

Australian Academy of Technologica Sciences and Engineering (ATSE)

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> > Austral

Australian Government Department of Industry

华能清洁能源研究院

# **ATSE/CERI WORKSHOP** 7th Australia-China Joint Coordination Group on Clean Coal Technology

REPORT

LANGHAM HOTEL, MELBOURNE, AUSTRALIA TUESDAY 22 OCTOBER 2013

**ATSE** 



**2013 Australia China Emerging Future Leaders with Dr David Brockway FTSE:** L-R: Dr Luguang Chen, Dr LIU Hongpeng, Dr Deanna D'Alessandro, Dr Kathryn Smith, Dr Chunbo Ma, Dr David Brockway FTSE, Dr William Conway, Dr ZHANG Xiaosong, Dr Vinay Sriram, Dr ZHU Dechen, Dr GUO Dongfang and Dr WANG Jun.



L-R: Professor John Agnew FTSE, Dr David Brockway FTSE, Ms Margaret Sewell and Dr Mike Sargent AM FTSE

#### BACKGROUND

To build on the growing relationship between Australia and China through the Australia-China Joint Coordination Group on Clean Coal Technology (JCG), the Department of Industry (DoI) invited the Australian Academy of Technological Sciences and Engineering (ATSE) to manage the Australia-China JCG Partnership Fund ('the Fund') for a range of activities that support the ongoing collaboration between Australia and China in low emission coal technology (LECT). The emphasis of the Fund is building critical mass in LECT and supporting the development of enduring partnerships and advancing the development and deployment of LECT in Australia and China. ATSE has managed the day to day operation of the Fund and the China Huaneng Clean Energy Research Group (CERI) has acted as a strategic liaison point for ATSE in China.

ATSE has managed Australian Government funding of \$1,150,000 (GST exclusive) and delivered, in consultation with CERI, two competitive calls in July/August 2012 and February/March 2013, to support:

- short term exchanges (up to 14 days) between Australia and China for Australian and Chinese Research and Industry Representatives to undertake cooperation in LECT.
- long term exchanges (up to 9 months) between Australia and China for Australian and Chinese Research and Industry Representatives to undertake cooperation in LECT.
- bilateral workshops and symposia between Australian and Chinese Research Institutions and/or Industry in Australia and China.
- Support for Emerging Research Leaders to attend various workshops

ATSE and CERI have actively worked together on strategic activities on behalf of DoI and the China's National Energy Administration (NEA)to deliver the broader JCG objectives.

Cooperation between Australia and China in LECT was further enhanced at the fifth JCG meeting, led by the Department of Resources, Energy and Tourism (RET) and China's National Energy Administration (NEA), held in Melbourne on 16 September 2011. At this JCG meeting, and in subsequent discussions, officials agreed to support a new JCG Partnership Fund ('the Fund'). The emphasis of the Fund is on supporting strategic collaboration of mutual benefit to Australia and China in LECT; supporting the development of enduring partnerships; and advancing the development and deployment of LECT in Australia and China.

The co-ordinating agencies responsible for this collaborative effort are ATSE on behalf of Dol (formerly Department of Resources, Energy and Tourism) and CERI on behalf of the NEA.

#### **EXECUTIVE SUMMARY**

The Dol invited ATSE to put together the themes for the 22 October 2013 Workshop in consultation with CERI and in turn ATSE drew on internal resources (Mrs Elizabeth Meier, Executive Manager International Linkages and ATSE Fellow Dr David Brockway FTSE) and CERI (Dr Xu Yue and Dr Gao Shiwang) for these arrangements. The Workshop in Melbourne, formed part of the official program for the 7<sup>th</sup> Australia-China Joint Coordination Group on Clean Coal Technology, with the Officials Meeting held on Wednesday 23 October and a technical visit on Thursday 24 October to the CO2CRC Otway Project.

In order to build on the momentum gained from previous JCG activities, ATSE and CERI brought together 62 Australian and 33 Chinese active researchers and industry organizations to explore the current state of low-emissions coal technology and, in particular, to identify areas in which China and Australia could usefully engage in collaborative research and development partnerships.

#### 1. ATSE/CERI Workshop

ATSE and CERI conducted an R&D Workshop in conjunction with the 7<sup>th</sup> JCG Meeting, at the Langham Hotel on 22 October 2013. Researchers from Australia and China discussed advances in low-emission coal technologies (LECT) and progress in demonstration projects. Emerging research leaders from Australia and China, funded through the JCG program, also presented on their collaborations and research. The program for the workshop is attached

The overall conclusions from the workshop was that

- the collaborations between China and Australia were expanding rapidly,
- there was a match between the needs of both countries, and
- the complementarity between the skills and R&D structures of China and Australia provided a strong basis for continuing expansion of collaboration

The presentations reinforced the position that the development of low-emission coal technologies was a global need and issue, which requires ongoing and sustained collaboration internationally.

The presentations dealt with

- the development and deployment of LECT at large scale in both greenfield and retrofit situations
- diverse technologies including oxy-firing, carbon capture, integrated gasification and combined cycle, and ultra-supercritical developments
- the potentially "disruptive" Direct Injection Carbon Engine (DICE) technology
- various technologies being researched for CO<sub>2</sub> absorption.

It was notable that advances were being made in modelling of systems and critical technology elements to provide an essential precursor to technology deployment. An increased focus on the end-to-end systems was evident.

There were a number of presentations relating to more lateral approaches to the evolution of LECT, such as DICE. These respond to the changes that new technologies are having on the supply/economies of scale balance, with input 'fuel' costs and distribution costs of traditional energy supply systems increasing while capital costs of production facilities are decreasing as alternative technologies mature.

There was general comment that there needs to be a continuing policy commitment to rapidly progress developing LECT technologies from R&D through pilot and demonstration stages.

The meeting recognised the contribution that the sponsoring Governments, ATSE and CERI had made to the enhanced collaboration and increased R&D pace of LECT technologies, and encouraged continuation of the programs of the JCG.

Powerpoint presentations and photographs from the ATSE/CERI Workshop are available from ATSE website

Dr Mike Sargent AM FTSE On behalf of ATSE Dr Xu Yue on behalf of CERI









#### ATSE/CERI RD&D WORKSHOP

#### **TUESDAY 22 OCTOBER 2013**

#### Venue: Alto Room, level 25 Langham Hotel Melbourne

#### Presentations: 20 minutes duration, Questions and Answer: 15 Minutes

Session 1: Co-Chairs: Professor John Agnew FTSE and Professor Xiaojiang LI 0900

- Introduction and Welcome from JCG Co-Chairs:
  - Ms Margaret Sewell, Department of Industry
  - Mr QIN Zhijun, National Energy Administration
- Workshop Introduction: Dr David Brockway FTSE and Dr XU Yue (Vice President, CERI) 0915

Workshop Photographs

- 0930 Chinese Speaker: Mr Michael MEI, Alstrom Power Presentation: "Recent developments on low or lower emissions coal-fired power generation in China"
- 0950 Australian Speaker: Dr Chris Spero, Manager Emerging Technology/Callide Oxyfuel Project Presentation: "Callide Oxyfiring Demonstration"
- 1010 **Questions and Answer**
- 1030 NETWORKING MORNING TEA

Session 2: Co-Chairs: Dr Noel Simento and Mr Michael Mei

- Chinese Speaker: Dr WU Xiaojiang, Director of R&D Division, Shanghai Boiler Works 1100 Presentation: "Development of Oxyfuel Combustion Technology in China"
- Chinese speaker: Dr XU Yue, Vice President, China Huaneng Clean Energy Research Institute 1120 Presentation: "GreenGen and-CCS Demonstration Projects"
- Australian speaker: Professor Sankar Bhattacharya, Monash University 1140 Presentation given by Dr David Brockway: "oxygen-blown gasification of Victorian Brown Coal"
- Questions and Answer 1200
- 1215 NETWORKING LUNCH

Session 3: Chair: Dr Phil Gurney

- 1320 Australian speaker: Dr David Brockway FTSE
- Presentation: "Victorian Brown Coal: Prospective Dewatering, Drying and Processing Technologies" Australian Speaker: Dr Louis Wibberley, CSIRO 1340
- Presentation: "direct injection carbon engine developments with MAN" **Questions and Answer**
- 1400

Session 4: Chair: Mr Dominique Van Gent

- Curtin University Presentation on research development from JCG Partnership program: Mr 1420 Tim Walton, Director, Energy Research Initiatives, Curtin University
- 1435 CSIRO Presentation on research developments from JCG Partnership program with Zhejiang University/Tsinghua University on post combustion capture: Dr Hai Yu, CSIRO Research Scientist
- 1450 **Questions and Answer**
- 1500 NETWORKING AFTERNOON TEA

#### ATSE/CERI RD&D WORKSHOP (continued)

Session 5: Co-Chairs: Dr Mike Sargent AM FTSE and Professor Xiaojiang LI 1525 Introduction of research expertise: 2013 Australia China Emerging Research Leaders Fellowship Awardees

AUSTRALIAN EMERGING FUTURE LEADERS AWARDEES CHINESE EMERGING FUTURE LEADERS AWARDEES		
Dr Luguang Chen Research Fellow, Monash University	Dr GUO Dongfang China Huaneng Clean Energy Research Institute	
Areas of expertise <ul> <li>Oxyfuel</li> <li>Combustion</li> <li>Gasification</li> <li>Pyrolysis</li> <li>Sulphur Emission</li> <li>Trace Element Emission</li> </ul>	<ul> <li>Areas of Expertise:</li> <li>Solvent development for post combustion CO2 capture</li> <li>CO2 absorption pilot plant operation and process modeling</li> <li>Implementation, validation and trials of large scale CO2 capture</li> <li>molecular simulation</li> </ul>	
Dr William Conway	Dr LIU Hongpeng	
Post Doctorial Research Fellow, CSIRO	Northeast Dianli University	
<ul> <li>Areas of expertise</li> <li>Fundamental chemical behaviour of amine solvents for CO<sub>2</sub> capture processes</li> <li>Practical application of amine solvents for CO<sub>2</sub> capture processes</li> </ul>	<ul> <li>Areas of expertise:</li> <li>Combustion, especially inferior fuel fluidized combustion</li> <li>Comprehensive utilization of oil shale</li> </ul>	
<b>Dr Deanna D'Alessandro</b> ARC QEII Fellow, University of Sydney	<b>Dr WANG Jun</b> Shenhua Guohua (Beijing) Electric Power Research Institute Co., Ltd	
<ul> <li>Areas of expertise</li> <li>Inorganic Chemistry</li> <li>Carbon Dioxide adsorption</li> <li>New materials for CO<sub>2</sub> separation</li> <li>Materials Characterisation and property measurement</li> </ul>	<ul> <li>Areas of expertise:</li> <li>Oxyfuel combustion technology,</li> <li>Compression and Purification technology of CO2</li> <li>Low emissions technology of coal-fired boiler</li> <li>Pilot-scale research &amp; enlargement of cct.</li> </ul>	
School of Agricultural and Resource Economics, University of Western Australia	Dr ZHANG Xiaosong Institute of Engineering Thermophysics, Chinese Academy of Sciences	
Areas of expertise: • Environmental Economics • Energy Economics • Efficiency and Productivity • Non-market Valuation • Spatial Economics • Chinese Energy Economy	<ul> <li>Areas of expertise:</li> <li>Chemical looping combustion</li> <li>Coal gasification</li> <li>Scenario analysis of CO2 capture</li> <li>System simulation and integration</li> </ul>	
Dr Kathryn Smith Research Fellow, CO2CRC; Chemical & Biomolecular Eng, University of Melbourne	Dr ZHU Dechen Zhejiang University & Guangdong Power Grid	
<ul> <li>Areas of expertise</li> <li>CO2 capture via solvent absorption</li> <li>Solvent absorption pilot plant operation Potassium carbonate reaction kinetics</li> <li>Dr Vinay Sriram</li> </ul>	<ul> <li>Fundamental Absorption-Regeneration Performance of Novel Absorbents for CO2 Capture Processes</li> <li>Regeneration Method of Low Energy-Cost</li> <li>Pilot Plant Design/Debug/Operation</li> </ul>	
Managing Director, IPACS Power Pty Ltd		
<ul> <li>Areas of expertise</li> <li>Coal fired boiler optimisation</li> <li>Automation</li> <li>Asset management</li> <li>Reliability engineering</li> <li>Embedded computer system design Asset performance monitoring</li> </ul>		

1625 RD&D Workshop Closure: Dr Mike Sargent AM FTSE and Professor Xiaojiang LI to wrap up

Mr Michael MEI

Director, Environmental Policies & Global Advocacy Alstom China 5/F, Entrance C, Qian Kun Plaza, No.6, Sanlitun West Street 6 Beijing, 100027 CHINA

Email: Michael.mei@power.alstom.com Mobile: +86-13801102015



#### Professional expertise:

Michael has profound experience in government relations and policy research in China, especially in the energy and power sectors.

**Alstom China** offers comprehensive rail transport, power generation as well as transmission solutions and is a long-term dedicated partner of China's rail transport, power and transmission infrastructure industry in the past 50 years. By joining hands with Chinese partners, Alstom enables customers to be more competitive, efficient and environmentally friendly. Alstom presents in China through more than 30 entities with around 10,000 employees. Michael Mei is currently working in Alstom China.

Alstom Group is a global leader in equipment and services for rail transport, power generation and transmission and, and it is recognized for innovative, environmentally friendly solutions. The Group employs more than 92,000 people in over 70 countries and regions. In fiscal year 2010/11 (as of March 31, 2011), Alstom registered order intake ( $\leq$ 19.1 billion) and sales ( $\leq$ 20.9 billion), up respectively by 28% and 6% over the previous year. The Group strives for sustainable business growth in harmony with environmental protection. Alstom Group has the following significant achievements: No 1 in integrated power plants; No 1 in high speed trains and very high speed trains; No 1 in services for electricity utilities; No 1 in hydro power; No 1 in air quality control systems; No 1 in Network management solutions.

Alstom has an extensive range of power solutions for a wide variety of energy sources, including hydro, nuclear, coal, gas, biomass, solar and wind, and is a leader in air quality control system (reduction of CO2 and nitrogen oxide emissions). Alstom has provided the conventional island for the EPR nuclear power plant in France. The Group is also developing CO2 capture systems to commercial scale by 2015. Alstom completes a decisive stage in its development by forming Alstom Grid on 7 June 2010 by acquiring Areva T&D's transmission business, to supplement the existing two sectors in power generation and rail transport, Power and Transport. Alstom Grid boasts its 100 years of experience in the development of the world electrical grids, advanced technologies and expertise in key domains such as power electronics, ultra high voltage, direct current interconnections, integration of renewables into the grid and network management solutions.

Alstom helps cities meeting the rising need for sustainable mobility through its comprehensive range of systems, equipment and services. From the first TGV delivered in 1978, Alstom has consolidated its leadership in the world's high speed and very high speed trains. The technology leadership also enabled Alstom to set the new world rail speed record of 574.8km/h on April 3, 2007.

**Alstom Australia** is a well-established company, it has 1000 employees at 18 sites, headquarters in Sydney and has offices in all major cities, the rest of the sites are manufacturing and workshop facilities. In Power Generation sector, Alstom is the leading provider of turnkey gas power plants and has supplied major equipment to 30% of the Australian installed base of gas-fired power plants, totaling nearly 3.5GW. Alstom is a leading provider of turnkey steam power stations, with 15% of the Australian market share in steam turbines greater than 100 MW, and 36% of the Australian market in utility boilers. Alstom has a long history in Australia's hydro generation market, having supplied generators to the oldest operating power generator in Tasmania in 1907 at the Moorinah hydro power plant. The plant still operates today. Alstom has installed major equipment in 44% of Australia's hydro fleet. In Grid sector, Alstom' Network Energy Management System is responsible for managing 92% of Australia's electricity transmission network. Through our local organization and world class products, we deliver solutions to utility customers that answer the need for smarter, more stable, more efficient and environmentally friendly electrical grids.

In Transport sector, throughout Australia, Alstom has established key references for Light Rail, Metro Trains and Signaling technology. Our current activity today focuses on rolling stock in Victoria for both Metro and Trams and Signaling systems in New South Wales.

Website: <u>www.alstom.com</u>

**Michael Mei** is Director of Environmental Policies & Global Advocacy in Alstom China. He is responsible for broader policy issues and related advocacy in all Alstom businesses in China. Alstom is a major global supplier of clean power generation & transmission, and rail transportation equipment and solutions.

Michael began his career with Ministry of Foreign Trade of China (currently Ministry of Commerce). After that, he worked for U.S. Department of Commerce, as Senior Commercial Manager on energy and power.

Prior to joining Alstom, he was Senior Manager of Government Affairs, in GE China.

Michael holds a Bachelor Degree in English from Beijing Language and Culture University and a Master Degree of Business Administration from Tsinghua University.

梅报春

政策及政府事务总监 阿尔斯通(中国)投资有限公司

門小別通 (甲酉) 仅页作 土山五十<u></u>佐<u></u>広正

专业及工作经历:

梅报春是阿尔斯通(中国)投资有限公司的政策及政府事务总监,负责阿尔斯通集团在华企业的 各种政策问题和与政府的沟通。阿尔斯通是全球清洁能源发电、电力传输及轨道交通领域设备和 解决方案的主要提供商。

梅报春的职业生涯开始于中国外经贸部(现为商务部)。之后,他曾任美国商务部驻华机构负责 能源与电力行业的高级商务经理。在加入阿尔斯通集团之前,他曾担任通用电气(中国)有限公 司政府事务高级经理。

梅报春拥有北京语言大学英语言文学学士学位和清华大学工商管理硕士学位。

**Presentation: "Recent developments on low or lower emissions coal-fired power generation in China"** *The presentation will address some recent developments on China's power industry, in particular the coal-fired power generation.* 

It will also briefly update Alstom's technology, offering and references in the coal-fired power generation sector in China.

Dr Chris Spero Manager Emerging Technology/Callide Oxyfuel Project CS Energy Ltd PO Box 2227 Fortitude Valley BC QLD 4006 AUSTRALIA

Email: cspero@csenergy.com.au Mobile: 0419 644 746



#### **Professional Expertise:**

Mechanical and chemical engineering related to coal, biomass and gas combustion for power generation; materials handling; waste management; and project management.

**Brief Description of Institution or Industry:** CS Energy – Government Owned Corporation – Electricity Generation (www.csenergy.com.au)

**Dr Chris Spero** is a Fellow of the Institution of Engineers (Australia) and a Member of the Australian Institute of Energy, and has a professional and technical background in mechanical engineering and fuel technology. Over the last 30 years he has worked on various aspects of new power technologies involving coal, gas, biomass and solar energies.

Over the last 9 years, Chris has been the leader of the Callide Oxyfuel Project which is now being implemented through a Joint Venture comprised of Australian and Japanese interests.

Chris also leads a small team of professionals that are responsible for power plant technologyenhancements, and has been involved at various levels in several National low emission coal R&D initiatives.

Chris also has the role of *Embedded Technology Manager – Oxyfuel* for the Australian National Low Emissions Coal Council (ANLEC).

#### Presentation: "Callide Oxyfiring demonstration"

The Callide Oxyfuel Project was developed by a Joint Venture established by CS Energy, Glencore Coal, Schlumberger, IHI Corporation, JPower, and Mitsui; with funding from the Australian and Japanese Governments, Queensland Government and JV Participants.

The Project consists of 5 main process units, viz: two x 330 TPD cryogenic Air Separation Units, Oxyfuel boiler (30 MWe generating capacity), flue gas low pressure pre-treatment plant (100 TPD), flue gas high pressure treatment and CO2 liquefaction plant (75 TPD), and CO2 load-out tank and facilities.

The Callide Oxyfuel Project is situated in Queensland (Australia) and is the largest operating oxycombustion power plant worldwide. The technology suppliers have included IHI Corporation (Oxyfuel boiler), GLP Plant Pty Ltd (flue gas pre-treatment), Air Liquide (CryocapTM system for the CO2 capture and purification on the pre-treated flue gas), and CS Energy Ltd (Project Engineering and Management, Operations and Maintenance). The overall system has been designed to produce up to 75 TPD of pure CO2 product suitable for geological storage.

The presentation will describe the Callide Oxyfuel project, what has been achieved, some description of RD&D Activities and future outlook for technology deployment.

**Dr WU Xiaojiang** R & D Department Shanghai Boiler Works Co. LTD (SBWL) No 250 Huaning Road Shanghai 200245 CHINA



Email Wuxj5@shanghai-electric.com Mobile: +86 15802167352

**Dr Xiaojiang WU,** Associate Researcher of Shanghai Boiler Works, Co., Ltd, graduated from University of Shanghai for Science & Technology (USST).

His research works are mainly focused on coal combustion, coal gasification, coal ash deposition and melting behaviours, CO<sub>2</sub> capture and storage technology, oxy-fuel combustion etc.

Dr Wu has published more than 30 papers and awarded the Shanghai municipal award of science and technological inventions (Second Prize) in 2007, SEC awards of science and technological inventions (First Prize) in 2011.

Dr Wu has worked as an investigator of several Chinese government Science and Technology projects, Shanghai government Science and technology projects and China-Australian international corporation projects, such as NSFC project, ANLEC project, JCG project, etc.

#### EMPLOYMENT:

2010.03-now: Director of R&D Department PhD, Shanghai Boiler Works Co. Ltd, China 2007.12-2010.01: Postdoctoral research, Shanghai Electric Power Generation Group, China 1995.11-2007.01: Technical support staff, Institute of Chemical Engineering, Nagoya University, Japan 2013, 03-2014, 03: Visitor in Monash University, Australian.

#### TECHNICAL RESEARCH PROJECTS:

- 1. As the chief investigator of National Natural Science Foundation of China (NFSC) project, The effect of ash melting behaviour on ash deposition characteristics on multi-interface during coal combustion with high content of alkali metals (2013-2016);
- 2. As a chief investigator of National Natural Science Foundation of China (NFSC) project, The quantum calculation and experimental study on minerals transition properties in coal ash during elevated temperature gasification. (2010-2012);
- 3. As a chief investigator of Australian-China collaboration project, Pilot-Scale Oxy-Fuel Combustion of Victorian Brown Coal. (2010- Now);
- 4. As a long-term exchange visitor to Monash University under the foundation by Australian-China JCG project, Advanced technology of super-critical plant boiler using of low-rank coal in oxy-fuel combustion. (2013,1-2013,9);
- 5. As a chief investigator of Chinese post doctoral foundation project, Study on the minerals transformation properties of coal ash during high temperature gaisification. (2009-2011);
- 6. As a chief investigator of a key project funded by department of shanghai science and technology, Key technology of power plant boiler under oxy-fuel combustion. (2010-2013);
- 7. As a chief investigator of Shanghai morning star project, the effect of micro structure to the macro behaviour of minerals for coal gasification. (2011-2013).

#### Presentation: "Development of Oxyfuel Combustion Technology in China"

**Dr XU Yue** Vice President China Huaneng Clean Energy Research Institute and Director, Renewable Energy Department CHINA



Email: xuyue@hnceri.com

**Dr XU Yue, Ph.D**., Research Professor, graduated from the Thermal Power Engineering Department of the Xi'an Jiaotong University of the People's Republic of China.

He is currently the Vice President of China Huaneng Clean Energy Research Institute and the Director of the Renewable Energy Department.

Dr Xu has worked on the research of steam turbine, improvement of thermal system of coal-fired power plant, design and simulation of Integrated Gasification Combined Cycle (IGCC) power plant.

He has participated in and was in charge of several research projects during "ninth-five", "tenth-five" and "eleventh-five" 863 projects. Dr Xu lead his research team to develop China's first integrated power generation system of IGCC power plant and design the simulator of IGCC power plan.

Dr Xu has published 30 papers in journals and has been awarded one first class provincial/ministry level technical prize, three second class provincial/ministry level technical prizes and two third class provincial/ministry level technical prizes.

**徐越:工学博士,研究员。1991 西安交通大学**毕业,现为中国华能集团清洁能源技术研究院 有限公司院长助理兼可再生能源发电技术部主任。先后从事汽轮机运行技术研究,火电厂热力系 统性能提高技术研究,联合循环发电技术系统设计与仿真技研究术,整体煤气化联合循环发电系 统集成与过程模拟以及仿真技术研究,负责与参加了科技部"九五"科技攻关项目,国家"十五"、" 十一五"、"863"计划项目研究,带领课题组开发完成了我国第一套IGCC发电系统设计集成系统的 开发,完成联合循环发电系统、IGCC发电系统仿真机等开发工作,并应用实际工程。在国内外科 技期刊发表学术论文30余篇,获省部级科学技术奖一等奖一项,二等奖3项,三等奖2项。

Presentation: "GreenGen and CCS Demonstration Projects"

**Dr Sankar Bhattacharya** Department of Chemical Engineering Monash University Wellington Road Clayton Victoria 3800 AUSTRALIA



Email: sankar.bhattacharya@monash.edu

#### **Research Interests**

- Gasification of coal, biomass, and wastes for fuel and chemicals production
- Advanced combustion for easier CO2 capture Chemical looping, Oxy-pf and Oxy-CFB combustion
- Biofuels from biomass and algae
- Coal and biomass drying

With his strong background in industry and now academia, Sankar Bhattacharya believes in tangible outcome from research.

Sankar started his career in India as a design and commissioning engineer for coal-fired power stations. He then worked in Thailand on utilization of agro-forestry residues for gaseous fuels production, as a Principal Research Engineer with Lignite CRC in Australia, as a Principal Process Engineer with Anglo Coal Australia, and as Senior Energy Analyst with the International Energy Agency in Paris managing their Cleaner Fossil Fuels programme.

He currently works in the Faculty of Engineering at Monash University as an Associate Professor. His research area includes advanced coal and biomass utilization for power and fuels production through gasification and combustion, and biofuels including algae. Sankar commissioned the first CFBC pilot plant in Australia, and managed hands-on the first oxygen blown gasification trials using HTW and transport reactor gasifiers.

Most of the research projects that Sankar initiated are focussed on practical problems, and first-ofits-kind in Australian universities. His current project areas include Oxy-fuel Pf, Oxy-fuel CFB, Entrained flow gasification, Coal drying, Liquid fuel synthesis from brown coal, Chemical looping, Algae processing, and Direct Carbon Fuel Cell. He currently leads a group of 14 PhD students and two research fellows.

Sankar advises various bodies overseas and nationally on low-rank coal utilisation. He contributes to the International Energy Agency's flagship publications, and also advises the United Nations Economic Commission for Europe and Inter-governmental Panel on Climate Change (IPCC) as an expert reviewer. He also acts as a reviewer for several refereed journals, Juelich- Germany and the South Africa Research Council.

Presentation: "Oxygen-blown gasification of Victorian Brown Coal"

Dr David Brockway FTSE Deputy Chair ATSE Energy Forum C/- ATSE GPO Box 4055 Melbourne 3001 AUSTRALIA

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#### Linkages with China

Numerous through ATSE and CSIRO, particularly with CHNG – CERI

**Dr David Brockway** has had a career in energy research and development for over 30 years. He was previously Chief, Division of Energy Technology for CSIRO from 2004 to 2010. From 1993-2003 he was CEO of the CRC for Clean Power from Lignite and its predecessor. Prior to 1993 he was a senior executive in R&D with the State Electricity Commission of Victoria, including roles as Manager Scientific Investigations, Principal Materials Scientist and Head of Coal Science. David has a wide range of publications.

David is Deputy Chair of the Australian Academy of Technological Sciences and Engineering Energy Forum.

Dr Brockway is a member of the Board of Exergen Pty Ltd and of the Brown Coal Innovation Australia Research Advisory Committee. He was previously a member of the AGL Energy Emerging Technology Steering Committee, a member of the Energy White Paper, High Level Consultative Committee (2009), Prime Minister's Science Engineering and Innovation Council, Foresighting Group on Climate Change, Energy, Water and the Environment (2009) and the Prime Minister's Biofuels Task Force (2005).

David holds B. Applied Science, Masters Science, and Doctorate of Philosophy.

David is a Fellow of Australian Academy of Technological Sciences and Engineering, a Fellow of the Australian Institute of Energy and a Fellow of the Australian Institute of Company Directors.

**Presentation :**"Victorian Brown Coal: Prospective Dewatering, Drying and Processing Technologies" Victoria's Latrobe Valley has one of the world's largest resources of brown coal. It is one of the world's lowest cost fossil fuels. It is very clean with low concentrations of ash, nitrogen, sulphur, and trace elements. It is highly reactive and can be readily converted to many products. The principal challenge facing on-going utilisation of brown coal in a carbon-constrained world is its high concentration of moisture, generally 62 to 67 per cent as mined. To overcome this challenge requires development and demonstration of energy efficient, dewatering, drying and processing technologies. Many exist and have been proven in the laboratory. This paper will describe a small number which have been successfully proven at pilot plant scale and are now seeking to move demonstration scale.



Dr Louis Wibberley Leader, Advanced Carbon Power CSIRO 10 Murray Dwyer Circuit Mayfield West NSW 2304 AUSTRALIA

Telephone: +61 2 4960 6050 Email: Louis.Wibberley@csiro.au



<u>Please provide a short description of your area of professional expertise</u> Pyrometallurgy, coal processing and combustion, emissions control, flyash, fouling, life cycle analysis, site remediation, power cycle modeling, CO2 capture, coal fired engines

#### **Brief Description of Institution or Industry:**

The Commonwealth Scientific and Industrial Research Organisation is the national government body for scientific research in Australia. **www.csiro.au** 

**Dr Wibberley** is the Leader of the Advanced Carbon Power Program in CSIRO Energy Technology. Louis has over 30 years industrial research experience in combustion, environmental control, metallurgical processing, and power generation.

Louis is currently responsible for the rapidly expanding Advanced Carbon Power area, including the development of an R&D program for the direct carbon fuel cell, and with recent projects involving Yancoal, Exergen, Newcrest, Xstrata, the Victorian Government and MAN. He was earlier responsible for establishing and developing post combustion capture into a major research program for CSIRO.

Prior to CSIRO, Louis spent 18 years in industrial research with BHP Billiton, from new iron and steelmaking technologies, process improvement and marketing using life cycle analysis, to the development of new energy and environmental technologies. The latter lead to the introduction of a sustainable development levy on coal extraction for additional research, which, in 2004 led to the COAL21 Action Plan - the principal technology development and implementation response of the Australian coal industry to the CO2 challenge. During this time, his leadership of projects in the Cooperative Research Centre for Coal in Sustainable Development provided the technical basis for a range of prospective low emissions coal technologies. Outcomes from this work have led to several pilot and demonstration projects currently underway in Australia.

Louis holds B. Metallurgy and Doctorate of Philosophy

#### WORKSHOP PRESENTATION TITLE " Direct Injection Carbon Engine – development with MAN"

The direct injection coal engine (DICE) is an alternative power generation technology with potential to exploit Australia's world-class coal reserves to generate low cost, low  $CO_2$  electricity. The technology involves producing coal water slurry (a micronised refined coal or MRC) which is injected into specially adapted large diesel engines. A range of well-established processes can be used for preparing the fuel – with the appropriate science and technology.

As diesel engines have very high thermal efficiency (even at small scale) and excellent flexibility, DICE has the potential to provide low  $CO_2$  base load, ancillary services and backup capacity – attributes essential to underpin a high penetration of renewables and rapidly changing electricity markets. DICE also provides the option of co-firing MRC produced from biochars to further reduce the carbon intensity of electricity production.

The presentation will cover recent developments and R&D being undertaken in Australia, the establishment of an engine development program by major engine manufacturers, the scientific hurdles necessary to derisk and commercialise the technology, the excellent fit with Australian Direct Action Policy, and the possibility of upgrading Chinese coal water mixtures for DICE fuel.

Dr Hai Yu Research Scientist CSIRO Energy Technology 10 Murray Dwyer Circuit Mayfield West NSW 2304 AUSTRALIA

#### Mobile: +61-(0)401269934 Email: <u>hai.yu@csiro.au</u>

**Dr Hai Yu** is a research scientist at CSIRO. He received his PhD in Chemical Engineering from the University of Newcastle, Australia in 2004. He was a lecturer in the School of Chemical Engineering at Ocean University of Qingdao from 1996-1999 and joined CSIRO in 2008.

His research focuses on the development of technologies for utilisation of synthetic greenhouse gases and post combustion  $CO_2$  capture (PCC). His research has led to publication of more than 60 papers in the international journals and conference proceedings. He was the lead researcher for the pilot plant trials of aqueous ammonia based PCC technologies at Munmorah Power Station in NSW, Australia.

Dr Hai Yu has been actively involved in the bilateral collaboration on post combustion capture between Australian and Chinese research organisations and participated in a number of collaborative projects between CSIRO and CERI including the first PCC pilot plant demonstration project in China.

He has been collaborating with Zhejiang University and Tsinghua University on PCC since 2009 and is co supervising a number of PhD students from Chinese and Australian universities.

Presentation: "Research developments from JCG Partnership program with Zhejiang University and Tsinghua University on post combustion capture"

#### **Mr Tim Walton**

Director Energy Research Initiatives Research and Development Curtin University GPO Box U1987 Perth WA 6845 AUSTRALIA

Telephone: +61 8 9266 9779 Email: t.walton@curtin.edu.au http://research.curtin.edu.au/



**Tim Walton** is the Director, Energy Research Initiatives, within Curtin University's Office of Research and Development in Perth, Western Australia.

His role is focused on developing the university's conventional, unconventional and renewable fuel, energy and power transmission capabilities, chiefly through building research collaborations.

With a professional background in corporate communications, government policy and strategy Tim has extensive experience in science leadership and administration, particularly within the Western Australian Government's science and innovation portfolio.

He has previously worked in a diverse range of areas including conservation education, natural resources management, policy and regulation, heavy industry and port logistics.

He holds an Arts degree in English from Edith Cowan University, a Master of Business Administration qualification from Curtin University and is a Graduate of the Australian Institute of Company Directors.

As well as his position with the Australian Centre for Natural Gas Management, Tim is currently a board member of the Western Australian Energy Research Alliance; and a steering committee member the Australian Resources Research Centre and National Geosequestration Laboratory; and a working group member of the National Resources Science Precinct.

Presentation: "JCG Funded Activities at Curtin University of Technology"









#### AUSTRALIA-CHINA EMERGING FUTURE LEADERS IN LOW EMISSIONS COAL TECHNOLOGY

CHINESE EMERGING FUTURE LEADERS 2013		
Dr GUO Dongfang	Mobile: +86 15120000255	
China Huaneng Clean Energy Research	Email:guodongfang@hnceri.com	
Institute		
	Areas of expertise:	
VISIT PROGRAM	Solvent development for post	
15-21 October 2013:	combustion CO2 canture	60
the University of Melhourne	• CO2 absorption pilot plant	
LICET. Dr Can dra Kantish	CO2 absorption pilot plant	
HUST: Dr Sandra Kentish	operation and process modeling	
	<ul> <li>Implementation, validation and</li> </ul>	
	trials of large scale CO2 capture	
	<ul> <li>Molecular simulation</li> </ul>	
Dr LIU Hongpeng	Mobile: +86 13844219419	
Northeast Dianli University	Email: hongpeng5460@126.com	
VISIT PROGRAM:	Areas of expertise:	
15-16 October 2013:	Combustion, especially inferior	
CSIRO HOST: Dr Paul Feron	fuel fluidized combustion	
17-18 October 2013	Comprehensive utilization of oil	
Monach University HOST: Dr Lian Zhang	shalo	
Wollash Oniversity HOST. Di Lian Zhang	Shale	
Dr WANG Jun	Mobile: +86 13811815024	
Shenhua Guohua (Beijing) Electric Power	Email: 810097@ghepc.com	
Research Institute Co., Ltd		
,	Oxyfuel Combustion technology	
VISIT PROGRAM	Compression and	
15-16 October 2013: the University of	nurification technology of CO2	6-0
Malbourna HOST: Dr Sandra Kontish	Low emissions technology of CO2	
17 19 October 2012, Monach University	• Low emissions technology of	
17-18 October 2015. Wondsh University		
HOST: Dr Lian Zhang	Phot-scale research and	
Dr ZHANG XIaosong	Mobile: +86 18612965569	
Chinage Academy of Sciences	Email: zhangxiaosong@iet.cn	
Chinese Academy of Sciences		
	Areas of expertise:	A man a comp
15-21 October 2012: the University of	<ul> <li>Chemical looping combustion</li> </ul>	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Malbourne HOST: Dr Kathryn Mumford	<ul> <li>Coal gasification</li> </ul>	
Weibourne nost. Dr katin yn Walinora	Scenario analysis of CO2	
	capture	
	<ul> <li>System simulation and</li> </ul>	
	integration	
Dr ZHU Dechen	Mobile: +86 18988824757	A set
Zheijang University & Guangdong Power	Email: zhudechen@ziu.edu.cn	
Grid China		
	Areas of exportise:	
	Eundamental Absorption-	
15 21 October 2012, CCIPO Neurostia	- Regeneration Performance of	60)
15-21 October 2013: CSIKO Newcastie	Novel Absorbents for CO2	-
HUST: Dr Hai Yu	Canture Processes	
	Regeneration Method of Low	
	Energy-Cost	
	Pilot Plant	
	Design/Debug/Operation	
	Design/Debug/Operation	









#### AUSTRALIA-CHINA EMERGING FUTURE LEADERS IN LOW EMISSIONS COAL TECHNOLOGY

AUSTRALIAN EM	ERGING FUTURE LEADERS	Area of Expertise
	Dr Luguang Chen	Areas of expertise
-	Research Fellow	Oxyfuel
	Monash University	Combsution
(3) (2)		Gasification
192	Mobile: 0433267025	Pyrolysis
	Email: luguang.chen@monash.edu	Sulphur Emission
		Trace Element Emission
AND COL	Dr William Conway	Areas of expertise
	Post Doctorial Research Fellow	Fundamental chemical behaviour of
(2)	CSIRO	amine solvents for CO <sub>2</sub> capture
7.5		processes
	Mobile: +61 439774918	<ul> <li>Practical application of amine solvents</li> </ul>
No.	Email: will.conway@csiro.au	for CO <sub>2</sub> capture processes
TI Same		
17		
1	Dr Deanna D'Alessandro	Areas of expertise
	ARC QEII Fellow	Inorganic Chemistry
	The University of Sydney	Carbon Dioxide adsorption
		<ul> <li>New materials for CO<sub>2</sub> separation</li> </ul>
	Mobile: 0411416449	Materials Characterisation and
	Email: deanna@chem.usvd.edu.au	Iviaterials Characterisation and     property measurement
And a second		property measurement
	Dr. Churche Ma	Areas of expertises
	Assistant Brofossor School of	Areas of expertise:
	Assistant Professor, School of	Environmental Economics     Enorgy Economics
	The University of Western Australia	Efficiency and Productivity
	The oniversity of western Australia	Non-market Valuation
	Mobile: 0433212967	Spatial Economics
	Email: chunbo.ma@uwa.edu.au	Chinese Energy Economy
HE		
	Dr Kathryn Smith	Areas of expertise
	Research Fellow. CO2CRC	CO2 capture via solvent absorption
	Department of Chemical and	<ul> <li>Solvent absorption pilot plant operation</li> </ul>
0	Biomolecular Engineering	Potassium carbonate reaction kinetics
101	The University of Melbourne	
	Mobile: 0417 526 685	
	Email: kathryn.smith@unimelb.edu.au	
	Dr Vinay Sriram	Areas of expertise
	Managing Director	Coal fired boiler optimisation
05	IPACS Power Pty Ltd	Automation
Car b		Asset management
	Mobile: 0402223214	Reliability engineering
	Email: vinay.sriram@ipacs.net.au	Embedded computer system design
		Asset performance monitoring



## SESSION CHAIRS AND KEY PARTICIPANTS

**Professor John Agnew FTSE** Emeritus Professor the University of Adelaide AUSTRALIA

Email: jbemagnew@theashbrook.com.au

#### Emeritus Professor John B. Agnew, FTSE, Hon FIEAust, PhD, BE(Chem)

Professor Agnew's early professional career was in industry, working for BP in the UK and South Yemen on oil refinery processing problems.

He subsequently held academic positions at Melbourne and Monash universities prior to being appointed Professor and Head of Chemical Engineering at The University of Adelaide, where he went on to become Dean of Engineering and an Executive Dean. He has also held visiting academic appointments in the U.K. and U.S.

His principal areas of research have been chemical reaction engineering, coal liquefaction and gasification, and waste oil recovery, and he was an original member of the CRC for New Technologies for Power Generation from Low-Rank Coal led by Dr David Brockway.

He is currently a sessional Commissioner of the Environment, Resources and Development Court and has led the development of the Science and Engineering Challenge for schools in South Australia.

John is a recipient of the Chemeca Medal, The Centenary Medal, The Engineers Australia Medal and other awards.



Professor LI Xiao-jiang Vice President China Huadian Electric Research Institute (CHDER) No 10 Xiyuan 1<sup>st</sup> Road Hangzhou 310030 CHINA

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Professor LI Xiao-jiang obtained his PhD from Monash University in 2006.

Before that he worked as a Director of the Department of Fuel Properties in Thermal Power Research Institute (TPRI) China; from 2005-2007 he worked as a project leader in Global Research Centre, GE China. Then he move to Sichuan Electric Industry Commissioning & Test Institute, State Grid, China working as a Chief Engineer.

From October 2010 he worked in China Huadian Electric Research Institute, coal quality inspection and metrological center, CHD as a Vice President.

His research area is on both coal fundamental research and technology development for effective utilization and environmental protection.



#### Dr Noel Simento

Managing Director Australian National Low Emissions Coal R&D PO Box 536 Civic Square ACT 2608 AUSTRALIA

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**Dr Noel Simento** is Managing Director of the Australian National Low Emissions Coal R&D (ANLEC R&D). This is a 150 million dollar research initiative over 6 years to accelerate and de-risk investment in demonstrating low emissions coal technologies in Australian conditions.

Noel has significant industry experience having held technical development roles in minerals processing and metal production operations. His research management experience includes technology transfer and communication responsibilities for two black coal CRCs.

Noel is also a Director of Brown Coal Innovation Australia, a member of the ANLEC R&D Science Leadership Group, BCIA's Research Advisory Committee and CO2CRC's Operations and Program Advisory Committees.



Mr Michael MEI Director, Environmental Policies & Global Advocacy Alstom China 5/F, Entrance C, Qian Kun Plaza, No.6, Sanlitun West Street 6 Beijing, 100027, CHINA

Email: Michael.mei@power.alstom.com Mobile: 86-13801102015

**Mr Michael Mei** is Director of Environmental Policies & Global Advocacy in Alstom China. He is responsible for broader policy issues and related advocacy in all Alstom businesses in China. Alstom is a major global supplier of clean power generation & transmission, and rail transportation equipment and solutions.

Michael began his career with Ministry of Foreign Trade of China (currently Ministry of Commerce). After that, he worked for U.S. Department of Commerce, as Senior Commercial Manager on energy and power. Prior to joining Alstom, he was Senior Manager of Government Affairs, in GE China.

Michael holds a Bachelor Degree in English from Beijing Language and Culture University and a Master Degree of Business Administration from Tsinghua University.



Dr Phil Gurney

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**Dr Phil Gurney** is CEO of Brown Coal Innovation Australia (BCIA), the leading national body funding research and skills activities for low-emissions uses of Australia's brown coal.

Phil has a strong track record in research management. His career spans a broad range of sectors including e-health, manufacturing, biomedical, telecoms, IT, defence and consultancy, with the common theme being identifying and obtaining the best commercial outcomes from R&D projects, and managing research teams to succeed in the broader competitive industry environment.

Prior to joining BCIA, Phil held a number of senior positions in international organisations, most recently as CEO of the Australian eHealth Research Centre; a joint venture between CSIRO and the Queensland Government.

He has held board positions with US and Australian organisations, and was a founder and Managing Director of telecoms software company VPIsystems, overseeing the expansion of the company from Australia to the US, Europe and Asia.



Mr Dominique Van Gent Coordinator Carbon Strategy / Carbon Strategy, Strategic Policy Department of Mines and Petroleum (Western Australia) 10<sup>th</sup> Floor, 61 Victoria Street Bunbury, Western Australia AUSTRALIA

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**Dominique Van Gent** is the Coordinator of Carbon Strategy with the Department of Mines and Petroleum in Western Australia. He has worked in Regional Development assisting the resources industry on major projects, on the development of industrial areas and on infrastructure issues. He played a key role in establishing local content strategies that maximised opportunities for regional firms on the construction of the Collie power station and other projects.

Dominique has been working closely with industry on low emissions technology that has now developed into the South West  $CO_2$  Geosequestration Hub.

The WA Department of Mines and Petroleum has a MOU with the following;

- People's Republic of China, Department of Land Information and Ministry of Land and Resources To establish long-term relationships between Western Australia and China mining sectors and land management areas.
- Shandong Department of Land and Resources to enhance knowledge of geoscience studies, exploration and development of mineral resources and knowledge exchange in relation to natural resources.
- China Geological Survey Established a framework for exchange of geoscientific information and other cooperation

A member of the Joint Venture consortium is Yancoal Premier Coal, whose coal mine is based in Collie.



Dr Michael Sargent AM FTSE

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Dr Sargent is a Director of M. A. Sargent & Associates, providing strategic corporate consulting services to industry, with a particular focus on the information technology, research, energy, environment and utilities sectors. Prior to this he was Chief Executive of Transfield Energy Group, and before that was Chief Executive Officer of ACTEW Corporation from November 1991. Dr Sargent has 50 years' experience in the utility industry in Australia, USA and Canada. He has consulted both in Australia and for the World Bank internationally on research and innovation systems. He has been Chair of a number of Australian Government Committees and Taskforces in the area of research and innovation, including the Australian Research Council and the National Collaborative Research Infrastructure Committee, and has been a director of the Australian Solar Institute.

Dr Sargent is a Director of the Australian Energy Market Operator and a Member of the Clean Energy Regulator. He is Chairman of Lighthouse Innovation Centre Limited, a high technology seed fund and incubator; an Adjunct Professor of the University of Technology Sydney & the University of Queensland. He has a degree in electrical engineering and a Doctor of Philosophy from the University of Queensland. He is active in professional and community matters. He is an Honorary Fellow of Engineers Australia, a Fellow of the Australian Institute of Company Directors, a Fellow of the Australian Academy of Technological Sciences and Engineering, Academician of the International Academy for Quality, and was President of The Institution of Engineers Australia in 1990. He is a Paul Harris Fellow of Rotary International, and a director of the Heart Foundation (ACT). In recognition of his service to engineering he was made a Member of the Order of Australia in 1993 and was awarded a Centenary Medal in 2003. He was awarded the Peter Nicol Russell Memorial Medal in 1992



Dr GAO Shiwang Director GHG Emission Reduction Department Huaneng Clean Energy Research Institute Floor 26, In.do Mansion Bldg A Zhichun Road No. 48A Haidian District Beijing, 100098 CHINA

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**Dr GAO Shiwang** graduated from Xi'an Jiaotong University with a doctoral degree in Power Engineering and Engineering Thermophysics in 2002.

He is a Research Fellow of the Huaneng Clean Energy Research Institute of China Huaneng Group since June 2011. Previously, he worked for Thermo Power Research Institute in Xi'an. He is a State Council Expert for Special Allowance. His research area is focused on clean coal technologies, CO<sub>2</sub> capture and storage and related areas. His has won 3 first-place awards and 3 second-place awards of ministry level.

As the team leader, his team succeeded in several RD&D projects on CO2 capture technologies, which are developed based on their independent intellectual properties. For instance, the 3,000 t/a CO2 Capture Unit in Huangneng Beijing Thermal Power Plant was built in July 2008, as the first PCC unit built for power plants in China. The 120,000 t/a CO2 Capture Unit in Huangneng Shidongkou No.2 Power Plant was built in December 2009, as the largest PCC unit built for power plants in the world.



Presenters and Session Chairs of the ATSE/CERI Workshop, 22 October 2013 with JCG Co-Chairs, Ms Margaret Sewell (Department of Industry) and Mr QIN Zhijun (China National Energy Administration)



L-R: Mr Michael Mei and Dr Chris Spero



The Australian Academy of Technological Sciences and Engineering (ATSE) is an independent, nongovernment organisation, promoting the development and adoption of existing and new technologies that will improve Australia's competiveness, economic and social wellbeing, and environmental sustainability.

ATSE, one of Australia's four learned Academies, was founded in 1976 to recognise and promote the outstanding achievement of Australian scientists, engineers and technologists. It consists of some 800 Fellows, including 19 Foreign Fellows, drawn from the wide spectrum of the applied sciences. The strategic priorities of ATSE are to:

- Provide a national forum for discussion and debate on critical issues of Australia's future, ensuring a valuable source of technological sciences and engineering based advice to government, academe, industry and the community.
- Improve education in the technological sciences and engineering through programs such as STELR (Science and Technology Education Leveraging Relevance) Project. This is a national secondary school science education initiative of ATSE.
- Promote technological sciences and engineering linkages globally and to foster technology transfer through its international program;
- Champion excellence in the technological sciences and engineering

Within this framework, and taking into account issues of national importance, the work of ATSE is given focus through a series of Topic Forums, Working Groups and Advisory Groups on Energy, Climate Change Impact, Water, Education, Emerging Technologies, Health Technologies and Built Environment. These foci inform the design and direction of the international program.

ATSE's international program of missions, workshops and delegations, together with support from specific grants and schemes, is directed at strengthening Australia's access to global science, engineering and technology and to maximising the benefits of Australia's science base and its global linkages.

#### www.atse.org.au

**Huaneng Clean Energy Research Institute (CERI)** focuses on the frontier technology research and development of clean energy. The main business of CERI includes technology research, development, transfer and service, the manufacture of key facilities and project implement of a wide range area including clean coal-based power generation and conversion, renewable energy power generation, and technology on emissions reduction of contaminations and greenhouse gases, etc. CERI has been authorized to establish several research centres and laboratories, as follows:

- National Energy Technology R&D Centre of Clean and Low-carbon Coal-fired Power Generation Technology
- National Energy Technology R&D Centre of Efficient Hydro-power Utilization and Dam Safety
- State Key Laboratory of Coal-based Clean Energy
- Beijing Engineering Research Centre of Qualify and Clean Efficient Utilization of Poor Fuel
- Beijing Key Laboratory of CO2 Capture and Utilization

www.hnceri.com:





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7th Australia-China Joint Coordination Group on Clean Coal Technology

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