

PERSPECTIVES ON BROWN COAL

THE NEWSLETTER OF BROWN COAL INNOVATION AUSTRALIA

October 2013 : Number 8



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CEO's Update: Funding For New Research in Brown Coal

It is always a pleasure for BCIA to be able to announce the availability of additional innovation funding, and to seek proposals for new research to be undertaken. In late September, we announced a call for proposals for both coal-to-power projects, and PhD projects – the details of these can be found on Page 2. We are looking forward to receiving some interesting research proposals, and are happy to discuss potential research areas with proponents.

The process of calling for proposals allows us to see in action the collaboration of industry and academic groups in advancing technologies for the environmentally responsible use of brown coal. This is particularly important for BCIA, as we are currently reviewing our long-term plans. If you have a view on the long-term future of brown coal R&D, and how BCIA can better support the environmentally responsible use of brown coal in Australia, we'd love to hear from you.

In this edition of *Perspectives on Brown Coal (Perspectives)* you will get an update on progress of some of the projects we are currently funding. PhD research student Joanne Tanner reports on an international collaboration that was facilitated, in part, by BCIA funding. Process Group R&D Manager, Trina Dreher also gives an update on the WES froth generator project. This is a larger scale research project that has received BCIA investment, and which is showing significant promise to help with lowering the cost of CCS. In addition, we hear from Bithi Roy, who gives an update on her PhD work, which focuses on oxy-fuel fluidised bed combustion.

We also update you on a recent Community Forum BCIA held in Traralgon. The forum is part of BCIA's successful seminar series, which allows us to share the outcomes of our research program, and the potential technologies for low-emissions use of brown coal, with researchers, industry and the community at large. We are planning a big end to the year with two further opportunities for you to learn about novel brown coal technologies and projects.

On **Friday, 6 December** we will be running our last major seminar of the year, titled **"Coal to Products – Gasification, Pyrolysis and Beyond"**. The seminar will involve some major local and international speakers, talking about what is available today and into the future. ***This seminar will be free to attend, but you will need to register in advance.***

The day before the seminar, **Thursday 5 December**, we will be running a **one-day short course** covering in detail some of the technical and commercial considerations of **coal gasification technologies**. The course will be presented by Jason Laumb, Senior Research Manager of the Energy and **Environment Research Centre in North Dakota**. In order to cover our costs in running this course, we will be charging a small fee.

Both the seminar and course will be held in Melbourne, see BCIA's [News and Events](#) page 10 for details. Also on the horizon for early next year is a further major seminar on carbon capture technologies.

I hope you enjoy this issue of Perspectives.

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BCIA 2013 R&D Funding Round and PhD Scholarships

BCIA recently held a forum at CSIRO in Clayton to update and inform stakeholders and proponents about what is required for the 2013 R&D Funding Round and PhD Scholarships. Information on both of these BCIA funding initiatives is provided below.

2013 R&D Funding Round

BCIA's mission is to invest proactively in the development of technologies and people to support a sustainable future for brown coal in Australia.

The funds invested by BCIA are intended to build skills and capacity in brown coal-related technologies, to accelerate the implementation of innovative technologies, and to build a knowledge base to support the growth of new industries in Australia.

Cost-competitive emissions reductions, together with efficiency improvements, are essential if brown coal is to continue to play a significant long-term role in the Australian energy sector. This presents a significant challenge for brown coal power generators.

At the same time, there is also a need to develop local expertise in brown coal technologies to maintain the skills base needed to attract and implement new, low emissions technologies for deployment in Australia.

BCIA is actively engaged in creating the environment to support a viable future for brown coal-related industries in Australia. BCIA's current research investment portfolio encompasses 22 research projects, ten of which are now complete, with a total leveraged value of more than \$31 million.

To date, our research investments have enabled 31 Australian research students to gain valuable experience working on brown coal related applications, and 12 are now employed by industry.

BCIA has recently announced two funding initiatives to stimulate further innovation in the Australian brown coal industry. Support for collaborative research projects will be provided through the **2013 R&D Funding Round** and skills development will be supported through the **2013 PhD Scholarship Program**.

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The 2013 R&D Funding **Round**, BCIA's third competitive funding round, will provide more than \$3.5 million for research and development to improve the efficiency of low-emissions brown coal power generation. The key priority areas for the 2013 R&D Funding Round are:

- improving power generation efficiency (eg. heat recovery, advanced control & instrumentation)
- reducing the cost of CO2 capture
- improving coal quality for combustion (eg. silica removal and dewatering)
- reducing the costs of coal preparation (eg. mill optimisation and maintenance)

BCIA is now calling for Full Proposals for R&D projects to start early in 2014. The duration of the projects may range from as little as six months, up to a maximum of three years. To be eligible, project participants must be able to at least match the level of funding provided by BCIA and, preferably, demonstrate a high level of industry involvement.

Application guidelines and downloads can be found in the 'Research' section of the BCIA website (www.bcinnovation.com.au/2013RDFundingRound).

Applications for the 2013 R&D Funding Round close 15 November 2013.

2013 PhD Scholarships

The 2013 PhD Scholarship Program will provide funding support for up to ten postgraduate research projects, focused on innovation in the development of brown coal low-emissions technologies.

BCIA PhD Scholarship support is open to Australian PhD candidates who receive an Australian Postgraduate Award (APA), or similar full PhD scholarship, commencing in 2014.

BCIA's PhD Scholarships are valued at \$10,000 per annum (for a maximum of three years), of which \$7,000 per annum will be paid as a stipend to the PhD student and \$3,000 per annum will be allocated to support travel and other research costs.

The process for awarding BCIA PhD Scholarships will involve initial selection and refining of research topics from potential supervisors, followed (later in the year) by applications from PhD candidates who have been awarded an APA or equivalent.

The deadline for submission of proposed research topics is now closed however late submissions may be accepted, at the discretion of BCIA, provided that full PhD scholarship applications are not jeopardised as a result.

To apply, potential supervisors or industrial participants must provide a brief synopsis of the proposed research topic. Further information, guidelines and application templates can be found in the 'Skills' section of the BCIA website (www.bcinnovation.com.au/2013ResearchScholarships).

Feedback on the proposed topics will be provided by BCIA's Research Advisory Committee. Supervisors will then be able to advise potential candidates of the availability of BCIA PhD Scholarships for accepted topics. Please refer to the BCIA PhD Scholarship Guidelines for further details.

The 2013 PhD Scholarship Program is worth \$300,000 and takes BCIA's total investment in research skills development and leadership to more than \$5.5 million.

Together, the 2013 R&D Funding Round and the 2013 PhD Scholarship Program represent a substantial expansion of BCIA's innovation investment in a sustainable future for the Australian brown coal industry.

Enquires about either of these initiatives should be directed to Dr David McManus, BCIA Research Investment Manager, david.mcmanus@bcinnovation.com.au.

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WES Froth Generator Absorber



By Trina Dreher, Research & Development Manager, Process Group

BCIA funds projects focussed on creating a viable and environmentally sustainable future for the brown coal industry in Australia. In this article, Process Group R&D Manager, Trina Dreher, provides a progress update on a BCIA funded carbon capture project. The WES froth generator technology enables the use of precipitating solvents and also shows the potential to significantly reduce the size of CO₂ absorber columns, with implications for significant reduction in capital and operating costs for Carbon Capture and Storage (CCS) plants.

It is widely recognised that large-scale CCS is will only become a mainstream technology if significant reductions in capital and operating costs can be achieved, compared to the projected costs as currently modelled.

Moreover, these cost reductions need to be achieved across many facets of the CCS chain, as no one "silver bullet" can be expected to provide the necessary cost step change.

The commercialisation of the WES froth generator absorber represents one opportunity to address this challenge in a meaningful way. To that end, it should be characterised as an important technical development which may enable commercial implementation of CCS for CO₂ mitigation.

The current state-of-the-art column internals for carbon capture consist of structured packing as well as the associated gas and liquid distributors and liquid collectors. Whilst existing state-of-the-art internals are suitable for CCS, the size of the absorbers dictated by the process performance of these internals is such that the physical equipment size (>20 metre diameter) is very much at the upper end of technical feasibility, as well constructability.

Furthermore, current internals technology is not suitable for precipitating solvents due to the scaling and blocking characteristics associated with the precipitants.

As well as realising CCS cost reductions, commercialisation of the WES froth generator technology also promises to provide the necessary technical link to allow the use of precipitating solvents for CCS processes, due to the froth generator's ability to handle solids without blocking. This limitation is significant due to the widely held belief by many CCS solvent developers that the next generation of carbon capture solvents will be precipitating solvents.

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At the heart of the WES Absorber technology is the patented Regenerative Froth Matrix packing which creates a froth matrix that continuously forms and collapses. It is this froth matrix, rather than the surface of the packing itself, that creates the surface area for mass transfer. Furthermore, the WES Absorber is enhanced by solvent pulsing phenomena that periodically increases the local liquid to gas ratio.

High speed photography of the absorber in operation displays dynamic high-frequency interaction between the gas and liquid phases. These interactions include rapidly and continuously forming droplets and bubbles, bursting bubbles and fragmenting droplets to form further micro-droplets. The transient nature of the froth ensures rapid regeneration of the liquid-gas interface. It is important to note that the WES "froth" collapses quickly so that there are no special requirements to de-foam the solvent once it exits the absorber.

The BCIA funded project has allowed considerable Computational Fluid Dynamics (CFD) modelling to be performed in order to model the fluid flow and pulsing through the WES Absorber, with the long-term aim to develop a model that can be used to scale up the WES internals.

The models developed have been compared to high speed photography and videos of the WES Absorber, which indicates that some of the hydraulics are accurately modelled while others still require refinement. Therefore, significant work still needs to be conducted in order to accurately model the highly complex phenomena that occur within the WES Absorber.

The WES experimental program currently consists of three parts:

- (i) a bench scale WES Absorber apparatus fitted with high-speed photography,
- (ii) a conventional and WES Absorber laboratory plant, and
- (iii) a conventional and WES Absorber industrial pilot plant.

The latter is incorporated into the CO2CRC solvent pilot plant located at GDF SUEZ Australian Energy's Hazelwood Power Station.

Laboratory testing conducted in Maui has consisted of CO₂ absorption from a synthetic flue gas with conventional solvents: MEA, sodium glycinate and potassium carbonate.

The program investigates a range of variables in order to obtain sufficient data to enable a direct comparison of the WES Absorber performance to that of a conventional absorber over a range of operating conditions.

Results for all solvents have consistently shown that the WES Absorber captures more CO₂ for a given absorber height than that achieved with conventional column packing.

In addition, the WES Absorber has been operated with precipitating solvents and, in contrast to conventional packing, did not suffer from clogging or precipitant build-up. The prevention of fouling is due to the rapid interface regeneration and the highly turbulent environment created in the WES Absorber that prevents precipitates from adhering to the column internals.

In addition to laboratory experiments, pilot plant trials are being conducted with actual flue gas at the Hazelwood Power Station in order to validate the Maui laboratory results. Results from the pilot plant WES Absorber are also directly compared to a conventional absorber via the data generated by the CO2CRC.

Preliminary results achieved so far support that generated in the Maui laboratory however, further work is required in order to draw definite conclusions.

To that end, forthcoming trials will investigate the performance of the CO2CRC's precipitating solvent and also that of a sodium glycinate solvent. It is anticipated that the results from these trials will provide invaluable information pertaining to the operating performance, theoretical model validation, and economics of the WES Absorber internals. This information will serve as a platform for the improvement of future commercial WES Absorbers to enable further development of a viable commercial product with the potential to provide a cost step change for large-scale CCS.

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UPDATE FROM BCIA POSTGRADUATE RESEARCH SCHOLARS

BCIA's annual program of postgraduate research scholarships is part of our commitment to strategic investment in skills development to secure the scientific, engineering and trades expertise required for the development of new low-emissions brown coal technologies.

To date, BCIA has awarded six research scholarships to PhD candidates at top-ranking Australian universities.

In this edition of Perspectives on Brown Coal, BCIA scholarship recipient Joanne Tanner from Monash University updates us on her recent overseas research trip as part of her PhD project.

International Collaborative Research at PhD Level - Opportunities and Advantages



By Joanne Tanner, Monash University PhD Candidate and BCIA Scholarship recipient (2011)

As part of her BCIA-funded PhD project, Joanne had the opportunity earlier this year to travel to Europe and the USA on a two-month collaborative research trip. Here she describes the aims and outcomes of the expedition, and demonstrates the many advantages to be gained by international collaborative activities at PhD level.

My doctoral project "Brown coal-derived syngas generation for higher value product processes", focuses on the need for reliable fundamental data concerning the behaviour of Victorian brown coals (VBC) under high temperature, entrained flow gasification conditions.

Once such data is available, it can be used to develop models of the VBC gasification process with the view to utilising state-of-the-art gasification technologies to convert this abundant, low quality resource into high quality, value added products for domestic and international markets.

In order to augment the research capabilities available to me at Monash and to foster international relationships, this year I was able to conduct some of the experimental work related to my thesis at Forschungszentrum Jülich GmbH (FZJ, Research Institute of Jülich) and Karlsruhe Institute of Technology (KIT) in Germany. I also attended the 38th International Technical Conference on Clean

Coal and Fuel Systems, colloquially known as The Clearwater Clean Coal Conference, to formally present my project to an international audience.



ABOVE: Joanne conducting high pressure measurements at KIT to determine fundamental kinetic parameters of VBC gasification.



ABOVE: Joanne conducting high temperature gasification measurements at FZJ to determine the species evolved from Victorian brown coal

The idea for the expedition and collaborative activities was conceived in mid-2012 when one of my two co-supervisors, A/Prof. Sankar Bhattacharya, suggested that I submit an application for a grant from the Go8 Germany Joint Research Co-operation Scheme¹. The application was successful, and funding was secured over two years to support reciprocal visits to FZJ. This new collaboration represents a continuation of the existing relationship between the Energy, Fuels and Reactions Engineering Group at Monash led by A/Prof. Bhattacharya and the Division of Thermochemistry at the FZJ Institute for Energy and Climate Change Research (IEK-2) led by Dr Michael Müller.

The experimental work I undertook at FZJ involved using high temperature analytical techniques to determine the release of reactive, intermediate and condensable inorganic species from low rank coals under gasification conditions. Both Victorian brown coals and German lignites were used in this study, and further work has been planned for a subsequent visit in 2014. The results of this and future related work may be used to predict which species will be released under various conditions, and to extrapolate the impact on downstream processes in commercial gasification applications.

Once the initial funding for the visit to Germany had been secured, it was decided to maximise this opportunity to gain exposure to the international research community with similar fields of interest by extending the research trip. Therefore, following the experimental work at FZJ, I attended the 2013 Clearwater Clean Coal Conference - a prestigious international meeting of academic and industrial experts in coal utilisation and related fields.

As a student presenter and panel member, I was able to publicise my project and progress to date, to receive feedback from experts in the field and to build and develop networks with peers having common or related research areas.

I returned to Germany after the conference to complete the final leg of my research trip and to instigate a new research partnership with the Division of Fuel Chemistry and Technology (CEB) in the Engler-Bunti-Institute (EBI) at KIT, headed by Prof. Thomas Kolb. This collaboration was established

¹ <http://www.go8.edu.au/university-staff/international-collaboration/go8-germany-joint-research-co-operation-scheme#sthash.XtwApWnT.dpuf>

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through the connections of my co-supervisor, Prof. Klaus R.G. Hein, a former BCIA Fellow, and was funded with a subsidiary grant from BCIA.

The aim was to utilise the complementary equipment available at KIT to expand the scope of my project and enable me to determine fundamental kinetic parameters at the high temperatures and pressures typical of entrained flow conditions. The data generated at KIT will be compared and contrasted with the ambient pressure measurements completed at Monash, and the results made available for future modelling and design applications.

This expedition, with its combination of collaborative research and conference participation, has proven to be an invaluable opportunity for me to network with peers and publicise my research project and results to date.

I have also been able to extend the scope of my research to better represent industrial gasification processes by forming relationships with international partner institutes having capabilities complementary to those available to me domestically. I am looking forward to returning to Germany in 2014 to continue my work with the group at FZJ and expect once again to be able to incorporate additional beneficial activities into the expedition.

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Oxy-fuel Fluidised Bed Combustion of Victorian Brown Coal



By Bithi Roy, PhD student, Energy, Fuels and Reaction Engineering Group, Department of Chemical Engineering, Monash University

The viability of Victorian brown coal as a future energy source will depend largely on the minimisation of its environmental impacts. This project investigates the applicability of a new technology using brown coal to produce electricity with fewer emissions, compared to conventional technologies.

In coal-fired power generation technologies, emission of CO₂ is one of the major environmental challenges to be managed. Oxy-fuel based fluidised bed (Oxy-FB) combustion has emerged as a promising low-emissions technology due to its ability to produce concentrated capture-ready CO₂ in flue gas.

Additional advantages of this technology include fuel flexibility, uniform temperature distribution, low NO_x emissions, in-bed SO₂ capture via sorbent addition and low air in-leakage. Oxy-FB technology in circulating fluidized bed (CFB) mode is currently being pioneered by Foster Wheeler at the 30MWth CIUDEN facility in Spain.

Despite the perceived advantages of Oxy-FB technology, nothing is known about its applicability for brown coal. My research project, supervised by A/Prof. Dr Sankar Bhattacharya, is an investigation of the suitability of Victorian brown coal for Oxy-FB combustion.

The broad aim of my project is to use a combined modelling and experimental approach to understand the combustion performance of Victorian brown coal under oxy-fuel fluidised bed conditions. The more specific aims of this project are:

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- To investigate fundamental combustion characteristics in a small laboratory scale reactor under well controlled operating conditions.
- To design and construct a 10kWth (around 2kg/hr coal feed) multi-functional fluidized bed unit for operation in both oxy-fired and air-fired mode using a variety of coals (shown in Figure 1).
- To conduct experiments on combustion characteristics of three Victorian brown coals to ascertain the combustion efficiency, conventional pollutant emissions (including N₂O, SO₃ and trace element emissions), sulphation characteristics, carbonation characteristics and agglomeration characteristics under Oxy-FB conditions.
- To analyse the ash collected from different sections of the fluidised bed unit, using techniques such as Scanning Electron Microscope (SEM), Energy-Dispersive X-ray Spectroscopy (EDXS), X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF), Inductively Coupled Plasma – Atomic Emissions Spectrometry (ICP-AES) and Atomic Absorption Spectrometry (AAS).
- To predict the compounds formed in both gas and solid phases using the thermodynamic equilibrium model *FactSage*.
- To create a generic process model for Oxy-FB using the commercial engineering package *Aspen Plus*.

My project is progressing well and generating important new information on Oxy-FB combustion of Victorian brown coals. The major outcome at this stage is that the three tested brown coals combust very well under Oxy-FB conditions, with low emissions and no agglomeration. I have presented the results of my research at conferences and in peer-reviewed journals, with several new publications in progress.

Further research on Oxy-FB combustion at Monash University will extend the investigations to operation of the reactor in circulating mode and investigating the combustion performance and emissions of a range of coals, including other Australian brown and black coals. These will provide definitive guidance on the extent of gas clean-up required for CO₂ capture, transportation and storage. We welcome industry involvement in our ongoing and future work.



Figure 1: Fluidised bed rig

Bibliography:

- Terry Wall and Sankar Bhattacharya, **A scoping study on oxy-CFB technology**, ANLECR&D report, 2012
- Bithi Roy, Wei Lit Choo and Sankar Bhattacharya, **Prediction of ash composition and agglomerating compounds formed during Oxy-CFB combustion of Victorian brown coals**, CHEMECA Conference, Sydney, Australia, 2011.
- Bithi Roy and Sankar Bhattacharya, **Oxy-fuel combustion in a bench-scale fluidized bed using Victorian brown coal**, The 38th International Technical Conference on Clean Coal & Fuel Systems, Clearwater, Florida, USA, 2013.
- Bithi Roy, Wei Lit Choo and Sankar Bhattacharya, **Prediction of distribution of trace elements under Oxy-fuel combustion condition using Victorian brown coals**, Fuel 114 (2013) 135-142
- Bithi Roy, Wei Lit Choo and Sankar Bhattacharya, **Oxy-fuel fluidised bed combustion using Victorian brown coal: An experimental investigation**, Fuel Processing Technology, In press, 2013

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Community Forum in Latrobe Valley

During August, BCIA held a second community forum in the Latrobe Valley to update local industry and community on BCIA's activities and programs.

BCIA Chair, Gerry Morvell, and Chief Executive Officer, Phil Gurney, addressed the forum of about 60 attendees on opportunities and challenges for a sustainable future for brown coal. Dr Gurney also provided an update on BCIA's innovation investment portfolio which comprises more than 20 research projects, ten of which are now complete, with a total leveraged value of more than \$31 million.

BCIA's role in securing a low emissions future for Australia's world class brown coal resource is focussed on R&D investment, skills development and analysis and communication of low emissions research results. BCIA invests proactively in the development of technologies and people to broaden the use of brown coal for a sustainable future.

The forum presentation included an outline of the projected impact of renewable energy targets and carbon pricing on the cost of electricity over the next 30 years. The model forecast the impact of carbon pricing on various energy sources, including brown coal and renewables, with the application of different technologies such as carbon capture and storage.

Dr Gurney also detailed the expected contribution from R&D in delivering low-cost, low-emissions energy from coal and provided an overview of potential uses of brown coal including non-energy, value-added products such as a feedstock for the chemical industry.

The presentation provided community members with an insight into BCIA's R&D investment approach including the company's strong focus on the development of low-emissions technologies that are expected to achieve cost-reductions, risk-reductions or breakthroughs when deployed.

Of major interest to the audience was highlights from BCIA's two competitive R&D funding rounds to date (the company has since announced a third competitive funding round for brown coal low-emissions energy projects). Dr Gurney outlined high-level outcomes from research projects across three major themes – improving energy efficiency, progressing carbon capture and alternate uses of brown coal.

In addition, the presentation included a brief overview of the linkages between BCIA and other government-related brown coal initiatives including the Advanced Lignite Demonstration Program (ALDP); Clean Coal Victoria and the CarbonNet Project.

Dr Gurney also highlighted BCIA's investments in developing research skills and Australia's future scientists through Research Fellowships and PhD scholarships, in addition to activities communicating the outcomes of the company's research program including newsletters, research and community seminars and published articles.

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The Victorian government member for Morwell, Russell Northe, attended the forum along with representatives from the CarbonNet project and various government bodies including Clean Coal Victoria and the Department of State Development, Business and Innovation.

The forum also included strong representation from the Latrobe Valley energy generators and broader brown coal industry sector, Latrobe City Council and Wellington Shire Council and the local tertiary education sector.

Dr Gurney's presentation was followed by an open question and answer session which generated strong audience interest and participation. Major themes of this session included questions about the adequacy of government support for low emissions research and development and the medium to long-term outlook for a sustainable future for brown coal.

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What's News at BCIA?

PLANNING FOR THE FUTURE

BCIA's goal is to support the people and technologies required for a vibrant brown coal industry focussed on the environmentally responsible exploitation of Australia's brown coal resources. This year, BCIA has been planning for the future, and looking to what the organisation can achieve over the next five to ten years.

The project commenced early in the year with a review by BCIA's Board and Research Advisory Committee on the potential for BCIA to boost its work in skills programs, and continued through our Strategic Review with BCIA members and brown coal stakeholders held in May.

BCIA is currently consulting with industry and international stakeholders, to identify areas where the company can boost collaboration and help to accelerate the development and deployment of novel technologies. The aim is to complete this activity by the end of October. If you would like to contribute to this review, please contact BCIA Chief Executive Officer, Dr Phil Gurney.

This has also been a busy time planning our new research funding round for 2013, and also planning the upcoming seminar program. As you will have read in the CEO update, we have been successful in collaborating with the Energy and Environmental Research Center from North Dakota to help run a coal Gasification short course in Melbourne in December. We expect this to be the start of a stronger relationship between the brown coal research in the USA and in Australia.

SKILLS DEVELOPMENT

To date, BCIA has supported 31 research students through our PhD scholarships, and our research programs. We are currently promoting scholarship support funding for up to 10 research scholars.

BCIA began its scholarship program in 2010 and many of the students inaugural scholarship awardees are reaching the end of their projects, and are looking towards the next steps in their careers.

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Already, 12 students who have participated in BCIA-funded research projects have taken up positions in industry but if your organisation is currently looking, or thinking of looking, for highly skilled and motivated researchers with a broad range of experience in coal, chemistry, chemical engineering or related areas, please let us know - we would be happy to put you in touch.

With this in mind, next year BCIA is also planning another networking event for students to meet and network with industry partners. - See more at:

<http://www.bcinnovation.com.au/2013Newsletter087#sthash.tJYIPpMI.dpuf>

RESEARCH AND DEVELOPMENT

BCIA strongly supports the view that brown coal-fired power generation can only have a long-term future in Australia if greenhouse gas emissions can be significantly reduced without dramatically increasing the cost of electricity. Reflecting this, BCIA's research portfolio has a strong emphasis on pilot-scale demonstration of lower-cost CO₂ capture technologies that could be deployed in Australia.

BCIA-supported CO₂ capture research is relevant not just for Australia, but for the world. Global warming is an international problem and, as a major coal exporter, Australia has an obligation to help find a solution. Successful technologies developed in Australia have the potential to be implemented worldwide.

One of the more promising technologies being investigated with BCIA support is the WES froth absorber, under development by Process Group. This is a unique gas-liquid contactor which is more efficient than standard technologies, and has the potential to significantly reduce the capital cost of CO₂ capture equipment. Dr Trina Dreher, the project leader, provides an update on page 3.

In another BCIA-funded project, known as coCAPco, CSIRO Energy Technology is operating a CO₂ capture pilot plant at AGL Loy Yang power station. This project is an investigation of new methods to combine CO₂ and SO₂ capture in a single unit, as an alternative to the (more expensive) conventional approach of having two sequential capture systems. CSIRO is collaborating with iCap, a European Union consortium led by the Norwegian University of Science and Technology, Trondheim, making this a truly international project.

The first phase of this project has recently been completed, in which an iCap technology was successfully tested. The process involved loading a solvent with CO₂ and SO₂ simultaneously, and then stripping them out sequentially. The CO₂ was extracted using a conventional heat regeneration process, while the SO₂ was recovered in the form of sulphate crystals, which could be sold as fertiliser. This novel process was found to have a lower operating cost than two sequential absorption steps, and could avoid the high capital cost of a separate SO₂ scrubbing system.

The CSIRO pilot plant is now in the final stages of refurbishment, in preparation for a new series of trials. These will test a patented CSIRO technology for simultaneous extraction of CO₂ and SO₂. After evaluating the two alternative technologies, the project participants will select the most promising for further commercial development.

Both the WES absorber and coCAPco projects have the potential to significantly reduce the cost of CO₂ capture, and are applicable in markets beyond Australia and beyond brown coal. As such, they are well placed to deliver a substantial return on BCIA's innovation investment.

COMMUNICATIONS

In mid-September, BCIA announced both its 2013 R&D Funding Round and funding support for up to ten PhD research scholarships. The company's third competitive funding round offers more than \$3.5 million in additional funding for R&D to improve the efficiency of low-emissions brown coal power generation.

The seventh edition of BCIA's e-newsletter, Perspectives on Brown Coal, was released in early August and featured an article on Advanced Virtual Energy Simulation Training and Research (AVESTAR) – a US centre for operational excellence of coal-fired power plants using dynamic simulation and virtual reality technologies.

BCIA held a community forum in the Latrobe Valley during August to provide an update on BCIA's innovation funding, highlights from BCIA's R&D program and an update on the outcomes of our recent skills activities. The forum was well received with almost 60 people attending (see page 6 for more information).

BCIA Chief Executive Officer, Dr Phil Gurney, addressed Monash University and a Barbarians luncheon during August on coal research for Victoria. Dr Gurney also participated in a panel at the All-Energy Australia conference in Melbourne on 9 October; the panel discussed the future energy mix for Australia.

BCIA members had the opportunity recently to participate in an online meeting with the Canadian Clean Power Coalition (CCPC) Technical Committee in September to share information about technologies such as biomass co-firing, partial capture IGCC, in-situ gasification, coal beneficiation, efficiency improvements, carbon capture and advanced uses of coal.

Work is well underway for the next event in the seminar series, the ***Coal to Products – Gasification, Pyrolysis and Beyond seminar*** supported by the CarbonNet Project through the Department of State Development, Business and Innovation, to be held on **Friday 6 December, 2013** in Melbourne. The seminar will focus on technologies for upgrading coal to value added products, including processes via gasification and pyrolysis.

To coincide with the seminar, BCIA has also been working with the Energy & Environmental Research Center (EERC) based in North Dakota, a world leader in gasification research, to deliver a ***one-day short course on gasification technologies*** on **Thursday 5 December**.

Details for both of these events can be found on BCIA's [News and Events](#) page.

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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.

On the next page, you can read about this edition's new member in the spotlight, [Monash University](#).

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

BCIA has updated our membership programs for 2013. Our current members include:



SPOTLIGHT ON BCIA MEMBER

Monash University

Established in Melbourne in 1958, Monash is Australia's most internationalised university. It has eight campuses including one in Malaysia and one in South Africa, and a centre in Prato, Italy. Monash is an energetic and dynamic university, committed to quality education and research.

About the Faculty of Engineering

The Faculty of Engineering is one of the largest in Australia, renowned worldwide for the high quality of teaching and research, and the calibre of graduates.

Monash teaches students to take an innovative approach to both the development and the application of engineering technology. Monash academic staff are acknowledged leaders in their fields who provide a stimulating learning environment that extends well beyond lectures. Monash Engineering degrees are in high demand due to their reputation, wide range of double degree options, the industry-led student leadership program (LITE) and wide range of scholarships.

Recent graduates can now be found working for large industrial corporations, government departments, and in the banking and finance sector. Many have gone on to form their own companies. Alumni have a firm foundation of technical problem-solving skills and business-ready skills developed during their time at Monash.

About Chemical Engineering

Established in 1962, the Department of Chemical Engineering is one of the leading Chemical Engineering Departments in Australia – currently ranked equal first in Australia (ERA 2012) and 25th in the world for Chemical Engineering (2012 QS Discipline Rankings).

It has a long history of research on pyrolysis, gasification, combustion and liquefaction of brown coal, starting in the 1970's with Prof Owen Potter's invention of Steam Fluidised Bed Drying and continuing later on with the CRC for Clean Power from Lignite.

Academics and researchers are involved in some of the first-of-its-kind trials in Australia, including circulating fluidised bed combustion of brown coal (see article page 5) and pressurised high-temperature Winkler and Transport Reactor gasification.

Several academics (including A/Prof Bhattacharya, A/Prof Hoadley and Dr Lian Zhang) who have considerable industry experience are now involved in fundamental research aimed at practical problems for the industry. The Department collaborates extensively with colleagues across Monash (eg. Prof Chaffee and Prof Patti in Chemistry) on a wide range of large, well structured, interdisciplinary research projects.

The Department's mission is to create fundamental knowledge and pioneer technologies in the chemical engineering sciences.

PERSPECTIVES ON BROWN COAL

THE NEWSLETTER OF BROWN COAL INNOVATION AUSTRALIA

October 2013 : Number 8



Its outstanding academic staff, well-funded research programs, and unique facilities provide excellent opportunities for postgraduate research work leading to Masters or PhD degrees. Research within the Department of Chemical Engineering at Monash University is focused on many aspects of clean and sustainable energy production from Victorian Brown Coal.

Brown coal contains a high fraction of water making combustion both inefficient and difficult. Significant research activities are underway to investigate improved methods for power and chemicals production from coal and biomass, including: advanced dewatering technologies, gasification processes, carbon capture technologies (both pre- and post- combustion), and chemical looping processes.

At any given time the Department has 15-20 postgraduate students and researchers working on coal-related research projects, as well as 6-10 final year undergraduate projects.

The Department's other strength is in training the next generation of chemical engineers. There are approximately 400 undergraduate students in Melbourne and a further 300 at the Malaysian campus.

Monash is particularly proud that every Melbourne student has an industry expert lecturer in each semester of third and fourth year. This is an unprecedented level of direct industry teaching engagement which gives students the optimal blend of academic excellence and industrial relevance.

Coal Facilities at Monash University include:

- Entrained Flow Reactor
- Chemisorption Unit
- CFB Reactor
- Steam Injected TGA
- Ion Chromatographs
- Gas Chromatographs
- Tubular Furnace
- Drop Tube Furnace
- High Pressure DME Synthesis Reactor

For more information, visit <http://www.eng.monash.edu.au/chemical/>

Or contact:

- **Mick Wade**, Business Development Manager, email: michael.wade@monash.edu
- **Associate Professor Karen Hapgood**, Head of Dept, email: karen.hapgood@monash.edu



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UPCOMING EVENTS

Calendar of Events

18-19 November 2013

10th Australian Coal Science Conference, Sofitel Brisbane Central Hotel, Brisbane, Australia

Hosted by the Australian Institute of Energy, the theme for this year's Conference is 'Solutions for Industry'. For all who are interested in the future of energy supply and the role of coal, this Conference will be a major event in the energy calendar. The Conference will bring together leading speakers from governments, industry and academia from around the world. Visit

<http://www.coalscience2013.com/>

21-22 November 2013

11th Coal Deep Processing Forum 2013, Beijing, China

Large Scale Modern Coal Chemical Projects: Update and Planning Outlook - understand regulatory aspects for coal conversion and utilization and learn about new initiatives, projects and techniques to develop a deep understanding of the China coal industry and worldwide. Visit

<http://www.cdmc.org.cn/2013/CDPF/index.asp>

4-5 December 2013

12th Clean Coal Forum Indonesia, Jakarta, Indonesia

This conference will keep you informed of the latest trends in Indonesia's coal market and understand where the smart money is headed. The conference will address the most critical industry issues affecting your performance objectives in Indonesia and globally, and will aim to help you gauge the pulse of this dynamic industry, and stay abreast of the most advanced clean coal technologies. Visit <http://www.cdmc.org.cn/2013/ccfi/index.asp>

5 December 2013

Gasification Short Course, Melbourne, Australia

BCIA has engaged the Energy & Environmental Research Center (EERC) based in North Dakota, a world leader in gasification research, to deliver a one-day short course on gasification technologies. The course is designed to provide technical personnel with a broad understanding of available gasification technologies, and will cover theory, commercial technologies, end-products and cost analysis aspects. Visit <http://www.bcinnovation.com.au/NewsEvents>

6 December 2013

BCIA Seminar on Coal to Products - Gasification, Pyrolysis and Beyond, Melbourne

To coincide with the gasification short course BCIA will be running a one day seminar focusing on Coal to Products via gasification and pyrolysis. This event is free to attend and is an exciting opportunity to hear from a variety of international and local companies and researchers about how Victoria's brown coal resources could deliver not just low emissions energy, but also be used as a feedstock for an expanded chemicals industry. This seminar initiative is supported by the Department of State Development, Business and Innovation through the CarbonNet Project. Visit

<http://www.bcinnovation.com.au/NewsEvents>

6 - 7 February 2014

Australia – China Oxyfuel Combustion Workshop, Melbourne, Australia

This workshop, sponsored by BCIA, will include various opening addresses, followed by seven plenary speeches and seventeen presentations ranging broadly from large/pilot-scale tests to process optimisation, techno-economic analysis, CFD modelling, ash deposition, pollutant emissions and next generation combustion technologies.

Late February 2014

Reducing Emissions from Brown Coal Use – What’s Possible and What’s Coming, Melbourne, Australia

BCIA is organising a full-day seminar focusing on carbon capture. More details will be provided as they become available.

28 April – 1 May 2014

3rd International Low Rank Coal conference, Melbourne, Australia

This high level industry symposium will focus strongly on the issues, opportunities, challenges and project drivers facing the low rank coal industry globally. To register your interest contact symposium.2014@dpi.vic.gov.au

13 -15 May 2014

2014 Australia-China Symposium on Energy, Taiyuan, China

This event is hosted by the Australia-China Joint Research Centre for Energy. The Symposium will provide an opportunity for knowledge sharing, information exchange and networking for those engaged in the research, development and deployment of low-emission energy technologies in Australian and Chinese research institutions, industry and governments. Visit <http://www.saec2014.com>