Energy Field of Study

ANNUAL REPORT 2012

School of Environment, Resources and Development

AIT
Asian Institute of Technology

Energy Field of Study: ***Annual Report 2012***

Table of Contents

List of Abbreviations

ADB	Asian Development Bank
ADBI	Asian Development Bank Institute, Japan
AIT	Asian Institute of Technology
EEP	Energy Environment Partnership (in the Mekong)
EPPO	Energy Planning and Policy Office, Thailand
FoS	Field of Study
GHG	Greenhouse gas
GMSARN	Greater Mekong Subregion Academic and Research Network
GNESD	Global Network on Energy for Sustainable Development
IASTED	International Association of Science and Technology for Development
NUOL	National University of Laos, Laos PDR
PEA	Provincial Electricity Authority, Thailand
SDCC	Sustainable Development in the context of Climate Change, AIT
SOM	School of Management, AIT
VSIS	Viswakarma School of International Studies, Pune, India

ENERGY IN NUMBERS 2012	
A. Academics	
a. Students enrolled in January 2012 (Total 86)	
Masters students: ……..	**54**
Doctoral students: ……	**32**
b. Students enrolled in August 2012 (Total: 95)	
Masters students: …….	**59 + 4 MBA(EBM) + 20 PMEBM**
Doctoral students: ……	**30**
c. Exchange students during 2012	**5**
d. Courses offered	
January 2012: ……..	**12**
August 2012: ……..	**12**
Inter-semester 2012: ……	**3**
e. Graduates in 2012	
Masters:……	**21**
Ph D: ……	**5**
B. Research, Publications and Outreach	
a. Completed sponsored projects in 2012 Number: 4 **Budget > 33 million Baht** b. Initiated sponsored projects in 2012 Number: 5**,Budget >12 million Baht** c. Continuing sponsored projects in 2012 Number: 13**,Budget >71 million Baht** d. Number of conferences/workshop organized in 2012: 10 e. Number of Books/Book chapters published in 2012: 5 f. Number of journal articles (published/accepted) in 2012: 16 g. Number of papers presented in conferences/workshop/seminars: 17	
C. Personnel	
a. Faculty:	**5**
b. Visiting and Adjunct:	**3**
c. Administrative and Technical Staff:	**6**
d. Sponsored Project researchers:	**13**

A. Introduction

The Asian Institute of Technology with its mission "*to develop highly qualified and committed professionals who play leading roles in the region's sustainable development and its integration into the global economy"*promotes technological change and sustainable development in the Asian-Pacific region through higher education, research and outreach.

In line with AIT's mission and goals, energy studies at AIT was initiated in 1979, and three areas of specialization – energy technology, energy economics and planning, and electric power systems management – are currently offered. The preferred background of students joining Energy field of study (fos) at AIT is engineering, science, economics and management. Since the first batch of students admitted in 1980, a total of 1134 students have graduated in Energy as of December 2012. Currently, about 100 students are enrolled in Energy studies at AIT of whom thirty percent are at doctoral level. International recognition of Energy fos faculty through memberships in editorial boards of international journals, invited presentations, reviewers, etc and linkages in the region and beyond have positioned the Energy fos to be a regional hub for energy related issues.

The Energy FoS in collaboration with School of Management has developed a curriculum on MBA in Energy Business and offered in August 2012. A Professional Masters Program on Energy Business Management (PMEBM) was initiated with 20 students in October 2012.

Energy fos has laboratory facilities to support research, testing and hands-on training. Hardware laboratory functions are focused mainly on solar thermal energy, photovoltaics, biomass energy, energy management, and electrical measurement and analysis. The facilities include two indoor laboratories, an energy park and a meteorological station. The indoor laboratories are equipped with experiment setups, testing apparatus and measuring equipment for thermal and electrical management studies, thermodynamics, fluid mechanics and heat transfer, and electrical power supply management. The outdoor laboratory (Energy Park) covers 3980-m^2 outdoor research and demonstration facility equipped with photovoltaic systems, solar thermal (air and water) systems, biomass research and day lighting setups. The meteorological station measures and records solar radiation and other meteorological data.

The Energy laboratory carries out testing services such as fuel quality tests, gas composition tests, tests for heating value of fuels, solar thermal collector performance tests, solar water heater system performance tests and stove efficiency tests. The fos has also a number of computer modeling software for energy planning and policy analysis, and electric power system management research and learning. A Power electronics laboratory is being set up.

The current research focuses of Energy fos are in the area of Energy, Environment and Climate Change; Energy for sustainable development; Renewable Energy; Energy efficiency and Conservation; Electric power system management; Restructuring of energy industries; and Energy economics and planning.

Details regarding Energy field of study activities are available at www.serd.ait.ac.th/energy

We would like to thank all our donors, sponsors, supporters and alumni for their continued support and goodwill, and look forward for their continued support.

B. Academic Activities

Courses Offered

The Energy FoS offered the following courses:

(a) During January 2012 semester

Course No.	Course Title and Credits	No. of Credits	Name of Instructor(s)
ED72.12	Energy Statistics and Energy Demand Forecasting	3(2-3)	Dr. Charles Marpaung
ED72.13	Development and Evaluation of Energy Projects	3(2-3)	Dr. Charles Marpaung
ED72.15	Energy Price Theory and Applications	3(2-3)	Dr. A. Gabrial
ED72.19	Biomass Conversion	3(2-3)	Dr. P. Abdul Salam
ED72.20	Workshop on Energy Issue and Communication	1(0-3)	Prof. S. Kumar
ED72.21	Power System Dynamics and Stability	3(2-3)	Dr. Jai G Singh
ED72.22	Power Sector Management under Deregulation	3(3-0)	Dr. Weerakorn O./ Dr. Jai G Singh
ED72.23	Optimization and AI Applications in Power System	3(2-3)	Dr. Weerakorn O.
ED72.25	Energy Economic Modeling and Policy Analysis	3(2-3)	Dr. A. Gabrial
ED72.28	Solar Energy	3(2-3)	Prof. S. Kumar
ED72.9018	Selected Topic: Clean Coal Technology and Carbon Capture and Sequestration	1(1-0)	Dr. P. Abdul Salam
ED82.01	Emission Mitigation in the International Context	2(20-0)	Prof. S. Kumar

(b) During Inter-semester 2012

Course No.	Course Title and Credits	No. of Credits	Name of Instructor(s)
ED72.03	Rational Use of Energy Industry	3(2-3)	Dr. B. Mohanty
ED72.9022	Smart Grid for Sustainable Development	2(2-0)	Dr. Jai G Singh
ED72.9024	Energy Management Systems	3(2-3)	Dr. B. Mohanty

(c) During August 2012 semester

Course No.	Course Title and Credits	No. of Credits	Name of Instructor(s)
ED72.01	Energy Resources and Technologies	2(2-0)	Prof. S. Kumar
ED72.06	Design and Management of Energy System	3(2-3)	Dr. P. Abdul Salam
ED72.07	Power system Design and Operation	3(2-3)	Dr. Jai G Singh
ED72.08	Power Distribution Systems	3(3-0)	Dr. Jai G Singh
ED72.10	Computer Aided Power System Analysis	3(2-3)	Dr. Weerakorn O.
ED72.11	Rural Electrification and Distributed Generation	3(3-0)	Dr. Weerakorn O.
ED72.24	Electricity Economics and Planning	3(2-3)	Dr. Charles Marpaung
ED72.26	Environmental Policy and Management of Energy Systems	2(2-0)	Dr. Shobhakar Dhakal
ED72.30	Energy, Environment and Climate Change: Issues and Strategies	2(2-0)	Prof. S. Kumar Dr. Shobhakar Dhakal
ED72.37	Integrated Approach to Energy Auditing	3(2-3)	Dr. B. Mohanty
ED72.9020	Selected topic: Rational Use of Energy in Buildings	3(2-3)	Dr. P. Abdul Salam Dr. B. Mohanty
ED72.9021	Selected topic: Energy Risk Management	1(1-0)	Dr. Charles Marpaung

Special Lectures

Mr. Thiyagarajan Velumail from UNDP Asia-Pacific Regional Centre, Bangkok made a presentation on “The Energy Plus Approach for the Poor” to ED72.20 Workshop on Energy Issues and Communication”students on 30 March 2012.

Dr. Gabrial Anandarajah from UCL Energy Institute, University College London, UK made a presentation on “Economics of hydrogen fuel cell vehicles: Results from the 16 Region TIAM-UCL global energy system model” to “ED72.12: Energy Statistics and Energy Demand Forecasting” and “ED72.13: Development and Evaluation of Energy Projects” students on 19 April 2012.

Mr. Chaiwat Muncharoen from Thailand Greenhouse Gas Management Organization (Public Organization) made a presentation on “Clean Development Mechanism (CDM) and POST – 2012” to “ED72.30 Workshop on Energy Issues and Communication” and “ED82.01 Emission Mitigation in the International Context”students on 27 April 2012.

CAD-IT CONSULTANTS (ASIA) PTE.LTD conducted a seminar “ANSYS software for Engineering Design” for energy students on 11 June 2012.

C. Students Research

Completed Master's Thesis and Research Study

May 2012

Daylight Availability and Light Pipe Application in an Academic Building
By: Miss Pimpapatsorn Thanhawat (Thailand)
Chair: Prof. S. Kumar
Members: Dr. P.Abdul Salam and Dr. B. Mohanty

A Study on Energy Consumption in Kandahar City, Afghanistan
By: Mr. Agha Mohammad (Afghanistan)
Chair: Prof. S. Kumar
Members: Dr. P.Abdul Salam and Dr. Charles O.P. Marpaung

Formulation of Green Growth Indicators and Their Composite index for the Asia-Pacific Countries
By: Miss Naga Srujana Goteti (India)
Chair: Prof. S. Kumar
Members: Dr. P.Abdul Salam and Dr. Charles O.P. Marpaung

PV Micro Utilities for Rural Electrificationin Bangladesh
By: Mr. S.M. Najmul Hoque (Bangladesh)
Chair: Prof. S. Kumar
Members: Dr. P.Abdul Salam and Dr. C. Marpaung

Role of Biomass for Energy Supply in Hinthada District, Myanmar: A Case Study on Rice Husk
By: Mr. Aung Myat (Myanmar)
Chair: Dr. P.Abdul Salam
Members: Prof. S. Kumar and Dr. Charles O.P. Marpaung

A Comparative Study on GHG Emission from Activities of Two Thai Municipalities
By: Mr. Kayasit Piyamongkolwong (Thailand)
Chair: Dr. P.Abdul Salam
Members: Prof. S. Kumar and Prof. Visvanathan

Impacts of Plug-in Hybrid Electric Vehicles on Power Sector Development in Thailand
By: Mr. Thanaset Petchwattananon (Thailand)
Chair: Dr. Charles O.P. Marpaung
Members: Dr. Weerakorn O. and Dr. Jai G. Singh

An Approach Towards Smart Distribution Network in Dhaka, Bangladesh by Rooftop Solar PV Using GIS
By: Mr. Taskin Jamal (Bangladesh)
Chair: Dr. Weerakorn O.
Members: Dr. Jai G. Singh and Dr. Yoshikazu Kamiya

Robust Combined-objective Particle Swarm Optimization for Planning Transition to Plug-in Hybrid Electric Vehicles
By: Mr. Sutisil Khedkaw (Thailand)
Chair: Dr. Weerakorn O.
Members: Dr. Charles O.P. Marpaung and Dr. Jai G. Singh

Combined Heating, Cooling and Power Systems in Thai Hotels
By: Mr. Ekawit Meteejaroenwong (Thailand)
Chair: Prof. S. Kumar
Members: Dr. P.Abdul Salam and Dr. Charles O.P. Marpaung

Optical Performance of a Two Stage Linear Fresnel Concentrator
By: Mr. Aurosree Biswas (Bangladesh)
Chair: Prof. S. Kumar
Members: Dr. P.Abdul Salam and Dr. B. Mohanty

A study on Small Scale Applications of Biogas.
By: Mr. Jakkrapun Tessiri (Thailand)
Chair: Dr. P.Abdul Salam
Members: Prof. S. Kumar and Dr. Jai G. Singh

Status of and Improvement Opportunities for Energy Usage in a Kraft Pulp and Paper Mill
By: Mr. Andri Setiyo Wibowo (Indonesia)
Chair: Dr. P. Abdul Salam
Members: Dr. Charles O.P. Marpaung and Dr. B. Mohanty

An Empirical Analysis on CO_2 Emissions from the Electricity Sector and Income Based on the Environmental Kuznets Curve
By: Mr. Passapong Saneaphunt (Thailand)
Chair: Dr. Charles O.P. Marpaung
Members: Dr. Weerakorn O. and Dr. Jai G. Singh

Impacts of Electric Vehicle charging on Distribution Transformers.
By: Miss Thunyaporn Harnboonyanon (Thailand)
Chair: Dr. Charles O.P. Marpaung
Members: Dr Weerakorn O. and Dr. Jai G. Singh

Impacts of AMI Deployment in Thailand: Generation Expansion Model
By: Miss Pradsamon Rodchuea (Thailand)
Chair: Dr. Charles O.P. Marpaung
Members: Dr. Weerakorn O. and Dr. Jai G. Singh

A probabilistic Power flow Analysis using the cumulant method and gram-charlier series expansion
By: Mr. Nguyen Vinh Phuc (Vietnam)
Chair: Dr. Jai G. Singh
Members: Dr. Weerakorn O. and Dr. Charles O.P. Marpaung

Technical and Financial Impact Assessment of a Wind Farm: A case study of An Phong Project, Vietnam
By: Mr. Tran Truong Han (Vietnam)
Chair: Dr. Weerakorn O.
Members: Dr. Charles O.P. Marpaung and Dr. Jai G. Singh

Inter Semester

Technical and Policy Options for Wind Energy Development in Thailand.
By: Mr. Bhawat Traipattanakul (Thailand)
Chair: Dr. P. Abdul Salam
Members: Prof. S. Kumar and Dr. Jai G. Singh

December 2012

Thermoelectric Generation from Low Temperature Waste Heat: A performance Analysis on Biomass Cookstove
By: Mr. Bijay Bahadur Pradhan
Chair: Dr. P. Abdul Salam
Members: Dr. S. Kumar and Dr. Charles O.P. Marpaung

Estimating Short and Long Run Time-of-Use Tariff Elasticities for PEA's Customer Demand
By: Ms. Prow Choompradit
Chair: Dr. Charles O.P. Marpaung
Members: Dr. Weerakorn O. and Dr. Jai G. Singh

Completed Doctoral Dissertation

Optimal Placement of FACTS Controllers and Distributed Generation for Maximization of the System Loadability

By: Mr. I Made Wartana (Indonesia)
Chair: Dr. J G Singh
Members: Dr. Weerakorn Ongsakul (Co-Chairperson) ,
Dr. Charles O. P. Marpaung and Dr. Poompat Saengudomlert
External: Dr. Issarachai Ngamroo, Department of Electrical Engineering, Faculty of Engineering, King Mongkot's Institute of Technology, Ladkrabang, Bangkok 10520.

This dissertation has proposed several single and a multi-objectives optimization approaches to enhance the power system loadability by optimal location of Flexible AC Transmission System (FACTS) controllers and Distributed Generation (DG) in power networks along with getting their optimum settings and sizing. Different types of FACTS controllers included: Thyristor-Controlled Series Capacitor (TCSC), Static VAr Compensator (SVC), and Unified Power Flow Controller (UPFC) and one type of DG namely variable speed Wind Turbine with DFIG (Doubly Fed Induction Generator) have been considered in this study. The FACTS controllers and the DG are utilized to obtain direct control of power flows over transmission lines and maximize the capacity of the transmission lines. The maximal benefits of these devices depend upon where they are placed, how much their capacity and size, and how they are controlled in the power system.

Based on evolutionary programming, two potent evolutionary algorithms namely Particle Swarm Optimization (PSO) and a new variant of Genetic Algorithm, particular in multi-objective optimizations problem recognized as Non-dominated Sorting Genetic Algorithm II (NSGA-II) have been utilized to optimally allocate the different type of the FACTS controllers and the DG. Moreover, three combined objectives viz., maximization of power system loadability, minimization of the FACTS installation costs, and system active power loss have been considered along with satisfying other operational equalities and inequalities constraints. In addition, the location and control settings of the FACTS controllers and the sizing of the DG have also been obtained.

Apart from above multi-objective functions, simultaneously some additional operational constraints, i.e., system stability and security margin e.g., small signal stability, Fast Voltage Stability Index (FVSI), and Line Stability Factor (LQP) have also been considered to make the approach close to practical scenario. Therefore, static as well as dynamic model of the FACTS controllers have been utilized, in this dissertation, to satisfy the small signal stability and system security condition at optimal solution of the above objectives.

The proposed methodology has been investigated effectively on the standard IEEE 14-bus, 30-bus, and a practical Indonesian Java-Bali 24-bus systems and the obtained results are compared with the method suggested in the literatures. The results on the three test systems indicate that optimally placed the FACTS controllers and the DG by the PSO and NSGA-II techniques could enhance system loadability far more than those from previous reported works.

Optimal Multiple Distribution Generation and Protective Devices Placement in Microgrid System.

By: Mr. Witoon Prommee
Chair: Dr. Weerakorn O.
Members: Dr. Charles O.P. Marpaung and
Prof. Voratas Kachitvichyanukul
External: Dr. Athula Rajapakse, Department of Electric and Computer Engineering, University of Manitoba, Canada

Microgrid (MG), a system of multiple distributed generations (DG) to serve loads, can reduce the system loss and improve system reliability. In MG planning, an improved reinitialized social structures particle swarm optimization (IRS-PSO) is proposed to minimize the total real power loss for optimal multiple DG placement, and an improved binary multi-objectives particle swarm optimization with new sigmoid function (IB-MOPSO with BSF) method is proposed to minimize reliability indices, and total cost for optimal protective devices placement in a MG system.

IRS-PSO is used for solving optimal multiple DGs placement in a MG system. The movement of each particle in IRS-PSO is pulled by an inertia term, a cognitive term (personal best) and three social learning terms including global best, local best and near neighbor best. The objective is to minimize the total real power loss within real and reactive power generation limits and voltage limits. Five DG types in a MG system are considered including MG with DG supplying real power only, MG with DG supplying reactive power only, MG with DG supplying real power and consuming reactive power, MG with DG supplying real power and reactive power, and MG with four different types of DG regulating the bus voltage. For a given number of DG units in each type, IRS-PSO can find better sizes and locations of multiple DGs than repetitive load flow, basic particle swarm optimization

(BPSO), adaptive weight particle swarm optimization (APSO), and global best, local and near neighbor best particle swarm optimization (GLN-PSO) on the 69-bus radial MG distribution system.

For MG reliability improvement, IB-MOPSO is applied for solving optimal placement of multi-protective devices in the improved MG reliability model. The multiple objectives are to minimize system average interruption frequency index (SAIFI), system average interruption duration index (SAIDI), and total cost (TC) including investment and interruption cost. Binary multi-objectives PSO (B-MOPSO) is improved by adding a bell shape function (BSF) and three particle movement strategies (MS) including global guidance located in the least crowded areas, perturbation with different evolution method, and coverage of untouched search space in the non-dominated front. In the improved MG reliability model, IB-MOPSO with BSF can find better locations and number of protective devices including reclosers, switches, and fuses than B-MOPSO, IB-MOPSO with conventional sigmoid function (CSF), and B-MOPSO with BSF on the 51 sections Provincial Electricity Authority (PEA) MG test system.

In summary, the proposed IRS-PSO, using re-initialization process to avoid premature convergence, can find the best location and size of three DG units in MG with DG supplying real and reactive power on the 69 bus MG test system. For multi-objectives optimal multiple protective devices placement, IB-MOPSO with BSF, using the improved reliability models, three movement strategies of particle, and BSF, can find a better compromised solution than Binary PSO on the 51 sections PEA MG test system. This will lead to substantial operation and investment cost savings, higher efficiency of distribution system, and higher reliability level.

Studies on Photoelectrode Optimization for Energy Efficiency Enhancement in Nanostructured Zinc Oxide Dye-Sensitized Solar Cells.

By: Mr. Pichanan Teesetsopon
Chair: Prof. S. Kumar
Members: Dr. Weerakorn O. and Dr. Joydeep Dutta
External: Prof. Askok K.Vaseashta, Director, Institute for Advanced Sciences Convergence and International Clean Water Institute., USA

A Dye-sensitized solar cell (DSSC) is a photoelectrochemical cell consisting mainly of photoelectrode, dye and counter electrode that are immersed in a redox electrolyte. Though the highest efficiency of DSSC was obtained from nanoparticulate titania (TiO_2) photoelectrodes, zinc oxide (ZnO) shows potential advantages in electron transport due to its 2-3 orders of magnitude higher electron mobility than anatase TiO_2. Moreover, a variety of nanostructured ZnO provide a good opportunity for improvement of ZnO based DSSC efficiency. However, very little knowledge exists regarding the photoelectrode interface effects on ZnO-DSSC's performance. Therefore, in this work, the photoelectrode interface optimization by thermal treatment, external reverse biasing and semiconductor-semiconductor contact on ZnO-DSSC performance were studied.

The charge transfer through individual interface in DSSC cell was investigated via electrochemical impedance analysis (EIS). Through modeling of experimental data, each internal interface characteristic was determined in terms of resistance and capacitance existing at the particular interface. The model was used to examine the effect of typical photoelectrode treatment

through annealing at moderate temperatures on the photoelectrode properties and the internal electrical characteristics of DSSC. By comparing the morphology of the electrode surfaces, dye adsorption and current-voltage characteristics, it was demonstrated that annealing in the air can improve DSSC efficiency due to the enhancement of charge collection, contributed by better ZnO crystallinity and reduction of interfacial charge transfer resistance at the ZnO/dye/electrolyte interface. The optimum annealing temperature was found at 400°C. Moreover, the electron recombination between transparent conducting oxide substrate and the electrolyte was also revealed for the first time in this work.

Interfacial characteristics of ZnO-DSSC under various reverse biasing conditions were also determined in this study. The revere biasing of solar cell normally occurs when the cell is under shade and it was found that fill factor and cell efficiency increased, influenced by the increment of internal interface resistances. This leads to lower charge recombination through all internal interfaces in the cell and so, higher conversion efficiencies could be achieved.

The photoelectrode interface properties also depend on the type of semiconductor contact. The comparison between homojunction and heterojunction semiconductor photoelectrode on ZnO-DSSC performance was investigated. The homojunction photoelectrode was prepared based on the optimized fluorine doped zinc oxide substrate (FZO) fabricated by Pyrosol technique with zinc oxide nanoparticles. The results were compared with the heterojunction photoelectrode based on commercial fluorine doped tin oxide substrate (FTO). The potential enhancement of ZnO-DSSC performance was observed for homojunction photoelectrode due to the reduction of charge recombination at photoelectrode substrate-semiconductor interface.

Development of an Aggregated Energy Security Performance Indicator (AESPI) and Its Application to Thailand.

By: Miss Juthamanee Martchamadol
Chair: Prof. S. Kumar
Members: Dr. Charles O.P. Marpaung, Dr. P. Abdul Salam and Dr. Mokbul M. Ahmad
External: Prof. Keiichi N. Ishihara, Department of Socio-Environmental Energy Science, Graduate School of Energy Science, Kyoto University, Japan

Energy is an important input for sustainable development, as it has strong influences on social, economic, and environmental development, leading to improved livelihoods, agricultural and industrial productivity, better health, and cleaner environment. Definition of energy security encompass issues related to social, environment & economic, and so an assessment of energy security requires a holistic analysis through appropriate indicators because indicators are measurable, present the degree of success, and are easy to understand. Earlier studies on energy security indicators addressed different objectives, perspectives and various dimensions: global, regional, economic and environment, and usually presented relations that deal with the pair: energy-economic, or energy-social, or energy-environment, and there was no linkage that represents the four dimensions - social, energy, economy and environment. Therefore, more than one indicator was usually needed to analyze the policy responses and measures. Moreover, using large set of indicators is unwieldy and difficult to use effectively. Some of the indicators needed expert judgment to provide weights for the involved parameters, which can lead to bias. Besides, the set of indicators are usually at a country (national) level, and so its effectiveness and use at provincial level is questionable as different provinces have varying degrees of development. Furthermore, the available aggregated indicators do not show the trend of energy security nor do they help in assessing

future performance of energy policy strategy/plan of the country. This study aimed to bridge these research gaps, with the overall objective to develop a single comprehensive measurement (an aggregated indicator) called "**A**ggregated **E**nergy **S**ecurity **P**erformance **I**ndicator (**AESPI**)" to capture the various dimensions of energy indices to assess and monitor energy security. This takes into consideration social, economic and environment perspectives, and also used to develop, monitor and evaluate energy policies. The research therefore had two specific objectives: AESPI development, and its application at a country and provincial level. The development of AESPI used 25 indicators of Energy Indicator for Sustainable Development (EISD). The AESPI, which varies between 1-10 (highest energy security), employs an eight step processes, from data collection to final AESPI estimation. The 25 individual indicators used to develop AESPI encompass parameters related to social,economic & environment dimensions of sustainable development, and based on the definition of energy security. The steps involve the application of energy policies, indicator formulation, and its standardization, following which the sampling adequacy and correlation testing is done. The Principal Component Analysis (PCA) technique was used for grouping of indicators and the estimation of weighing factors. These results are then used to calculate the group index (GI), and then the AESPI.

The developed AESPI method was then applied using the data for Thailand, considering four foci: past performance of energy security, national energy scenario analysis (1986- 2030), monitoring the actual energy security performance at national level (2010), and at 2 provincial level (2001-2009) of three selected provinces - Ayutthaya (industrial province), Krabi (agriculture province) and Phuket (tourism province).

The past performance of AESPI for Thailand for the period 1986-1991, showed that it had a decreasing trend from level 9.1 in 1986 to level 6.9 in 1991. Then, AESPI varied between level 6.1 and 6.8 during 1992-2009 when Thailand launched many energy conservation, energy efficiency and renewable energy promotion programs.

Six energy policy scenarios during 1986-2030 were used to estimate AESPI – Current policy (CP), High Economic Growth and Least cost option (HEG&LC), Low Carbon Society (LCS), Current Policy including AEDP plan (update), 450ppm of Non-OECD and 450ppm of OECD. The six scenarios present an improvement of AESPI during 2010-2030 compared to the period of 2000-2009. The CP, LCS, Current Policy (AEDP), 450ppm of Non-OECD and 450ppm of OECD presents an improving trend, at an the annual average improvement rate during 2010-2030 of 0.6%, 1.3%, 0.8%, 0.9% and 1.0%, respectively.HEG&LC presents significant improvement during 2010-2015 and then it would be low during 2016-2030. The annual average improvement rate would be 1.1% during 2010- 2030. Therefore, LCS scenario provides the best energy security performance among the considered scenarios.

AESPI applied to monitor the energy policy shows that the actual AESPI of Thailand in 2010 was lower by 3% as compared to the target, indicating that the energy security performance of Thailand in 2010 did not meet the target planned by the policy. The analysis shows that this was due to the low performance of FEC/capita, electricity/capita, household electricity per capita, FEC/GDP, commercial energy intensity, agriculture energy intensity, loss in transmission, RPR of oil and natural gas, share of renewable energy in power sector, renewable energy per FEC, household access electricity, and share of income spent on electricity. To understand how AESPI can help provinces, AESPI of three provinces was calculated and compared with national level during 2001-2009. The energy security

performance of Ayutthaya varied between level 5.2-6.2, which was found to be lower than that of Thailand during 2001-2007, and it improved during 2008 and 2009 (to level 6.6) due to the reduction of final energy intensity, energy consumption per capita, and CO_2 per GDP. The AESPI of Krabi showed decreasing trend from level 7.8 in 2001 to level 6.6 in 2009, due to increasing energy/electricity consumption per capita, energy intensity, CO_2 per capita (and per GDP) including electricity expenditure. The AESPI of Phuket had moderate performance (level 5.5-6.1) and lower than that of Thailand (level 6.1-6.4) during 2001-2009. This was mainly because of increase in energy/electricity consumption per capita and electricity expenditure, and lower share of renewable energy consumption. Thus,AESPI is found to show issues that need to be addressed at provincial level, so that corrective improvement options could be identified. In addition, the annual AESPI of each province helps to monitor the progress and observe the outcome of the corrective actions that were implemented in the previous year.

The three provinces had moderate energy security performance (between level 5-7.5). Among these provinces, the agricultural province had lower energy consumption per capita, CO_2 emission per capita, and electricity expenditure compared to industrial and tourism province. In 2009, tourism province (Phuket) had energy intensity, household electricity consumption per capita, CO_2 per capita, CO_2 per GDP, electricity expenditure higher than industrial province (Ayutthaya).3 AESPI is an aggregated indicator showing a country's (and provinces) status in its energy system, and is linked with social, economic and environment dimension. It represents quantitatively the energy security performance for easy understanding and interpretation by showing the pathway of existing policies/measures trend (scenario) in the future compared to the past. It can also show the pathway of new/alternate scenarios of new policy outcomes. Thus, AESPI is a useful tool for monitoring and evaluation of the outcome of policy implemented at national and provincial level.

Keyword: Energy security, Energy policy, Principle Component Analysis (PCA),Thailand

Analysis of Low Carbon Development, Strategies: Role of Transport sector Electrification and Carbon Tax in Nepal.

By: Mr. Shree Raj Shakya
Chair: Prof. S. Kumar
Co-chair: Prof. Ram M. Shrestha
Members: Dr. Charles O.P. Marpaung and Dr. Rajendra Shrestha
External: Prof. Toshihiko Masui, Department of Social Engineering, Tokyo Institute of Technology, Japan

The main objective of this study is to analyze the energy, environmental and economy-wide implications of selected low carbon development strategies in Nepal with huge untapped hydropower potential but still relying heavily on the imported fossil fuels. The study developed and used soft linked integrated energy-environment-economic modeling tools to examine the mid and long term effects of a sectoral low carbon strategy, i.e., transport sector electrification and an economy-wide carbon tax strategy. The bottom up energy system model (Nepal-ESM) was used to study the effects of selected low carbon strategies on the hydropower development, energy supply mix, energy system cost and global and local environmental emissions, while the overall macroeconomic and welfare implications of the low carbon strategies were assessed by hybrid top-down type Computable General Equilibrium (Nepal-CGE) model.

In order to analyze implications of transport sector electrification, a base case scenario without any policy resulting transport electrification and five counterfactual scenarios with different levels of electrification of the transport system during 2015- 2050 were developed. The analysis based on the bottom up Nepal-ESM model shows that the transport sector electrification would promote development of indigenous hydropower resource in the country with additional hydropower capacity requirement for various transport electrification scenarios compared to the base case scenario. The hydropower capacity addition would increase by up to 538 MW under high (35%) transport electrification scenario EMT20+EV15 (20% modal shifts to electric mass transport (EMT) and 15% penetration of the electric vehicles (EV) by 2050). With the electrification of the transport system, there would be a noticeable improvement in the energy security of the country with decline in the cumulative imported energy (in the range of 6.3% to 14.6%) and improvement in diversification of the primary energy supply system. There would be a decrease in the discounted total energy system cost under the transport electrification scenarios (in the range of 1.0% to 2.0%) as compared to the base case. As a climate related co-benefit, there would be a reduction of 13% greenhouse gas (GHG) emissions in cumulative terms under the 35% transport sector electrification (EMT20+EV15). In addition, there would be a reduction in the emissions of local pollutants (CO, NO_x, SO_2, NMVOC and PM_{10}). The study also shows that there would be additional employment generation during 2015-2050 associated purely with the additional hydropower development and recharging stations serving electric vehicles required under the transport electrification scenarios.

The economy-wide effects of the transport sector electrification were studied using the Nepal-CGE model. The main finding of the study indicates that Nepal would benefit economically from the implementation of the transport sector electrification process in the long run with an increase in the cumulative undiscounted real GDP (in the range of 2.5% to 3.1%) and household welfare under all the transport electrification scenarios. Besides, transport electrification would promote energy efficiency improvement and green economy with a significant reduction in the average energy intensity (in the range of 2.7% to 4.1%) and average GHG emission intensity of GDP (in the range of 4.7% to 7.7%) under different transport electrification scenarios. This highlights the importance of the transport sector electrification as one of the desirable options for a low carbon development path in the country. It also indicates that the transport sector electrification would result in the appreciation of the national currency triggering reduction in the export of the other non-transport and non-electricity related commodities produced in the country in the long run (i.e., the presence of Dutch disease kind of effect). Introducing foreign direct investment would reduce such effects to some level.

The effects of the carbon tax were studied by developing a base case scenario without any environmental policy and three counterfactual scenarios with introduction of carbon tax under different GHG stabilization targets of 450 ppmv (CT-HIG), 550 ppmv (CT-MED) and 650 ppmv (CT-LOW) during 2015-2050. The analysis using Nepal-ESM model reveals that there would be a need to install additional hydropower capacity of 614 MW in CT-MED to 945 MW in CT-HIG by 2050. It indicates an improvement in the efficiency of the cumulative total final energy consumption (in the range of 0.03% under CT-HIG to 0.5% under CT-MED) in all the carbon tax scenarios compared to the base case. The study also shows the co-benefits in terms of employment generation associated with additional hydropower development under the carbon tax scenarios and that through the establishment of more electric recharging stations under CT-MED and CT-HIG. It reveals that there would be a reduction in the emission of short-lived local pollutants. The adoption of the carbon tax would decrease the discounted net fuel import cost (in the range of 2.2% under CT-LOW to 5.5% under CT-HIG) but increases the discounted total energy system cost including carbon tax (in the range of 0.6% under CT-LOW to 4.7% under CT-HIG). However, if recycling of 100% of the carbon tax revenue back to the economy is

considered, the discounted total energy system cost excluding carbon tax is expected to decrease under CT-HIG.

Nepal-CGE model was also used to examine the economy-wide consequences of the carbon tax. It indicates that if the carbon tax is implemented in Nepal, there would be significant decrease in average energy intensity (in the range of 5.0% under CT-LOW to 2.4% under CT-HIG) and average GHG emission intensity of GDP (in the range of 6.2% under CT-LOW to 13.7% under CT-HIG) but at the cost of moderate loss in the cumulative undiscounted real GDP (in the range of 2.3% under CT-LOW to 8.1% under CT-HIG) and household welfare as compared to the base case. Under CT-HIG there would be a significant increase in the electricity consumption. However, carbon tax revenue recycling scheme would help to reduce GDP loss and improve household welfare. There would be an additional benefit related to the reduction in average energy intensity if carbon tax revenue is recycled above 50%.

Continuing Doctoral Students and their ResearchTopics

 **Miss Anongpun Man-Im** Risk limiting economic dispatch considering wind and PV uncertainties	 **Miss Kate-Natee Noipin** Fatty Acid Ethyl Ester (Ethanol Derived Biodiesel) Production
 **Mr. Atthavute Ruenruengjai** Rice Straw Utilization for energy purposes	 **Mr. Kawin Ruamsuke** Coursework
 **Mr. Anuman Chanthawong** Coursework	 **Mr. Kitti Leangkrua** Proximity Indices for Power Distribution System Stability with Distributed Generators
 **Miss Chanamon Chantana** Development of a Thermal Energy Storage Type Heat Exchanger for Waste Heat Recovery	 **Mr. Kittavit Buayai** Microgrid Planning in Distribution System
 **Mr. Javed Anwar** Energy Security from a Developing Country Perspective	 **Mr. Muhammad Khalid Farooq** General Equilibrium Analysis of Renewable Energy Promotion Policies in Pakistan

 **Miss Jirawadee Polprasert** Augmented Lagrange Augmented Hopfield Network Based Method for Profit Based Unit Commitment	 **Mr. Nopporn Preamjai** Solar Regenerated Solid Desiccant Evaporative Cooling System
 **Mr. Jakkapong Udomsirichakorm** A study on caO-Based catalytic Tar Reforming for H2-Rich Gas Production in Chemical Looping Gasification	 **Miss Ongorn Rattananatthawon** Stability Analysis of Power Grids with Wind Farm Providing Ancillary Services
 **Mrs. Onicha Meangbua** Coursework	 **Mr. Sittichocke Pookpunt** Optimal Placement of Wind Turbine Using A Discrete Particle Swarm Optimization with Time-varying Acceleration Coefficients
 **Mr. Purisan Lakasorn** Economic Dispatch by Using Artificial Neural Networks	 **Mr. Songkarn Pisanupoj** Multi-agent based Management of an Isolated Microgrid
 **Miss Rotchana Intharathirat** Energy recovery from municipal solid waste through gasification and GHG emission reduction potential	 **Mr. Thanapoom Chareonsiri** Coursework
 **Miss Santisouk Phimphachanh** Transmission Expansion Planning in Lao PDR considering Interconnection with GMS Countries	 **Mr. Titipong Samakpong** Robust optimization based optimal power flow considering wind and solar uncertainly

 **Mr. Saksorn Chalermchaiarbha** Multi-Attribute Decision Making on Stochastic Multi-Objective Thermal Power Dispatch	 **Miss Unchalee Parinyacupt** Renewable hybrid (solar-bimass) system for space cooling and water heating applications
 **Mrs. Sirirat Muneesawang** Prioritizing Mitigation and Adaptation Initiatives: in low cost housing systems	

D. Student Activities

Field/study visits

ED72.28: Solar Energy: ***29 March 2012:*** Solar hot water system, Chulabhorn Hospital, 54 Kampheng Phet 6, Talat Bangkhen, Laksi, Bangkok.

ED72.06: Design and Management of Energy System: ***21 April 2012:*** Biomass Plant (rice husk gasifier), Saraburi.

ED72.06: Design and Management of Energy System, ED72.37: Integrated Approach to Energy Auditing and ED72.9020: Rational Use of Energy in Building:

21May 2012:

Department of Alternative Energy Development and Efficiency (DEDE), Tambol Klong-Nueng, Ampur Klong Luang, Pathumthani 12120.

22 May 2012:

Bangkok Solar, 39/1 M.1 Bangpakong-chachoengsao Rd., Sanphudas, Banpho, Chachoengsao 24140.

ED72.9022: Smart Grids for Sustainable Development: ***27 June 2012:*** The PEA Smart Grids Project: Smart Home Demonstration and SCADA Center, Electric Vehicle, etc, Bangkok.

ED72.03: Rational Use of Energy in Industry and ED72.9024: Energy Management System: ***28 June 2012*****:** SOSUCO Ceramic Co.,Ltd., 33/2 Moo 2 Rimklongnapeepat Road, Nongpling NongKhae, Saraburi 18140.

ED72.01: Energy Resources and Technology:

15 Oct 12:

1. Energy Efficiency Building (Krungthai Bank), Khao Yai and
2. Wind turbine (EGAT), Korat

16 Oct 12:

1. Hydro Power Plant and Bhumibol Dam
2. Biodiesel (Technology and Promotion Transferred Department), Lampoon


<u>17 Oct 12</u>:

1. Geothermal Power Plant, Fang and
2. Oil refinery & Cogeneration system (NPDC) Chiang Mai


<u>18 Oct 12</u>:

1. Mae Moh Coal Mine and
2. Mae Moh Power Plant, Lampang


<u>19 Oct 12</u>:

1. PV plant, Ratchaburi Electricity Generating Co.Ltd., Ayutthaya and
2. Rice - husk gasifier, Saraburi


Visits abroad

Australia:
Miss Prow Choompradit, Miss Hathaikan Mee-Kham, Mr. Piyachai Sritunya and Mr. Pok Palpibal, Master Students, were at University of Queensland during 23 May 2012 – 20 August 2012 to carry out part of their research under the PEA-AIT programme.

Canada:
Mr. Jakkapong Udomsirichakorn, Doctoral student, was selected as a full time visiting research student during 1 September 2012 – September 2013 at Dalhousie University.

England:
Mr. Jakkapong Udomsirichakorn,Doctoral student, was selected to attend an event that was specifically designed to give 100 international second year PhD students an understanding of energy systems as a whole and of pathways to low-carbon resilient energy systems, organized by UK Energy Research center Summer School and Annual Assembly during 17th – 22nd June, 2012 atUniversity of Warwick, Coventry, UK.

Germany
Miss Nattworadee Adiruttphatharasiri, Master student, was selected under the exchange program to visit Heidelberg University, Germany from 16 April 2011 – 29 July 2012.

Japan
Mr. Bijay Bahadur Pradhan, Master student, was selected for the exchange program toChubu University, Japan from 27 July – 27 September 2012.

Sweden
Miss Tipaporn Munkong, Master student, was selected under the exchange program to visit Uppsala University, Sweden from 25 August 2011– 15 June 2012.

Others:
Mr. Bhawat Traipattanakul, Energy Master student waselected as a President of AIT Student Union during December 2011 - May 2012.

E. Grant and Sponsored Research Projects

Completed Projects:

1. **AIT Support to National University of Laos (NUOL), 2007-2010 Extension Research Financial Management**.
   AIT provided support to NUOL in i) improvement of strategies and structures for development of research ii) development of curriculum and training for Master degree courses iii) financial management (including financial hands-on training) iv) Information Communication Technology (ICT) development v) assist the department of higher education (DHE) ministry of education, Laos PDR in development of "national policy and strategy to support research and research management.

   Duration: April 2007 – 30 June 2012
   Investigator: Prof. S. Kumar
   Sponsor: Sida
   Total contracted amount: Baht 31,807,061

2. **Biofuel Sustainability Policy Study**
   The objectives of the project are as follows: To analyze biofuel production in Thailand from on ecological/environmental, economic and social perspective. Employing an integrated approach that effectively identifies and suggest opportunities presented in synergies among ecological/environmental, economic and social dimensions specific to biofuels in Thailand. Minimizing trade-offs between biofuel and food production i.e. land use change related to the diversion of land from food to the biofuel production. Recommended biofuel production should result in significant net greenhouse gas emissions reductions when considered on a life cycle perspective. The role biofuel plays in existing or planned bioenergy policy for Thailand and to estimate as best as possible the potential benefits/cost from an ecological/environmental, economic and social perspective.

   Duration: 1 May 2011 – 30 November 2012
   Investigator: Prof. S. Kumar and Dr. P. Abdul Salam
   Sponsor: Global Network on Energy for Sustainable Development (GNESD), Denmark
   Total contracted amount: Baht 300,000

3. **UNEP RRC.AP Project**
   The objective of the studies to analyze the possibility of expanding the use of renewable energy sources and introducing of cleaner energy technologies and their market development in Central Asia, by promoting improved policies and regulations, development of national clean technology plan, and establishment of energy performance standards.

   Duration: August 2011 - August 2012
   Investigator: Prof. S. Kumar and Dr .Charles O.P. Marpaung
   Sponsor: UNEP RRC-AP
   Total contracted amount: Baht 600,000 (US$20,000)

4. Urban and Peri-urban Energy Access III (GNESD – UPEA III)

The objectives of the project are as follows:
To build upon the research conducted in UPEA II and provide snapshot of the region studied and discuss on the access to legal and cleaner energy access by the urban poor ii) To identify the supply – and demand-side barriers to energy access iii) To collect and compile barrier specific best practices that have supported or enabled energy access for the urban poor iv) To provide specific recommendations to address the barriers identified above, and v) To establish a policy dialogue panel

Duration: August 2011 – 28 June 2012
Investigator: Prof. S. Kumar and Dr. Abdul Salam
Sponsor: Global Network on Energy for Sustainable Development (GNESD), Denmark
Total contracted amount: Baht 1,200,000 (US$ 40,000)

More details available at: www.gnesd.ait.ac.th and www.gnesd.wordpress.com

Continuing Projects:

1. Actions towards Resource-efficient and Low carbon Cities in Asia

In order to assist urban decision makers, The French Environment and Energy Management Agency or ADEME (Agence de l'Environment et de la Maitris de l'Energy) has developed methodologies and tools such as the "Territorial Climate Energy Plan" (PCET) which aims to address climate change mitigation and adaptation using the "Bilan Carbone TM" tool. Such approaches are already widely used in France. The project will aim to: (a) Study "Territorial Climate and Energy Plan (PCET) and "Bilan Carbone TM" developed by ADEME and their applicability to Asian small- and medium-size cities; (b) Identity and select of small but growing cities in Asia that are keen to adopt the path of low carbon growth (LCG); (c) discuss with stakeholders and other organizations on implementing LCG; (d) Implementation of pilot scale activities identified by "Bilan carbone™" tool: (e) Dissemination and information sharing.

Duration: December 2009- April 2013
Investigator: Prof. S. Kumar, Prof. C. Visvanathan, Dr. Ranjith Perera, Dr. P. Abdul Salam, Dr. Charles O.P. Marpaung and Dr. Kyoko Kusakabe
Sponsor: ADEME (French Environment and Energy Management Agency)
Total contracted amount: Baht 11,052,979

More details available at: http://lcc.ait.asia

2. Bangkok Greenhouse Gas Emissions Study. (Tongji)

Climate change has become issue of global concern, and the action we take today will have dramatic implications for future generations. At present, as more than half of the world's population is living in the towns and cities, study on response mechanisms and strategies for climate change at city level is of practical significance, especially in regions with high population density. This study aims to identify key factors which

influence carbon emissions and reduction in Bangkok and analyzing the balance between carbon sources and sinks.

Duration: 1 January 2010 – 31 September 2013
Investigator: Prof. S. Kumar and Dr. Charles P.O. Marpaung
Sponsor: Tongji University China
Total contracted amount: Baht 495,000

3. **Energy Field of Studies Publications**
The Renewable Energy Resources Information Center (RERIC) houses the publication arm of the Energy Field of Study. It publishes the International Energy Journal (IEJ), formerly known as the RERIC International Energy Journal. The IEJ, published since 1979, is dedicated to advancing knowledge in energy by vigorous examination and analysis of theories and good practices, and encouraging innovations needed to solve energy-related issues. IEJ is a quarterly journal with papers on technical, socio-economic and environmental aspects of energy planning, energy conservation, renewable sources of energy, electric power transmission, generation and management.

Duration: 1 January 2011 – 31 December 2012
Investigator: Prof. S. Kumar and Dr. P. Abdul Salam
Sponsor: Membership fees, AIT
Total contracted amount: Baht 1,521,149

More details available at: www.rericjournal.ait.ac.th

4. **King HRD Scholarship Project**
To provide fellowships for eligible Thai candidate and all expenses are related to support tuition & fee and education activities only.

Duration: 1 October 2009 – September 2013
Investigator: Dr. Weerakorn Ongsakul
Sponsor: Energy Planning and Policy Office (EPPO), Thailand
Total contracted amount: Baht 12,753,200

6. **Provincial Electricity Authority (PEA)-AIT Cooperation Project**
To provide fellowships for eligible PEA staff and all expenses are related to support tuition & fee, and education activities only

Duration: January 2009 – December 2012
Investigator: Dr. Weerakorn Ongsakul
Sponsor: Provincial Electricity Authority (PEA), Thailand
Total contracted amount: Baht 27,374,000

7. **Energy-Environmental Data Analysis for Low Carbon Society (EEDA)**
The project is about collection data related to low carbon society for selected South East and South Asian countries from the available publications. The research project also analyzes future energy consumptions and emissions of greenhouse gases under the reference and low carbon scenarios.

Duration: 1 December 2009 – 31 December 2012
Investigator: Prof. Ram M. Shrestha and Prof. Kumar
Sponsor: MHIR (Mizhou)
Total contracted amount: Baht 740,000

8. Micro hydro – PV hybrid system. (Ebara Project)

The project aims to design, develop and install a micro hydro – photovoltaic system at the Energy Park of AIT and conduct tests to evaluate the performance of the system working in hybrid mode.

Duration: 1 February 2010– 28 Feb 2013
Investigator: Prof. S. Kumar, Dr. P. Abdul Salam, Dr. Jai Govind Singh and Dr. Charles O.P. Marpaung
Sponsor: Ebara Katayema Memorial Fund, Japan
Total contracted amount: Baht 1,440,000

9. Technology Needs Assessments in Asia for Climate Change Mitigation(TNA)

The objective of the project is to assist participant developing country parties identify and analyze priority technology needs, which can form the basis for a portfolio of environmentally sound technology (EST) projects and programmes to facilitate the transfer of, and access to, the ESTs and know-how in the implementation of Article 4.5 of the UNFCCC convention. The project involves research, capacity building and training for participants (government ministries) from 10-12 Asian countries in 2 phases.

Duration: 1 July 2010 – 30 May 2013
Investigator: Prof. S. Kumar, Dr. P. Abdul Salam and Dr. Charles O.P. Marpaung and Dr. R. Shrestha
Sponsor: UNEP Riso Centre
Total contracted amount: Baht 11,068,470

More details available at: www.sdcc.ait.ac.th/tna-mitigation

10. Low Carbon Cities: Learning from the experiences in France

The project will manage a regional workshop at AIT by the end of 2012 and would involve all stakeholders, Asian and French (in particular ADEME, AFD, etc.) of the project Low Carbon Cities: Learning from the experiences in France.

Duration: September 2010 – 31 September 2012
Investigator: Prof. S. Kumar, Prof. C. Visvanathan, Dr. P. Abdul Salam, Dr. Charles Marpaung, Dr. L.A.S. Ranjith Perera and Dr. Kyoko Kusakabe
Sponsor: SDCC/AIT – France Network
Total contracted amount: Baht480,000

11. Indicator for Low Carbon Green Growth/Green (GDP)

The study on Climate Change and Green Asia examines how emerging economies of Asia are operating amid changing demands for low carbon development and what kind of pro-active policies would strengthen such green growth practices in development Asia. The main objectives of the study are (i) examine the key issues

and challenges in reducing GHG emissions without adversely affecting economic growth (ii) assesses the scope and merits of current pledges, programs, strategies and institutions and provide recommendations for a new, low carbon growth paradigm (iii) develop an effective policy framework based on the principles of equity, market orientation and regional cooperation to speed up the transition towards a low carbon Asia. The study will develop an index for low carbon green growth based on Policy, Economy, Technology and Social indicators. The indicators and the measurement framework will be kept flexible enough to adapt to different national contexts.

Duration: September 2011 – March 2013
Investigator: Prof. S. Kumar
Sponsor: Asian Development Bank Institute (ADBI), Japan
Total contracted amount: Baht 750,000 (US$ 25,000)

12. Sustainable Urban Tourism through Low Carbon Initiatives: Experiences from Hue and Chiang Mai

This research aims to explore strategies for alleviating poverty and low carbon emissions in the urban tourism sector of Hue and Chiang Mai cities. The project will aim to: a) improve understanding and assist in the reduction of carbon emissions in urban tourism sector, and b) recommend GHG mitigation policies and plans that could generate green and decent jobs for women and men, especially targeting lower.

Duration: 26 September 2011 – 31 January 2013
Investigator: Prof. S. Kumar and Kyoko Kusakabe
Sponsor: Sumernet Climate Development and Knowledge Network (CDKN)
Total contracted amount: Baht 2,250,000 (US$ 75,000)

More details available at: http://sut.ait.asia

13. Promoting Renewable Energy, Clean Fuels, and Energy Efficiency in the Greater Mekong Subregion

This project aims to provide technical support to the Sub-regional Energy Forum (SEF) to promote SEF as the vehicle for knowledge dissemination in the GMS. This projected is initiated to: ensure the realization of the GMS Road Map for Expanded Cooperation in the energy sector, build capacities in the GMS countries in renewable energy, clean fuels, and energy efficiency policies, plans, and program formulation, and develop a strategic development framework through preparation of business models for the selected clean energy technologies by considering disparate energy market conditions, institutional arrangements & frameworks, and technology transfer schemes.

Duration: August 2011 – June 2013
Investigator: Prof. S. Kumar
Sponsor: Lahmeyer/ADB
Total contracted amount: Baht 2,640,000 (US$ 88,000)

Projects Initiated in 2012:

1. **Capacity Development on Clean Coal Technology and Carbon Sequestration:2012**
The objective of this sponsored activity is to provide support to the design, development and offering of a course on clean coal technology and carbon sequestration at AIT.

Duration: 1 February 2012 – 21 October 2012
Investigator: Prof. S. Kumar
Sponsor: ADW, Inc/NexGen Systems Corporation, USA
Total contracted amount: Baht 480,000 (US$ 16,000)

2. **Training on Design and Management of Domestic Biogas Systems**
The dissemination of domestic biogas plants around the world is sharply rising, both in terms of number of units as well as geographical coverage. More than 40 million plants have been installed by the end of 2009, most of them in china and India, providing about 200 million people access to multiple benefits. More and more countries have embarked on market-based national programmes on domestic biogas and have started to develop a sustainable biogas sector. As a result of the extension of biogas programmes in the region, there is a huge need for the capacity building on biogas systems. The objective of the project is to organize a one week international training program on design and Management of Domestic Biogas Systems.

Duration: 1 July 2012 – 31 October 2012
Investigator: Dr. P. Abdul Salam
Sponsor: EEP Mekong/ADB
Total contracted amount: Baht 1,333,000 (US$ 43,000)

3. Gender Inclusive Capacity Development for Electricity Distribution Loss Reduction in Rural Area of Madhya Pradesh, India
This is a training program for power distribution planning and operations engineers from one of the three electricity distribution utilities in the state of Madhya Pradesh, India. All delegates are permanent employees of this utility. This training program will cover first two days lectures by different expertise from AIT and industry and followed by site/field visit for two days. Participants including engineers and the senior officers from the utility would get knowledge and info about power loss reduction as well as enhancing the performances of the utility like increasing the revenue and maintaining the required service standards by using appropriate methods and technologies.

Duration: 1 July 2012 – 31 October 2012
Investigator: Dr. Jai G. Singh
Sponsor: Energy Division, South Asia Department, ADB
Total contracted amount: Baht 244,900 (US$ 7,900)

4. Professional Master in Energy Business Management.
Customised Degree Program: Professional Master in Energy Business Management
Duration: 1 August 2012– 31 December 2013
Investigator: Dr. P. Abdul Salam and Prof. Nazrul Islam
Sponsor: World Bank/Power Distribution Companies - Pakistan
Total contracted amount: Baht 10,336,000.00 (US$ 344,530)

5. Capacity Development of the Assam Power sector Utilities, Overseas Study Tour in Bangkok

This is a technical assistance capacity development program which aims to assist the Assam state Electricity Board (ASEB), the Assam Power Generation Corporation Limited (APGCL), the Assam Electricity Grid Corporation Limited (AEGCL), and the Assam Power Distribution company Limited (APDCL) in (i) introducing new business processes, (ii) strengthening their human resources and financial management capabilities, and (iii) mainstreaming rural electrification. This program will be conducted in terms of classroom discussion in morning session followed by site visits in afternoon session for selected senior staffs from above mentioned power utilities. The objective of this program is to provide an exposure to technology, operations and maintenance, and overall management aspects of transmission and distribution loss reduction in a middle income Asian country. The dates for the program are: Power Distribution Management: 26-30 Novermber 2012 and Transmission System Management: 3-7 December 2012.

Duration: 1 October 2012 – 30 June 2013
Investigator: Dr. Jai G. Singh
Sponsor: Energy Division, South Asia Department, ADB
Total contracted amount: Baht 294,900 (US$ 9,830)

F. Workshops/Conferences/Organized

1. 2nd Regional Capacity Building workshop on Barrier Analysis, Enabling Environment and Development of Technology Action Plans (2nd Round countries)
   Date and location: 21-24 February 2012/ Novotel Siam Square, Bangkok
   Organizer: AIT
   Number of Participants: 45

2. Policy Dialogue on Urban Peri Urban Energy Access (UPEA III)
   Date and location: 6 March 2012/ Novotel Siam Square, Bangkok
   Organizer: AIT
   Number of Participants: 18

Front Row (L-R): Ms. Thanaporn Kemdang, Ms. Suwanna Jungrungruang, Prof. Sivanappan Kumar, Dr. Bundit Limmeechokchai, Mr. Thanee Parichatintranee, Ms. Sirirat Muneesawang, Ms. Neriza Cabahug
Second Row (L-R): Ms. Pujan Shrestha, Ms. Yanee Kaewprasit, Mr. Borwornpong Sunipasa, Dr. P. Abdul Salam, Ms. Nutta Ratanachaichan, Mr. Thiyagarajan Velumail, Dr. Ludovic Lacrosse, Dr. Mokbul M. Ahmad, Ms. Naga S. Goteti, Mr. Bijay B. Pradhan, Mr. Rudhpol Jaturapreuk

3. International Training course on "Design and Management of Domestic Biogas Systems"
   Date and location: 6-10 August 2012/ ET238/AIT, Bangkok
   Organizer: AIT
   Number of Participants 30

4. Training course on Gender Inclusive Capacity Development for Electricity Distribution Loss Reduction in Rural Area of Madhya Pradesh, India.
   Date and location: 20-24 August 2012, Conrad Hotel, Bangkok
   Organizer: AIT
   Number of Participants: 15

5. Experience Sharing Workshop in Asia for Technology Needs Assessment (TNA)
   Date and location: 10-12 September2012/ Pullman Bangkok King Power Hotel
   Organizer: AIT
   Number of Participants: 85

6. Consultative meeting, Sustainable Urban tourism: Experiences from Chiang Mai and Hue. (with Dr K. Kusakabe)
   Date and location: 1-2 October 2012/Chiang Mai
   Organizer: AIT/Chiang Mai
   Number of Participants: 52

7. Consultative meeting, Sustainable Urban tourism: Experiences from Chiang Mai and Hue.
   Date and location: 26 November 2012/ Bangkok
   Organizer: AIT
   Number of Participants: 8

8. Training course on New Trends in Power Distribution Planning and Loss Reduction Strategies for Rural Areas of Assam.
   Date and location: 26-30 November 2012/ Centara Grand Bangkok
   Organizer: AIT
   Number of Participants: 15

9. Capacity Development Program on New Trends in Power Transmission planning, Operation and Maintenance in Assam, India.
   Date and location: 3-7 December 2012/ Centara Grand Bangkok
   Organizer: AIT
   Number of Participants: 17

10. The 7th GMSARN International Conference 2012 on "Green Economy with Energy Environmental & Social Responsibility".
    Date and location: 19-21 December 2012/ Siem Reap, Kingdom of Cambodia
    Organizer: AIT
    Number of Participants: 17

G. Publications

Books/Book Chapters:

Kumar S, Kyoko Kusakabe, Pravakar Pradhan, Pujan Shrestha, Srujana Goteti, Tran Anh Tuan, Ekawit Meteejaroenwong, Trinnawat Suwanprik, Khanh Linh, "Greenhouse Gas Emissions from Tourism Service Providers: Case Studies in Chiang Mai, Thailand and Hue, Vietnam", in "Livelihoods, Ecosystem Services and the Challenges of Regional Integration in the Mekong Region", edited by Louis Lebel, Chu Thai Hoanh, Chayanis Krittasudthacheewa and Rajesh Daniel, and published by Strategic Information and Research Development Centre (SIRD), Selangor, Malaysia. (in press)

Mohanty B, M. Scherfler and V. Devatha, Lifestyle Choices & Societal Behavior Changes as Local Climate Strategy, ADBI Working Paper 398, Asian Development Bank Institute, Tokyo, 2012.

Mohanty B, Sustainable Consumption and Production: A Handbook for Policy Makers with Cases from Asia and the Pacific, Author for Chapters 8.1 and 13 and co-author of Chapter 10, Switch-Asia Policy Support Program, UNEP Publication, Bangkok, 2012

Mohanty B, Buildings: Policy Recommendations for the Development of Eco-Efficient Infrastructure, Background Policy Paper for Low Carbon Green Growth Roadmap for Asia and Pacific, UN-ESCAP and KOICA, United Nations Publication, Bangkok, 2012.

Mohanty B, Sustainable Urban Energy: A Sourcebook for Asia, UN-Habitat and IUTC, Nairobi, 2012.

Journals:

1. Adeel Waqas and S. Kumar, Phase Change Material (PCM)-Based Solar Air Heating System For Residential Space Heating In Winter, *International Journal of Green Energy*, accepted for publication, 2012.

2. Boonrit Prasartkaew and S. Kumar, Experimental Study on the Performance of a Solar-Biomass Hybrid Air-Conditioning System, *Renewable Energy*, accepted for publication, 2012.

3. Daya Ram Nhuchhen and P. Abdul Salam "Experimental study on two-stage air supply downdraft gasifier and dual fuel engine system" *Biomass Conversion and Biorefinery*: Vol. 2 No. 2, pp. 159-168, 2012.

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5. Jutamanee Martchamadol andS. Kumar, An aggregated energy security performance indicator, *Applied Energy*, 103, 653 – 670, 2012.

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3. S. Kumar, Renewable Energy Education and Research at the Asian Institute of Technology, 6th UN-CECAR International Conference: Renewable Energy, Bangkok, 22-23 May 2012
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3. P. Abdul Salam, Biofuels in ASEAN. Low Emission Development strategy (LEDS) forum. Organized by USAID. Sofitel Hotel, Bangkok, 18-21 September 2012.

H. RERIC Activities

Regional Energy Resources Information Center (RERIC)

The Center houses the publication arm of the Energy Field of Study. It publishes the International Energy Journal (IEJ), formerly known as the RERIC International Energy Journal. The IEJ, published since 1979, is dedicated to advancing knowledge in energy by vigorous examination and analysis of theories and good practices, and encouraging innovations needed to solve energy-related issues. IEJ is a quarterly journal with papers on technical, socio-economic and environmental aspects of energy planning, energy conservation, renewable sources of energy, electric power transmission, generation and management.

In 2012, the International Energy Journal (IEJ) published three issues with fourteen (14) peer-reviewed research articles. The authors were from Japan, India, Canada and Iran. Topics varied from biomass utilization for power and heat production, biofuels, solar, wind power and even electric power transmission and distribution.

IEJ continues to receive several submissions and is expanding its scope with exciting future articles in clean development mechanisms, energy-related policies in road transport, among others.

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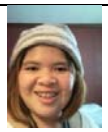
 **Ms. Maria Kathrina Gratuito** *Research Associate* RERIC	 **Ms. Parichart Kammeerak** *Secretary* RERIC
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