PERSPECTIVES ON BROWN COAL
THE NEWSLETTER OF BROWN COAL INNOVATION AUSTRALIA
August 2014 : Special Edition

BROWN COAL INNOVATION AUSTRALIA
Positioning brown coal for a brighter future

PAGE 1

In this issue

CEO UPDATE

BCIA's 2013/14 R&D Funding Round

I am proud to announce in this special issue of BCIA's *Perspectives* newsletter that BCIA has now completed its assessment process for the 2013/14 funding round. The response to our call for new opportunities for low emissions brown coal power generation technologies was outstanding. We received 18 applications involving nearly 40 international and Australian based companies and research institutes. Following a thorough assessment process, BCIA has awarded $3.1 million towards a $12M portfolio of world-class research and development projects.

In this special edition of *Perspectives on Brown Coal* we look at six of the nine successful projects in our recent funding round. These projects will target improved efficiency and significantly reduced carbon emissions from brown coal power generation in Victoria and the technologies developed have applicability throughout the world.

BCIA was delighted that the successful projects could be announced by the Victorian Minister for Energy and Resources, Russell Northe at the opening of the Third Low Rank Coal Symposium, which was held in Melbourne recently. Mr Northe showed his support for these R&D projects and their potential to boost the economy, create more jobs and deliver a sustainable energy source.

"Victoria has a great opportunity to capitalise on projects such as this with its abundant reserves of brown coal which, with the right measures in place for making brown coal an efficient and sustainable industry, has great potential for boosting the economy.

"That is why the Victorian Government is supporting and investing in projects that can deliver real outcomes for innovating the industry, creating jobs and delivering a sustainable energy source for future demand," Mr Northe said.

Our 2013/14 R&D funding round demonstrates there is substantial international and domestic commercial interest in securing a sustainable future for Victoria's vast and unique brown coal resource; one of the largest and lowest cost lignite coal resources to be found anywhere in the world.

The latest report from the Intergovernmental Panel on Climate Change (IPCC) acknowledges the urgent need for low emission energy technologies – including fossil fuel plants equipped with carbon capture and storage (CCS) – and highlights the critical role that CCS must play in mitigating the impacts of global warming.

The projects we have announced will accelerate efforts to deliver sustainable energy from brown coal by reducing carbon emissions from coal-fired power and cutting the cost of carbon capture technologies.

The involvement in our research program of significant international and local industry players not only shows a recognition of the world-class research being undertaken in Australia, but will also enable the innovative technologies developed here to be commercially adopted as quickly as possible. The commercial success of such technologies would secure Victoria's - and indeed Australia's - future economic prosperity by enabling the continuation of low cost power generation while also creating valuable new industries and employment opportunities in the State's Latrobe Valley.

BCIA's direct innovation investment for the current funding round is $3.1 million. The new portfolio of low emissions R&D projects includes co-investment from participating research institutes and industry in addition to the State and Commonwealth Government (via Australian National Low Emissions Coal R&D) investments managed by BCIA. When the full co-investment allocation is finalised, the full value of the research portfolio is expected to exceed $12 million.

PAGE 2 & 3

OVERVIEW OF SUCCESSFUL PROJECTS

BCIA awarded $1M in funding for a CSIRO project that plans to trial high efficiency power generation using Victorian brown coal processed into a water-based slurry and directly injected into a large adapted diesel engine. The Direct Injection Carbon Engine (DICE) project is targeting a step-change in fuel cycle efficiency enabling a 50 per cent reduction in CO2 emissions intensity compared with Victoria's existing brown coal-fired power plants.

Successful completion of a stage one risk assessment will facilitate a new three year research program. This is a significant progression of earlier BCIA-funded research and will inform development plans for commercial production of the first direct injection carbon engine powered by water-based lignite slurry.

The project will include a world-first trial of 20 tonnes of micronised refined carbon fuel from Victorian brown coal in a large stationary diesel engine, to be specially adapted in Japan by leading international engine manufacturer, MAN Diesel &Turbo.

Previous research in a laboratory-scale prototype direct injection carbon engine proved that the lignite slurry can make a high quality fuel. The new CSIRO research project will help to determine if DICE technology can deliver Australia's lowest cost, low emissions power generation from brown coal; providing an option for the staged replacement of existing brown coal power plants.

The direct injection carbon engine also offers the potential of increased operational flexibility to support peak load electricity demand and supply from intermittent renewable energy; thereby supporting a higher penetration of renewable energy supplies in both Australia and developing countries throughout the world. CSIRO scientists also believe successful development of the technology will create valuable new export markets for brown and black coal (see page 4 for more detail).

In addition, BCIA allocated a total of $850,000 for funding of two research projects submitted by Victoria's Monash University. Both of the Monash projects significantly extend earlier BCIA-funded research - including the first known study of chemical looping combustion (CLC) and gasification of Victorian brown coal - as an emerging alternate technology for the capture of CO2 at a significantly lower energy and cost penalty. This research project aims to advance the commercial prospects – in Victoria – of this emerging technology (see page 6 for details).

The second Monash project is a continuation of earlier BCIA-funded research (via ANLEC R&D) and is expected to accelerate the deployment of oxy-fuel combustion for Victorian brown coal; thereby improving power generation efficiency and significantly reducing CO2 capture costs. Oxy-firing technology is a process for the combustion of coal in a mixture of high-purity oxygen and recirculated flue gas; the resultant high purity CO2 requires minimal additional treatment and can be stored almost directly deep underground in geological formations or used in other conversion processes (see page 7 for details).

BCIA recently announced $650,000 towards a new research project which combines CSIRO technology with that of major Japanese technology vendor IHI Corporation.

By operating a new PCC pilot plant, the project also aims to demonstrate technologies that could slash the capital and operational costs for large-scale carbon capture plants; arguably the greatest challenge facing global deployment of carbon capture for fossil fuel power generation.

Specifically, this project will allow long-term trials of technologies that have the potential to deliver a 40 per cent reduction in the energy usage of current plant post combustion capture (PCC) processes for Victorian brown coal-fired power plants (see page 5 for more detail).

BCIA has awarded $350,000 for a further project submitted by CSIRO, building upon earlier BCIA-funded research and aims to achieve significant reductions - up to $200 million for a 550MW plant - in the capital costs for retrofitted post combustion capture (PCC) of CO2 from coal-fired power stations.

This research program is targeting a 50 per cent reduction in PCC capital costs by integrating the removal of sulphur (SO2) and carbon (CO2) in PCC with a CSIRO-developed solvent (see page 8 for details).

A further research project announced in April aims to improve the efficiency of brown coal-fired power stations by using state-of-the-art tuneable laser sensors to measure oxygen (O2) and carbon monoxide (CO) in power station flue gases prior to emission (see page 9 for details).

Project trials will determine whether novel Tuneable Laser Diode Spectroscopy (TLDS) instrumentation, used successfully in the oil and gas industry, can optimise the burning of brown coal in existing Latrobe Valley power stations; thereby improving power plant efficiency and simultaneously reducing CO2 emissions.

The significant industry investment in this R&D round shows that Australia is recognised as a leader in low emissions technology innovation. Each of the research projects will contribute to the global push for clean energy and commercialisation of these technologies will create new industries and employment and export opportunities for our country from low emissions brown coal utilisation.

For more information on BCIA's successful funding projects, contact BCIA Research Investment Manager, Dr David McManus by email david.mcmanus@bcinnovation.com.au or phone +61 3 9653 9601.

BCIA 2013/14 Funding Round Process

The BCIA Research Advisory Committee (RAC) assessed the merits of all submitted proposals and provided advice to the BCIA Board. As a co-investor in brown coal research, BCIA sought well-leveraged projects that offered high value for the company's financial contribution. To be eligible, project participants were required to at least match the level of funding provided by BCIA and, preferably, to demonstrate a high level of industry involvement.

The BCIA Board considered all proposals; only project applications of the highest merit were selected. The amount of funding released and the funding allocations against each focus area were at the discretion of the BCIA Board. All approved projects will be stage-gated to ensure continuing support only on the basis of demonstrable achievement of clearly-defined milestones.

BCIA 2013/14 research and development project grants

DICE PROJECT

- $1,000,000 funding for *'Victorian Direct Injection Carbon Engine (DICE) development – derisking and small scale development';* submitted by **Commonwealth Scientific and Industrial Research Organisation (CSIRO)**. Project participants include **MAN Diesel & Turbo Australia Pty Ltd**, **Exergen Pty Ltd**, **Ignite Energy Resources Pty Ltd**, **AGL Loy Yang Pty Ltd** and **Energy Australia**.

This project is a significant progression of earlier BCIA-funded research and will inform development plans for commercial production of the world's first direct injection carbon engine (DICE) powered by water-based lignite slurry; within the next three years. The research program is targeting a step-change in fuel cycle efficiency which will enable a 48 - 50 per cent reduction in CO2 emissions compared with existing Victorian brown coal-fired power plants. The initial laboratory-scale research funded by BCIA achieved excellent ignition and combustion results from lignite slurries prepared by hydrothermal treatment and also addressed a range of technical issues related to fuel production and coal engine interactions.

The new research program includes development of an adapted engine design by MAN Diesel & Turbo, the world's largest manufacturer of stationary diesel engines, and testing of 20 tonnes of micronised refined carbon (MRC) from Victorian brown coal in a pilot-scale engine facility located in Japan. The increased efficiency of the direct injection carbon engine powered by lignite water fuel can be achieved at one fifth the unit capacity of proposed new low emissions coal fired power plants; thereby substantially reducing the capital costs of low-emissions brown coal energy in the near term. The direct injection carbon engine also offers the potential for increased operational flexibility to support peak load electricity demand and supply from intermittent renewable energy; thereby supporting a higher penetration of renewable energy supplies.

The DICE research plan encompasses an initial risk definition and mitigation project to address remaining technical uncertainties for the low ash Loy Yang lignite coal to be utilised in the integrated engine test program. Aspects to be covered include the fouling tendency of the lignite slurry under laboratory test engine conditions and optimisation of lignite water fuel preparation procedures. Successful completion of the risk assessment will facilitate a second-stage 30 month research project encompassing fuel production for DICE tests, engine facilities development and research on logistics, standards and fundamentals R&D. The latter stage is expected to provide MAN and coal fuel providers with key performance data which would facilitate commercial scale demonstration of the DICE technology.

PAGE 5

POST COMBUSTION CAPTURE PROJECT

- $650,000 funding for *'Evaluation of advanced Post Combustion Capture process and equipment with two advanced liquid absorbents for application in Victorian brown coal-fired power stations'*; submitted by **Commonwealth Scientific and Industrial Research Organisation (CSIRO)** in association with **IHI Corporation**, Japan and **AGL Loy Yang Power Pty Ltd**.

This research project is targeting a 40 per cent reduction in the parasitic energy penalty of current post combustion capture (PCC) processes and will see the installation of a $1M Japanese-built PCC pilot plant at AGL Loy Yang Power station; the first in Victoria to operate around the clock. Existing PCC processes result in a significant reduction in power plant output – with today's commercial technology this could be up to 40 per cent for retro-fit to existing Australian brown coal plants. The targeted reduction of this energy penalty would lead to significant savings in the cost of energy supplied to the consumer compared to implementing carbon capture using current-generation PCC plant.

Achieving a significant reduction in capital and operational costs for large-scale carbon capture plants is arguably the greatest challenge facing global commercial deployment of PCC for coal-fired energy plants. There are about 25 PCC pilot plants currently in operation world-wide, however most are focused on validation of liquid absorbents for PCC in standard process designs. This project entails a two-year evaluation of two advanced liquid absorbents, two advanced process designs and an advanced gas/liquid contactor. The combination of these three aspects represents a significant step forward in PCC technology application for Victorian brown coal-fired power stations.

This research project is a major collaboration between internationally renowned technology provider, IHI Corporation, and Australia's world-class research organisation; CSIRO. The collaboration is a world-first evaluation of a technology provider-developed PCC process in flue gases from Victorian lignite-fired power. Successful completion of the project is expected to enable scale-up of the next technology phase; most likely a demonstration project at a scale of between 100 and 1000kton CO2 per year.

In the first year of the research program, a 0.5 tpd CO2 capture pilot plant - incorporating an advanced, low-pressure packing material - will be designed and manufactured by IHI in Japan. The plant will then be transported to Australia and re-commissioned at AGL Loy Yang Power station in Victoria's Latrobe Valley. The combination of three new technology innovations - simultaneous improvements in capture agents, equipment and process design - is expected to deliver almost a 40 per cent reduction in the absorbent energy requirement of the pilot plant compared to a standard amine process.

IHI's amine based PCC technology for brown coal-fired power stations will then be evaluated through a parametric study to determine the minimum thermal energy requirement for liquid absorbent regeneration for the two selected absorbents and two process configurations. Two year-long duration experiments totalling 5000 hours will also be undertaken to assess the robustness of the two liquid absorbents under brown coal flue gas conditions with the minimum thermal energy requirement.

The duration experiments differentiate this project from known PCC pilot plant test results and will make a significant contribution to the global body of research into amine based reactive gas/liquid absorption for CO2 capture; the leading PCC technology. The experimental campaign will provide critical knowledge about both the performance of the technology process over time and the robustness of the two liquid absorbents; the latter information is essential to enable deployment of commercial-scale PCC and is urgently required to facilitate assessment of the environmental impacts of PCC.

PAGE 6

ADVANCED CHEMICAL LOOPING PROJECT

- $450,000 funding for *'Advanced chemical looping combustion technology for Victorian brown coals'*; submitted by **Monash University** in association with **Commonwealth Scientific and Industrial Research Organisation (CSIRO)**; **Alstom Boiler**, France; **Energy Australia**; **VITO**, Belgium (oxygen carrier manufacturer); and **Lycopodium Process Industries Australia** (engineering consultancy); **Southeast University, China** and **University of Alberta**, Canada.

This project extends earlier BCIA-funded research - the first known study of chemical looping combustion (CLC) and gasification of Victorian brown coal - as an emerging alternate technology for the capture of CO2 at a significantly lower energy and cost penalty. A targeted focus of this research project is to advance the commercial prospects of this emerging technology through an evaluation of brown coal CLC performance under more continuous operating conditions and to improve understanding of the longer term coal and oxygen carrier interaction effects.

Chemical looping has been widely studied for the combustion of natural gas but research into its potential application for solid fuels commenced only in recent years. Utilising metal oxides as a major source of oxidising agent, rather than concentrated gaseous oxygen from air separation plants, the technology removes the energy and capital costs of air separation plants. The initial BCIA-funded project systematically assessed various oxygen carriers for use with Victorian and international lignite samples and found that the low ash content, high reactivity and high oxygen content of Victorian brown coal is particularly suited to chemical looping.

The current project will extend this research through both bench-scale research and targeted experiments to be conducted in a Victorian purpose-built, compact fully looped and continuously fed reactor system. The primary research objectives are to examine the feasibility of the CLC process in the continuously looping reactor, establish the techno-economics of a commercial scale brown coal CLC and develop a detailed process model for a commercial scale CLC plant. The techno-economic evaluation will identify the greatest opportunities for reducing the cost of CLC carbon capture and ascertain where a commercial brown coal CLC plant can meet international carbon capture targets of above 90 per cent CO2 capture efficiency with less than a 35 per cent consequent increase in power generation costs.

PAGE 7

OXY-FUEL COMBUSTION PROJECT

- $400,000 funding for *'Accelerating the deployment of oxy-fuel combustion technology for Victorian brown coal'*; submitted by the Department of Chemical Engineering, **Monash University**. Project participants include **Shanghai Boiler Works**; **Energy Australia**; **GDF Suez Australian Energy; Chubu University**, Japan and **Shanghai Jiao Tong University** (University of Electric Power), China.

This project is a continuation of earlier BCIA-funded research (via ANLEC R&D) and is expected to accelerate the deployment of oxy-fuel combustion for Victorian brown coal; thereby improving power generation efficiency and significantly reducing CO2 capture costs. Oxy-firing technology is a process for the combustion of coal in a mixture of high-purity oxygen and recirculated flue gas. Through prior removal of nitrogen and the optimisation of boiler operating parameters, oxy-fuel combustion testing has delivered up to 95 per cent CO2 purity in flue gases which can be sequestered or utilised with minimal treatment.

The initial research project proved a range of outcomes including the stable and faster combustion of Victorian brown coal in a pilot-scale oxy-fuel fired furnace, production of high purity CO2 (up to 80 per cent) in flue gases and led to a greater understanding of the distinct slagging /fouling propensities of Victorian brown coal in oxy-fuel mode. The current research project will investigate technical issues related to oxy-fuel combustion of externally dried Victorian brown coal under supercritical and ultra-supercritical conditions. The project will undertake long-term ash exposure experiments and will also develop advanced modelling tools for the prediction of lignite ash slagging/fouling and water tube corrosion propensities in an industrial oxy-firing boiler.

The research program encompasses laboratory-scale experiments, pilot-scale tests in a 3MW air/oxy-firing facility built by Shanghai Boiler Works and computational fluid dynamic modelling. Techno-economic evaluation has previously indicated oxy-firing of Victorian brown coal can deliver a similar or lower levelised cost of electricity compared with existing post combustion capture processes. Integration with pre-drying of brown coal and super-critical steam conditions can significantly improve net efficiency and minimise the energy penalty of the plant air-separation unit and CO2 compression. This project recognises ash-related slagging/fouling and water tube corrosion propensities under optimised oxy-firing mode are critical issues which could hinder advancement of this technology through process scale-up to demonstration mode.

PAGE 8

PRE-TREATMENT OF FLUE GAS AND CO2 CAPTURE PROJECT

- $350,000 funding for *'Combined low-cost pre-treatment of flue gas and capture of CO2 from brown coal-fired power stations using a novel integrated process concept – closing the Sulphur loop (coCAPco2)'*; submitted by **Commonwealth Scientific and Industrial Research Organisation (CSIRO)**. Project participants include **AGL Loy Yang Pty Ltd** and **Energy Australia.**

This project builds upon earlier BCIA-funded research and aims to significantly reduce capital costs – by up to $200 million for a 550MW plant - in retrofitted post-combustion capture of CO2 from coal-fired power stations. The research objective is to integrate the removal of sulphur (SO2) and carbon (CO2) in a single column, with a single liquid absorbent, thus removing the requirement for a separate flue gas desulphurisation unit.

The initial BCIA-funded research project proved the sulphur pre-treatment and CO_2 removal steps could be successfully integrated into a combined process for amine and amino acid-based liquid absorbents. That project obtained a proof-of-concept for the amino acid system through collaboration with a European consortium (iCap). This project aims to obtain a proof-of-concept for the removal of sulphur from amine based absorbents utilised in the combined SO_2/CO_2 removal process. Researchers will focus on the feasibility and cost-effectiveness of a range of methods for regeneration of these liquid absorbents including distillation and alternatives such as crystallisation, electrodialysis, ion-exchange and nanofiltration. The research project is targeting a $40 to $50 per tonne avoided CO_2 cost with specific application to Victorian brown coal-fired power plants.

The technology concept could be further developed and utilised to retrofit the State's existing power stations and existing flue gas desulphurisation units throughout the world. The expected outcomes of this project will also feed into the development route for deployment of a new combined technology as a viable alternative to the installation of a flue gas desulphurisation unit prior to post-combustion capture of CO_2.

PAGE 9

Laser Based O2 and CO Monitoring Project

- $250,000 funding for *'Laser based O2 and CO monitoring'*; submitted by **HRL Technology Pty Ltd** with support **from Energy Australia, Siemens Ltd, AGL Loy Yang Pty Ltd, GDF Suez Hazelwood, Macquarie Generation, Intergen - MOC, Origin Eraring, CS Energy, Alinta Energy** and a number of other Australian power industry participants.

The performance of existing coal-fired power stations can be improved to reduce the coal utilisation and therefore CO2 gases emitted. Continuous measurement of the composition of the flue gases allows on-line modification of the plant boiler and fan operation to optimise coal combustion. However, power station boiler ducts present a very hostile environment for sensors and, consequently, current-generation sensor technologies have proven to be unreliable for process control.

This research project will test state-of-the-art tuneable laser sensors to measure oxygen (O2) and carbon monoxide (CO) in brown coal-fired power station flue gases. Project trials will determine whether Tuneable Laser Diode Spectroscopy (TLDS) instrumentation, utilised successfully in the oil and gas industry, can provide a more accurate representation of oxygen and CO concentrations in station boiler economiser outlets.

Current CO measurement technologies in Australian coal-fired power stations are compromised by high levels of dust, moisture and the sheer size of the boiler ducts. Inaccurate readings of oxygen content within the boiler ducts can result in increased coal usage to generate the same amount of energy. This research project is targeting improved CO measurement in order to optimise the combustion of both brown and black coals; thereby reducing coal fuel demand and boiler draft fan power consumption.

This is the first trial of this technology in Australia and a successful outcome could lead to tuneable laser instrumentation being widely adopted in brown and black coal-fired power stations throughout the country. Improved plant efficiency will simultaneously reduce CO2 emissions produced in the boiler and achieve plant operational savings such as lower fuel and CO2 penalty costs and reduced auxiliary load.

PAGE 10

2013 BCIA PhD Top-Up Scholarships

BCIA is pleased to announce the eight successful applicants who have been awarded a 2013 BCIA PhD top-up scholarship to undertake postgraduate research projects, focused on innovation in the development of brown coal low-emissions technologies.

Project topics were pre-approved by the BCIA Board as part of the 2013 PhD top-up scholarship program.

BCIA's PhD top-up scholarships are valued at $10,000 per annum (for a maximum of three years), commencing 1 January 2014.

PhD Student	Project Title	Supervisor Name	Research Institution
Mr Baiqian Dai	Coal blending combustion and gasification – the mixing of beneficiated brown coal and high-rank bituminous coal	Dr Lian Zhang	**Monash University**
Mr Tao Xu	Development of entrained flow gasification for use with Victorian brown coals	Prof Sankar Bhattacharya	**Monash University**
Mr Biplob Saha	Optimising fertiliser formulation utilising brown coal, biomass wastes, and conventional fertilisers	A/Prof Antonio Patti	**Monash University**
Mr Hiep Lu	The impact of impurities on the performance of cellulose acetate membranes for CO_2 separation	Prof Sandra Kentish	**University of Melbourne**
Mr Anthony De Girolamo	Developing advanced computer modelling program for the prediction of brown coal ash slagging/fouling propensity under oxy-fuel combustion mode	Dr Lian Zhang	**Monash University**
Mr Amandeep Oberoi	Reversible electrochemical storage of hydrogen in activated carbons from Victorian brown coal and other precursors.	Prof Alan Chaffee , Monash University and Prof John Andrews, RMIT	**RMIT**
Mr Rahmat Dirgantara	Development of brown coal geopolymer concrete	Dr David Law	**RMIT**
Mr Manabendra Saha	Experimental and computational study of solid fuels under MILD combustion	Prof Bassam Dally Dr Paul Medwell Prof Graham Nathan	**University of Adelaide**

PAGE 11

BCIA Membership

As a member-based company, BCIA undertakes a range of programs of interest to brown coal stakeholders including industry, research and education providers, governments and international coal technology organisations.

BCIA industry stakeholders encompass a broad range of sectors including coal-fired energy operators, original equipment manufacturers, companies involved in the conversion of brown coal to value-added products and services companies operating in the brown coal sector.

Membership enables BCIA's stakeholders to work with like-minded organisations to drive the future of the brown coal sector through active participation in our skills, networking and R&D programs.

BCIA is delighted to announce that Greenpower Energy Ltd. and Federation University Australia have joined as members, extending BCIA's partner network

For more information about BCIA membership, contact info@bcinnovation.com.au.

BCIA has updated our membership programs for 2014. Our current members include:

PAGE 12

Funding Opportunity: Victoria-Israeli Science and R&D Fund

Applications are currently open for the Victoria-Israel Science and R&D fund.

The fund aims to enable "market-oriented collaborative research and development projects by Victorian and Israeli businesses" and is focussed on a range of areas, including "clean technologies".

Funding of up to $250,000 per project is available, and projects must involve at least one Victorian, and one Israeli company.

Funds received under the program must be matched, and while academic and research entities are not eligible to apply for funding directly, they may undertake sub-projects on behalf of the applicant companies.

More detail on this program, which is administered through the Victorian Department of State Development, Business and Innovation, is available from the Business Victoria Website.

Events Calendar

31 August – 3 September 2014
2014 National Carbon Capture and Storage Conference, Sydney, Australia
This biennial conference, 'CCS in Action: Today, Tomorrow and Beyond', will bring together eminent Australian and international CCS experts, project proponents, innovative members of industry, senior policy and decision makers and leading scientific thinkers. To register your interest, visit https://www2.iceaustralia.com/ei/getdemo.ei?id=246&s=_4D80M0YPM or for information about past conferences, visit www.nationalccs.com.au

15-17 September 2014
10th European Conference on Coal Research and its Applications (ECCRIA), University of Hull, UK
This conference is organised by the Coal Research Forum to encourage, promote and co-ordinate basic research on coal, coal characterisation, coal products and coal utilisation in the UK. The purpose of this conference is to bring together researchers in universities, with participants from industry, who are also carrying out research or are interested in the application of the research in industry. Visit http://www.coalresearchforum.org/conference.html

16-18 September 2014
3rd Annual International Symposium of Clean Coal Technology (CCT-2014), Taiyuan, China
CCT-2014 features a technical program focused on CCT Policy, Coal Gasification Technologies, Carbon Capture and Storage, Coal Liquefaction, Coal Combustion, and CCT Markets. Visit http://www.bitcongress.com/cct2014/default.asp

15-16 October 2014
All-Energy Australia Conference, Melbourne
All-Energy Australia is an annual, free-to-delegate, business-to-business conference and networking forum hosted alongside an impressive exhibition showcasing renewable energy, clean energy, sustainable transport and energy efficiency. Visit www.all-energy.com.au

18-20 November 2014
SD2014 – Science, Society & Sustainability, Adelaide, Australia
Held annually, the Minerals Council of Australia's Sustainable Development Conference is recognised as the leading minerals industry forum to discuss and debate sustainable development and its practical implementation. Visit http://sdconference.com.au/2014/

24-28 November 2014
Engineers Australia Convention 2014, Melbourne
This event expects 10,000 delegates, over 5 days, with 6 conferences in 1 convention. Call for abstracts is now open. For more information visit www.all-energy.com.au

3-5 December 2014
14th Indo-Coal 2014, Jakarta, Indonesia
Exploring and seizing the golden opportunities for a sustainable coal industry in Indonesia. Visit http://www.cdmc.org.cn/2014/ic/

27 Sept - 1 Oct 2015
2015 ICCS&T, MCEC Melbourne
The 15th International Conference on Coal Science & Technology will be visiting Australia for the first time. The conference aims to bring together academic, industrial, and government communities to exchange ideas, concepts and innovations for the shared purpose of facilitating coal research advances. Visit http://www.engineersaustralia.org.au/iccst-2015