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International Practices for Alternative Energy in Developing Countries

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Working Group Chinese Electricity Infrastructure

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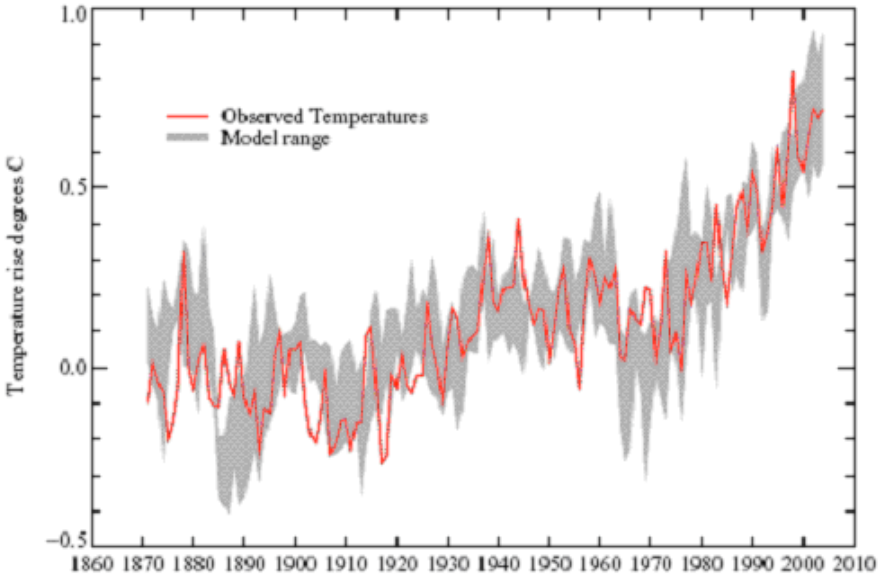
Track 4: Going Green

INTRODUCTION

According to the report from Intergovernmental Panel on Climate Change (IPCC), the world's surface air temperature increased by an average of 0.6° Celsius over the past 100 years. This may not sound like very much change, but even a one-degree change can affect the earth. Some effects of climate change include: sea level is rising, arctic sea ice is melting, glaciers and permafrost are melting, sea-surface temperatures are warming, heavier rainfall cause flooding in many regions; extreme drought is increasing, hurricanes have changed in frequency and strength, heat waves more frequent and seawater is becoming more acidic. Figure 1 shows the observed and simulated global warming effect. One important way to



Source: Hadley Centre UK

Figure 1: Simulated global warming

reduce impact of Climate Change is to use more alternative energy sources. Also, as the amount of fossil fuel resources decreases, it is becoming increasingly important to find and utilize alternative fuels. Examples of alternative energy resources include: wind power; solar power; biofuels; hydroelectric power; geothermal energy; tidal power; and wave energy. The most popular power generator technology at present is onshore and offshore wind power. The technology is well proven, is scalable with turbines over 5MW capacity now commonplace and as an example, the UK has an abundance of potential wind energy.

The UK Energy White Paper commits the Government to putting the UK on a path towards a reduction in carbon dioxide emissions of some 60 per cent by around 2050, or around 65 Million tonnes Carbon per year (MtC/y) against a baseline of some 165MtC/y. The White Paper sets out a few goals for energy policy as below:

- to put ourselves on a path to cut the UK's carbon dioxide emissions - the main contributor to global warming - by some 60 per cent by about 2050, as recommended by the Royal Commission on Environmental Pollution (RCEP), with real progress by 2020;
- to maintain the reliability of energy supplies;
- to promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve our productivity; and to ensure that every home is adequately and affordably heated.

The climate change levy is a tax on the use of energy in industry, commerce and the public sector, with offsetting cuts in employers' National Insurance Contributions and additional support for energy efficiency schemes and renewable sources of energy. The aim of the levy is to encourage users to improve energy efficiency and reduce emissions of greenhouse gases. Climate Change Agreements allow energy intensive business users to receive an 80 per cent discount from the Climate Change Levy, in return for meeting energy efficiency or carbon saving targets.

The Clean Development Mechanism (CDM) allows net global greenhouse gas emissions to be reduced at a much lower global cost by financing emissions reduction projects in developing countries where costs are lower than in industrialized countries.

Electricity transmission and distribution systems are among the most important technologies serving the world today, bringing clean and useful energy to meet the demand of end users in many parts of the world. However, in the light of concerns on energy security and access, environmental impacts of energy use and depletion and rising costs of non-renewable energy resources, the existing energy distributed generations have begun to show signs of inflexibility, vulnerability, high costs and inefficiencies. At the same time, distributed energy resources are becoming increasingly widespread and important, and entail the development and use of new and innovative approaches and technologies in energy supply and distribution.

Distributed energy resources are smaller in capacity and output as compared to existing centralized power and energy conversion systems. They are based on a variety of different alternative and renewable energy resources with different technical and economic characteristics, including intermittency in output in the case of many forms of renewable energy resources.

Sensing and communication technologies, for example, smarting metering, are essential to support the development, integration and deployment of flexible, safe, reliable and efficient power distribution management systems. The design, control, management and optimization of these new distributed energy resources and technologies, and their integration into existing energy transmission and distribution networks, pose significant technological challenges to ensure their reliability and safety, and to improve and maximize their cost competitiveness.

Micro-grids and other smaller-scale power networks can make important contributions to the wider application of distributed energy resources. They enable distributed energy technologies to be safely and reliably integrated with centralized networks where they exist, or to operate on their own in islanded mode in remote locations not served by centralized power grids. They offer opportunities to improve energy efficiency and can ease the strain on and cost of developing centralized power grid infrastructure.

With the necessary information embedded into energy distribution systems through the use of smart sensor and communication technologies and controllers, they will be able to utilize, integrate and optimize diverse energy resources, and provide reliable, cost competitive, and environmentally sustainable energy to customers. Such information will enable effective exchange of energy between distributed alternative resources and centralized power systems. Price awareness and sensitivity are possible shared between energy suppliers and customers, creating a sophisticated real-time energy market which is interconnected.

Advancement in Internet database software for optimal energy management and distribution will be critical to the development of a system that is highly reliable, robust, secure and intelligent. The developed system will also be standards-compatible

in terms of its data structures, algorithms, and design and development techniques. Integration of alternative energy will enhance the efficient utilization and management of a variety of energy technologies and carriers such as electrical power, heat and cooling. Development in power conversion techniques, methods, policy and practices which enable safe, quick-response, high-quality and efficient generation power from distributed energy sources will be considered.

The panel will cover the international practices and challenges in producing alternative energy together with the realistic prospects for widespread deployment of cost effective, green and emerging technologies.

Some of the key persons in the industry will participate with technical presentations.

The Panelists and Titles of their Presentations are:

1. T. J. Hammons (Glasgow University, UK), L. L. Lai (City University, London, UK), K. P. Wong (Hong Kong Polytechnic University, China). International Practices for Alternative Energy in Developing Countries ((Invited Panel Presentation Summary 09GM 0160).
2. C. Chai/Chow, M. Leelajindakrairerk, S. Banjongjit, P. Fuangfoo and Wei-jen Lee (University of Texas at Arlington, USA). Biomass Power Generation Development in Thailand (Invited Panel Presentation Summary 09GM1018).
3. Norman Tse (City University of Hong Kong, Hong Kong, China) and Long Zhou (City University London, UK). Detection of Voltage Variations due to Distributed Energy Resources (Invited Panel Presentation Summary 09GM0915).
4. Ringo Lee (Powerpeg NSI Ltd, Hong Kong, China), L. L. Lai (City University London, UK). A Practical Approach of Smart Metering in Remote Monitoring of Renewable Energy Applications (Invited Panel Presentation Summary 09GM0925).
5. Yanping Zhang and Yuping Lu (Southeast University, Nanjing, China), A Novel Power Flow Analysis Based on Newton Current Equation in Microgrid (Invited Panel Presentation Summary 09GM0496).
6. Jizhong Zhu and Kwok Cheung (Areva Company, WA, USA). Analysis of Regulating Wind Power for Power Systems (Invited Panel Presentation Summary 09GM0831).
7. S. N. Singh, Bharat Singh (Indian Institute of Technology Kanpur, India) and Jacob Ostergaard (Center for Electric Technology, Technical University of Denmark). Renewable Energy Generation in India: Present Scenario and Future Prospects (Invited Panel Presentation Summary 09GM1091).
8. Tze-Fun Chan (Hong Kong Polytechnic University, China) and L. L. Lai (City University London, UK), A Novel Wind Energy System (Invited Panel Presentation Summary 09GM0706).
9. X. Zhou (The University of Queensland, St Lucia, Australia), Z.Y. Dong (Hong Kong Polytechnic University, China), A. Liebman (Sanctuary Energy, Tuggerah NSW, Australia) and G. James (CSIRO ICT Centre, North Ryde, NSW, Australia). Australian Electricity Market Power Analysis under Potential Emission Trading Scheme (Invited Panel Presentation Summary 09GM0057).
10. Zhao Xu (Technical University of Denmark), Henrik Rosenborg (BALSLEV A/S, Denmark), Poul Sørensen (Technical University of Denmark), and Hans Abildgaard, Ole Holmstrøm, Yong Nin Chi and Wei Sheng Wang. Wind Energy Development in China (WED)--The Danish-Chinese Collaboration Project (Invited Panel Presentation Summary 09GM0938).
11. Chun Che Fung, Wigrai Thanadechteemapat and David Harries (Murdoch University, WA, Australia). Acquiring Knowledge and Information on Alternative Energy from the World Wide Web (Invited Panel Presentation Summary 09GM0962).
12. Tae-Il Choi (Korea Electric Power Corporation, Korea) and Kwang Y. Lee (Baylor University, USA). Interface of the Fuel Cell Distributed Generator with Distribution System Network (Invited Panel Presentation Summary 09GM0973).
13. Invited Discussers.

Each Panelist will speak for approximately 20 minutes. Each presentation will be discussed immediately following the respective presentation. There will be a further opportunity for discussion of the presentations following the final presentation.

The Panel Session has been organized by Loi Lei Lai (Professor, City University London, UK); Kit Po Wong (Professor, Hong Kong Polytechnic University, Hong Kong, China) and Tom Hammons (Chair of International Practices for Energy Development and Power Generation IEEE, University of Glasgow, UK).

Loi Lei. Lai, Kit Po Wong and Tom Hammons will moderate the Panel Session.

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BIOGRAPHIES

Thomas James Hammons (F'96) received the degree of ACGI from City and Guilds College, London, U.K. and the B.Sc. degree in Engineering (1st Class Honors), and the DIC, and Ph.D. degrees from Imperial College, London University.

He is a member of the teaching faculty of the Faculty of Engineering, University of Glasgow, Scotland, U.K. Prior to this he was employed as an Engineer in the Systems Engineering Department of Associated Electrical Industries, Manchester, UK. He was Professor of Electrical and Computer Engineering at McMaster University, Hamilton, Ontario, Canada in 1978-1979. He was a Visiting Professor at the Silesian Polytechnic University, Poland in 1978, a Visiting Professor at the Czechoslovakian Academy of Sciences, Prague in 1982, 1985 and 1988, and a Visiting Professor at the Polytechnic University of Grenoble, France in 1984. He is the author/co-author of over 400 scientific articles and papers on electrical power engineering. He has lectured extensively in North America, Africa, Asia, and both in Eastern and Western Europe.

Dr Hammons is Chair of International Practices for Energy Development and Power Generation of IEEE, and Past Chair of United Kingdom and Republic of Ireland (UKRI) Section IEEE. He received the IEEE Power Engineering Society 2003 Outstanding Large Chapter Award as Chair of the United Kingdom and Republic of Ireland Section Power Engineering Chapter (1994~2003) in 2004; and the IEEE Power Engineering Society Energy Development and Power Generation Award in Recognition of Distinguished Service to the Committee in 1996. He also received two higher honorary Doctorates in Engineering. He is a Founder Member of the International Universities Power Engineering Conference (UPEC) (Convener 1967). He is currently Permanent Secretary of UPEC. He is a registered European Engineer in the Federation of National Engineering Associations in Europe.

Loi Lei LAI (SM'92, F'2007) received the B.Sc. (First Class Honors) and the Ph.D. degrees from the University of Aston in Birmingham, UK. He also gained his D.Sc. from City University London. Currently he is Professor and Head of Energy Systems Group at City University, London, UK. He is a Visiting Professor at Southeast University, Nanjing, China and also a Guest Professor at Fudan University, Shanghai, China. He has authored/co-authored over 200 technical papers. In 1998, he also wrote a book entitled Intelligent System Applications in Power Engineering Evolutionary Programming and Neural Networks. Recently, he edited a book entitled Power System Restructuring and Deregulation Trading, Performance and Information Technology. In 1995, he received a high-quality paper prize from the International Association of Desalination, USA. Among his professional activities are his contributions to the organization of several international conferences in power engineering and evolutionary computing, and he was the Conference Chairman of the IEEE/IEE International Conference on Power Utility Deregulation, Restructuring and Power Technologies 2000. Dr. Lai is a Corporate Member of the IEE. He was awarded the IEEE Third Millennium Medal, 2000 IEEE Power Engineering Society UKRI Chapter Outstanding Engineer Award, and 2003 IEEE Power Engineering Society Outstanding Large Chapter Award.

Kit Po WONG (M'87-SM'90-F'02) obtained M.Sc and Ph.D. degrees from the University of Manchester, Institute of Science and Technology, UK in 1972 and 1974, respectively. UMIST awarded Prof. Wong a higher doctorate DEng degree in 2001. Prof. Wong is currently a Chair Professor of the Department of Electrical Engineering, Hong Kong Polytechnic University and an Adjunct Professor of School of EECE at The University of Western Australia. He was Guest Professor at Tsinghua University, Beijing, China and is Guest Professor at Southeast University, Nanjing, China. Prof. Wong was a Professor at the University of Western Australia. During this period he received three Sir John Madsen Medals (1981, 1982 and 1988) from the Institute of Engineers Australia, the 1999 Outstanding Engineer Award from the IEEE Power Chapter Western Australia and the 2000 IEEE Third Millennium Award. Professor Wong has published numerous research papers in power systems and on the applications of artificial intelligence and evolutionary computation to power system planning and operations. His current research interests include evolutionary optimization in power, power market analysis, power system planning and operation in the deregulated environment, and power quality. Professor Wong has served as Editor in Chief for IEE Proceedings Generation, Transmission and Distribution. He was the Conference Chair of IEEE/CSEE PowerCon2000. He is a Fellow of IEEE, IEE, HKIE and IEAust.