ceiling system established in a typical office. The dimension of the test chamber is 10 (Length), 7.6 (Width), and 3.85 meter (Height). The objective of this research is to figure out different supplying water temperature accompanies flow rate embedded in radiant ceiling panels with a water circulatory system, which influences the cooling and energy efficiency of the test room. The heat transfer principles of radiation and natural convection are used to remove the sensible heat from the studied office without using any additional mechanical ventilation system to provide forced convection. We adopt five conditions of inlet water temperature 16, 18, 20, 22, and 24 °C with water flow rate 40, 60, 80, and 100 LPM (liter per minute) to test the vertical temperature gradient inside the room and discuss the interactive effects between the parameters within one hour. The experimental values reveal that the better operative efficiency occurs as the inlet water temperature is 18 °C and flow rate is 100 LPM without condensation water on the radiant panel surface. The obtained results also indicate the radiative heat flux of radiant ceiling system using in the subtropical region in Taiwan.*

### **S 13.5 Energy Efficiency Practices for Green Buildings**

*Jatuwat Varodompun*

Thammasat University; Schneider Electric (Thailand) Limited

*Buildings are accounting for 60% of the electricity consumption in Thailand but only 0.85% of the number of consumers. Benchmarking the energy consumption of buildings shows clearly how buildings have the potential to reduce wasted energy usage and reduce the bills for the tenants. One way to achieve low-energy buildings is through green building accreditation. What are the practices to be implemented to receive these point-based certifications? What are the benefits of these green buildings?*

## S 14: Energy Efficiency and Heat Transfer 2

Time: 10:20 – 12:00

Room Assignment: Chiang Mai B

### S 14.1 **Laminar Periodic Flow and Heat Transfer in Square Channel with 30° Inclined Baffles**

S. Kwankaomeng, W. Jedsadaratanachai and P. Promvonge  
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*A numerical investigation has been carried out to study laminar flow and heat transfer characteristics in a three-dimensional isothermal wall square-channel with 30° staggered angled-baffles. The computations are based on the finite volume method, and the SIMPLE algorithm has been implemented. The fluid flow and heat transfer characteristics are presented for Reynolds numbers based on the hydraulic diameter of the channel ranging from 100 to 1200. To generate a pair of streamwise counter-rotating vortex (P-vortex) flows through the tested channel, the baffles (like rectangular winglet) with the attack angle of 30° are mounted in tandem and staggered arrangement on both upper and lower walls of the test channel. Effects of different baffle heights at a single pitch ratio ( $PR=3$ ) on heat transfer and pressure loss in the channel are studied. It is found that P-vortex flows created by the 30° baffle exist and help to induce impinging jets on a side wall and the upper and lower wall leading to drastic increase in heat transfer rate over the test channel. In addition, the increase in the baffle height results in the rise of Nusselt number and friction factor values. The computational results reveal that the optimum thermal enhancement factor of the baffle is about 2.9 at height of 0.15 times of the channel height.*

### S 14.2 **Augmented Heat Transfer in Rectangular Duct with Angled Z-Shaped Ribs**

Monsak Pimsarn, Parkpoom Sriromreun and Pongjet Promvonge  
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Technology Ladkrabang, Bangkok 10520, Thailand.  
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*An experiment is focused on the design of the suitable ribs used for enhancing heat transfer in a rectangular duct heat exchanger by using wall heat transfer (Nusselt number), friction loss (friction factor) and thermal performance (thermal enhancement factor) data. The Z-shaped ribs were set on the rectangular duct at 30°, 45° and 60° and flat rib was set at 90° relative to the air flow direction. Reynolds numbers studied ranging from 5000 to 25,000 in the test section. The rectangular duct has aspect ratio,  $AR = 10$  and height,  $H = 30$  mm with the Z-rib height ( $e$ ),  $e/H = 0.2$  and the rib pitch ( $P$ ),  $P/H = 3$ . The ribs were fitted in Z-shape (Z-rib) aligned in series on the whole area of the upper plate. The results of the Z-ribs show the significant increase in heat transfer rate and friction loss over the smooth channel. The 45° Z-rib provides the highest increase in the heat transfer rate and the best thermal performance.*

### S 14.3 **Experimental Study on Heat Transfer and Pressure Drop in a Channel with Triangular V-ribs**

Dumri Jansangasuk, Chitakorn Khanoknaiyakarn and Pongjet Promvonge  
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*The paper presents an experimental study on heat transfer and pressure drop characteristics in a rectangular channel fitted with periodic triangular v-pattern ribs. The ribs are tested for pointing*

downstream ( $v$ -down) to the flow. The channel has an aspect ratio (width to height ratio),  $AR = 10$  and height,  $H = 30$  mm; the rib-to-channel height,  $e/H = 0.1, 0.2,$  and  $0.3$ ; the rib pitch to channel height,  $PR=P/H = 3$  and  $4$ ; the attack angle ( $\alpha$ ) of  $30^\circ$  relative to the flow direction. The experiment has been conducted by varying air flow velocity in order to adjust Reynolds number range from  $5000$  to  $20,000$ . The upper plate of channel is uniformly heated as a constant heat flux while the whole test section is covered with insulation to reduce heat loss to surroundings. These boundary conditions correspond closely to those founded in solar air heaters. The experimental results show a significant effect of the presence of the ribs on the heat transfer rate and pressure drop over the plain channel. The measured data indicates that the triangular  $v$ -type rib with  $e/H = 0.3$  and  $PR = 3$  yields higher heat transfer rate in terms of Nusselt number,  $Nu$ , and the pressure drop in the form of friction factor,  $f$ , than the others and also much higher than the smooth wall channel.

#### S 14.4 **Thermal Characteristics in Square Channel with $45^\circ$ Staggered Baffle inserts**

*Sutapat Kwankaomeng, Sompol Skullong, Thavee Teschareon and Pongjet Promvonge*

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The paper presents a study of heat transfer in a heat exchanger channel inserted with staggered inclined baffles. The channel has a square section with uniform wall heat flux conditions. The fluid flow and heat transfer characteristics are presented for Reynolds numbers based on the hydraulic diameter of the channel ranging from  $4000$  to  $25,000$ . The inclined baffles with an axial pitch equal to three times of channel height and with the attack angle of  $45^\circ$  are mounted in tandem and staggered arrangement on the lower and upper walls of the test channel. Effects of four baffle-to-channel height ratios ( $e/H = 0.1, 0.2, 0.3$  and  $0.4$ ) on heat transfer in terms of Nusselt number and pressure loss in the form of friction factor are experimentally investigated. The experimental result shows that the insertion of staggered inclined baffles with the  $e/H=0.4$  provides higher heat transfer and friction factor values than others. This is caused by higher baffle-to-channel height ratios of using  $e/H = 0.4$  interrupting the flow and diverting its direction thus promoting high levels of mixing over others.

#### S 14.5 **Active Building Envelope System (ABE): Wind and Solar –driven Ventilation, Electricity and Heat Pump**

*Bor-Jang Tsai and Chien-Ho Lee*

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This study takes the ventilation into consideration, making the active building envelope (ABE) system more close to the realistic application conditions. The ABE system is comprised of a photovoltaic unit (PV unit) and a thermoelectric heat pump unit (TE unit). The PV unit consists of photovoltaic cells, which convert solar radiation energy into electrical energy. The TE unit consists of thermoelectric heaters/coolers (referred to here onwards as TE coolers), which convert electrical energy into thermal energy, or the reverse. The PV and the TE units are integrated within the overall ABE enclosure. The new mechanism of a hybrid system was proposed. A ducted wind turbine will be integrated with the ABE system becoming dual core. Then the analytic model of original ABE system has to be revised and analytic solution will be resulted and verified by the numerical solution of CFD. The ducted wind mill will provide air conditioning and power the ABE system, to higher the thermal efficiency of the heat sinks of TE system. Numerical and experimental works will be investigated. a building installed the ABE

system wind, solar driven, bypass the windmill flow as a air flow, ambient temperature,  $T_o$  is equal to  $35^{\circ}\text{C}$  and indoor temperature,  $T_i$  is  $28^{\circ}\text{C}$ . Numerical results show the  $T_i$  will decrease  $2^{\circ}\text{C}$  when the ABE operating with heat sinks, without fan. As fan is opened, strong convective heat transfer,  $T_i$  will decrease approximately  $4$  to  $5^{\circ}\text{C}$ . We hope findings of this study can make the dream of healthy living, comfortable room come true.



## TECHNICAL TOURS

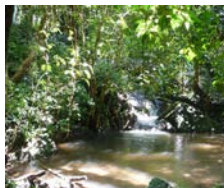
### A. Solar Home Village and Wat Phraphutthabat See Roi



A scenic travel north of the center of Chiang Mai will take you to an uphill village consisting of households that rely entirely on solar home systems. This village is on a remote area with no access to electricity grids. Here, you will see how villagers are living in a simple yet sustainable way using autonomous power supply for their everyday life.

Going with this trip, you will also get see the legendary Wat Phraphutthabat See Roi. Past generations believed that the Lord Buddha Gotama along with his followers traveled to spread the Dhamma philosophy through the region of present-day northern Thailand. When they arrived at the mountain top, Lord Buddha Gotama discovered through his transcendent vision or perception that the three previous Buddhas before his time, namely, Buddha Gooksantha, Buddha Gonakomma and Buddha Gassapa also visited here. It was obvious that the footprints of three Buddhas from different times had accumulated altogether on the boulder. Lord Buddha Gotama then decided to add his own footprint which is visible now at the present time, now known as "Four Buddhas' Footprints".

### B. EGAT PV Power Plant and Micro Hydro Power Plant at Mae Kham Pong Village



Situated in San Kampaeng district of Chiang Mai province, this solar energy station is a demonstration of a grid-connected PV that EGAT has started in 1992. Nowadays, grid-connected PV (without battery) of 60 single crystalline, 4.5 kW capacity, have been installed on the demonstrated solar house's roof. Furthermore, 240 single crystalline, amorphous and poly crystalline with 14.06 kW capacity on the office's roof were also installed. This system is a demonstration for electricity self-generation and consumption, including selling its surplus or buying deficit from the electricity utilities.

This trip will also include a nature side trip to the micro-hydro power station at Mae Khampong village, with dwellings that obtain their power requirements both from solar and micro-hydro systems. This village is also a popular spot for "home stay" programs for tourist with nature adventure attractions such as the "flying gibbon", where one can experience the zip lines in this village thick natural forest.

### C. Elephant Village at Mae Rim



A social/nature tour for those who want to experience a truly Northern Thai experience. The village is approximately 60 km. from Chiangmai town, on Chiangmai-Fang road, with more than 70 elephants living. It is located in the middle of the jungle and river which perfectly matches the elephant's environment. The village



offers activities such as an elephant show with the elephants showing their adorable talents in music, sports, massage, and even painting! <http://www.elephantvillage.com/>

## D. Baan Tawai Handicraft Center, Royal Flora Ratchapruerk Garden and Sun Sweet Company (bio waste digester)



Baan Tawai village is the renowned village of fine handicrafts in Hangdong, Chiang Mai. The village was awarded OTOP Tourism Village of Thailand because of its unique character as the wood carving village. For a long time it became the center for various kinds of handicrafts and the largest handicraft village of Thailand. Products of Baantawai are meticulously hand-made by skilled craftsmen with over 40-year of reputable experience in wood sculpturing. The village has created numerous wood sculptures and woodcarvings both for domestic sale and export and thus it has been known as the major cultural attraction of Chiang Mai for local and foreign tourists. The best quality and bargains of wood carving items are in Baan Tawai. You will be delighted to explore the different product zones of Baan Tawai that continues to sell only good-quality handmade merchandises such as wood carvings and other decorative items like silverware, lacquer ware, hand-woven textile, basketry and earthenware.

The Chaloeam Phrakiat Ratchaphruek Garden, located in the south of Chiang Mai, is better known by foreigners as the Royal Flora Ratchaphruek, as this was the area of the former International Horticultural Exposition, "Royal Flora Ratchaphruek Expo", held from 1 Nov 2006 to 31 Jan 2007. The Garden, originally developed for the Exposition, is part of a 470 rai (75 hectare) farming research area, and comprises several lakes and many buildings. The Royal Pavilion (Ho Kham Luang), a two-storey teak pavilion in Lanna architectural style, stands tall amid exquisite garden surroundings as a cultural landmark. Numerous tropical and subtropical plants have been grown, but very old trees are hardly to find there. The general garden design represents a contemporary Thai style which is typically representative and showy. Now, the area suits as a public garden, and for events and shows, and it is said to be a botanical learning center. The name, Chaloeam Phrakiat Ratchaphruek Garden, can be freely translated as Golden Shower Garden in Honor of The King. Ratchaphruek is the Thai common name of *Cassia fistula* L. (Leguminosae: Caesalpinioideae), a medium-sized tree with spectacular yellow flowers in drooping, 20-40 cm long clusters. These flowers are often referred to as Thailand's national flower, whose bright yellow color serves as a symbol of both Buddhism and royalty.

Sun Sweet Company Limited located in the San Patong District of Chiang Mai, Thailand was first established in 1991. The company is a well known manufacturer and exporter of canned fruits and vegetables in Thailand providing products through every channel to cover consumers in every countries with a reliable services and high quality products. Through the years the company had constantly expanded, upgraded and improved their sweet corn processing operation in their continuing effort to provide customers with the finest product at the highest international standard. Sun Sweet Company Limited is proud to be one of Thailand's leading exporters. Sun Sweet Company Limited's concern to its surrounding and the environment are emphasized not only in its investment in standardized waste water treatment system but also in waste digesters that have proven friendly with community and environment.

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## ESD 2010

An interesting international forum for researchers and practitioners to report latest developments, exchange new ideas and technologies, share practical experiences, and highlight related programs and policies on energy issues in the context of sustainable development.

ESD 2010 is a collaboration between the Asian Institute of Technology (AIT) and the Provincial Electricity Authority (PEA) Thailand. This year, AIT is on its 51st year of empowering Asia through education and post-graduate research, while PEA is also celebrating its 50th year of providing reliable electricity, power and energy services to the general public, business and industrial sectors of Thailand.

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