

21 December 2011

MEDIA RELEASE

Research to Slash Costs from Brown Coal Emissions Capture

Brown Coal Innovation Australia (BCIA) today announced funding for two world-leading technology innovations which offer enormous potential to slash capital and operational costs for large-scale carbon capture plants; arguably the greatest challenge facing commercial deployment of carbon capture.

Both R&D projects were selected as part of BCIA's \$8.3 million 2011 funding round and are to be funded by BCIA in collaboration with Australian National Low Emissions Coal R&D (ANLEC R&D). The total leveraged value of the 2011 BCIA research projects is \$20.6 million including industry, research institute and State and Federal Government funding. Eight other projects which secured funding were announced earlier this year.

BCIA Chief Executive, Dr Phil Gurney, said "By 2030, coal is expected to account for more than 40 per cent of the world's needs for power generation. Together, these ground-breaking R&D projects provide an opportunity for Australian research to advance the sustainable use of brown coal through significant advancement of the global carbon capture industry."

BCIA will provide \$1.5 million for a research project which aims to achieve significant cost reductions - up to \$200 million for a 550MW plant - in the cost of retrofitted post-combustion emissions capture from brown coal-fired power. The research objective is to integrate the removal of sulphur (SO₂) and carbon (CO₂) in a single column, with a single liquid absorbent, thereby eliminating the requirement for a separate flue gas desulphurisation unit.

The project involving Loy Yang Power, TRUenergy and Commonwealth Scientific and Industrial Research Organisation (CSIRO) incorporates thermodynamic modelling, laboratory testing and trial tests with flue gas in a modified post-combustion capture plant at the Loy Yang power station in Victoria. The combined SO₂/CO₂ technology concept could be further developed and utilised to retrofit existing flue gas desulphurisation units in coal-fired power stations throughout the world.

In addition, BCIA will provide \$1 million in funding for a project which offers the potential to halve the size and cost of the large primary absorber vessels required in carbon capture plants. A collaboration between the Process Group and CO2CRC (Cooperative Research Centre for Greenhouse Gas Technologies), the project aim is to develop the US based WES froth generator absorber technology through to commercialisation.

The research plan incorporates a series of field trials on an existing carbon capture plant to be upgraded and installed at International Power's Hazelwood Power Station in Victoria. In addition to the projected capital cost reductions for carbon capture, the WES absorber technology is expected to achieve operational cost savings through the use of new high capacity absorption technologies.

More information:

Mandy Frostick, BCIA Communications, Tel: + 61 419 546 245 Email: mandy.frostick@messageworks.com.au

Brown Coal Innovation Australia Limited

Level 27, 101 Collins Street, Melbourne VIC 3000 Australia
Tel +61 3 9653 9601 | Fax +61 3 9653 9026 | ABN 51 141 273 261
Web www.bcinnovation.com.au | Email info@bcinnovation.com.au

Brown Coal Innovation Australia Limited

Level 1, The Realm, 18 National Circuit, Barton ACT Australia
Tel +61 2 6198 3265 | Fax +61 2 6198 3232 | ABN 51 141 273 261
Web www.bcinnovation.com.au | Email info@bcinnovation.com.au

BROWN COAL INNOVATION AUSTRALIA FUNDING ROUND FACTSHEET

Brown Coal Innovation Australia (BCIA) today announced a further \$2.5 million in funding for two highly meritorious research and development projects in brown coal low-emissions and innovation technologies. The projects were selected as part of BCIA's \$8.3 million 2011 funding round.

The total leveraged value of BCIA's 2011 R&D projects is \$20.6 million including research institute, industry and State and Federal Government (via Australian National Low Emissions Coal R&D) contributions.

ABOUT BROWN COAL INNOVATION AUSTRALIA

Brown Coal Innovation Australia (BCIA) is a not-for-profit company with a mandate to co-invest with stakeholders in brown coal innovation and emissions reduction technologies.

BCIA funds and facilitates multi-million dollar research and skills development investments to drive innovation in the brown coal value-chain, from mine-mouth to the capture of CO₂. The company's mission is to invest proactively in the development of technologies and people that broadens the use of Australia's world-class brown coal resource for a sustainable future.

Strategic management of its R&D investment portfolio underpins BCIA's innovation support and operational activities. The company is addressing the challenges and opportunities of fostering low-emissions brown coal development by:

- providing a key entry point to progress shared research and development activity between industry, research and government stakeholders
- focusing strongly on skills-development and the expansion of training opportunities to secure the scientific, engineering and trades expertise needed for development of new low-emissions brown coal technologies.

BCIA innovation funding supports research and development initiatives that are technically excellent and that will lead to increased commercial deployment of low-emissions brown coal technologies in the short, medium and long term.

Australia has vast brown coal reserves; encompassing about a quarter of the world's known reserves. Innovation of improved technology for brown coal usage involves substantial costs and time and under-investment in R&D has significant implications for industry competitiveness and Australia's future economic prosperity.

To date, the vast majority of R&D activity in brown coal technologies has focused on power generation and, more recently, efficient water removal technologies. Beyond emissions reduction, current and future international price indications for oil, gas and metallurgical coal provide new exploitation opportunities for the conversion of brown coal to liquids and other high-value commodities.

BCIA's innovation support spans three key spectrums:

- R&D in low-emissions, low-cost, coal technologies and novel, high-value products derived from brown coal
- Skills development and new training opportunities to secure scientific, engineering and trades expertise
- Linkages and networks to foster international collaboration in innovation and low-emissions technologies.

BCIA 2011 FUNDING ROUND FOCUS AREAS

BCIA identified cost and risk reduction as focus areas for the organisation's inaugural funding round. Successful grant applications were required to demonstrate how they would make a significant contribution to the following cost reduction targets:

COST REDUCTION

- \$100/200/2020 – a levelised production cost target for electricity generation from brown coal of \$100 per MWh (sent out) at a CO₂ emission level of not more than 200 kg per MWh in commercial-scale demonstration by 2020

- 50%/100/2020 – a levelised production cost target for non-power generation products derived from brown coal (including novel, high-value products) that is at least 50 per cent lower than those from conventional sources, at a CO₂ emission level of not more than 100 kg per MWh in commercial-scale demonstration by 2020.

RISK REDUCTION

Risk reduction projects were required to demonstrate how they would contribute to reducing the risks likely to affect the success over the next five to seven years of proposed large-scale demonstration and/or early-deployment projects for low-emissions power generation from brown coal.

BCIA 2011 FUNDING ROUND PROCESS

The BCIA R&D funding round was undertaken in two stages: a call for Expressions of Interest, followed by an invitation for shortlisted applicants to submit full proposals. The BCIA Research Advisory Committee (RAC) assessed both EOIs and full proposals and provided advice to the BCIA Board.

The BCIA RAC assessed the merits of the EOIs against the following high-level selection criteria:

- The project: The strategic, technical, competitiveness, budgetary and 'value for money' merit of the proposed project. BCIA seeks projects that offer high value for our contribution to the total cost of the project. A minimum 1:1 funding criterion is required for R&D projects.
- The people and collaborations: The quality of the key people, including their capability and capacity to achieve the objectives of the project, together with the synergies in proposed collaborations to produce genuine, collaborative outcomes.
- The contribution to BCIA's research investment objectives and priorities.

The BCIA Board considered all submitted EOIs and full proposals; only project applications of the highest merit were selected. In all areas, industry and government partnerships that increased project funding leverage beyond the matched funding criteria and reduced commercialisation risk were viewed favourably.

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 2011 RESEARCH AND DEVELOPMENT PROJECT GRANTS

- ▶ \$1,500,000 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 - coCAPco*'; submitted by Loy Yang Power Management Pty Ltd in association with TRUenergy and CSIRO Energy Technology.

This project seeks to achieve a significant capital cost-reduction - 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 project aims to obtain a proof-of-concept for a combined SO₂/CO₂ removal process for initial application in 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 research plan comprises thermodynamic modelling of the process concept, laboratory testing of basic solvent properties and trial tests with real flue gas in a modified post-combustion capture pilot plant at the Loy Yang power station in Victoria.

- ▶ \$1,000,000 funding for '*Development of contactor internals for application of the WES froth generator gas/liquid absorption technology*'; submitted by Process Group Ltd in association with Westec Environmental Solutions LLC.

The primary objective of this project is to commercialise the WES froth generator absorber technology in order to significantly reduce the capital and operational costs of the primary absorber vessels and associated inventories required for large-scale carbon capture plants. Current contactor internals technology for carbon capture consists of structured packing plus associated gas and liquid distributors and liquid collectors. This technology is not

suitable for precipitating solvents, believed to be the next generation of carbon capture solvents, and the physical size of the equipment is at the upper end of technical feasibility. This research project will seek to advance the new WES froth generator technology as a commercial product for the global carbon capture industry through modelling, prototype construction and product performance trials.

- ▶ \$1,300,000 funding for '*High efficiency power from Victorian brown coals*'; submitted by CSIRO Advanced Coal Technology. Project participants include Exergen Pty Ltd and Ignite Energy Resources Pty Ltd.

This project will investigate high efficiency power generation using processed Victorian brown coal in an adapted diesel engine. A range of low-cost, coal processing technologies will be examined and the research program expects a step-change in fuel cycle efficiency which will enable a 45 per cent reduction in CO₂ emissions compared with the best existing brown coal power plants. The increased efficiency of the direct injection coal 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 coal engine also offers the potential of increased operational flexibility to support peak load electricity demand and supply from intermittent renewable energy.

- ▶ \$300,000 funding for '*Hydrogen energy supply chain development*'; submitted by HRL Developments Pty Ltd in association with Kawasaki Heavy Industries Limited. Project participant HRL Technology Pty Ltd.

Hydrogen produced from the gasification of brown coal, linked with carbon capture and storage technology, can provide a valuable energy source with low CO₂ emissions. This project will examine the process design and key infrastructure requirements for hydrogen production at both the pilot and commercial-scale using both commercially available and new technologies. The market potential for the product will be examined and the cost effectiveness of the process will be assessed against alternative means of production.

- ▶ \$1,500,000 funding for '*CO2CRC's Solvent-Based Carbon Capture Technology in Brown Coal Fired Power Plants – (CSCCT-BCFPP) Capture Demonstration for Cost Reduction*'; submitted by CO2CRC Limited in association with International Power Hazelwood; CO2CRC partners and Process Group.

This project will identify the best-performing and most cost-effective solvent absorbent technologies for the capture of CO₂ emissions from brown coal through modification of two existing pilot-scale facilities in Victoria. Recent research trials have demonstrated a range of benefits from the use of solvent potassium carbonate including negating the need for separate flue gas desulphurisation facilities. An experimental program and simulation studies will be used to further improve the performance of the potassium carbonate process for CO₂ removal. The project will also examine CO2CRC's precipitating potassium carbonate process including the removal of sulphur and nitrogen oxide impurities; a valuable by-product which could be further processed as fertilisers. Additionally, a modified pre-combustion solvent-based capture plant will undertake world-first trials of state-of-the-art WES absorber technology. Research results will enable international benchmarking of solvent absorbent technologies against current CO₂ capture techniques, develop clear directions for large-scale deployment and create the necessary competitive tension to drive down CO₂ capture costs.

- ▶ \$605,000 funding for '*Development of chemical looping process for fuels production and CO₂ capture from Victorian brown coals*'; submitted by Monash University in association with TRUenergy; CSIRO Process Science and Engineering and leading European universities engaged in chemical looping research - Chalmers University of Technology Gothenburg, Sweden and Technical University of Darmstadt, Germany.

This is the first known study of chemical looping combustion and gasification of Victorian brown coal as an emerging alternate technology for the capture of CO₂ at a lower energy and cost penalty. Chemical looping has been widely studied for the combustion of natural gas but research into its potential application for solid fuels commenced only recently. 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. It is believed the low ash content, high reactivity and high oxygen content of Victorian brown coal is particularly suited to chemical looping and the process also has the potential to advance value-added brown coal technologies such as low-emissions hydrogen production.

- ▶ \$603,028 funding for '*Development of entrained flow gasification technology with brown coal for generation of power, fuel and chemicals*'; submitted by Department of Chemical Engineering, Monash University in association with Mitsubishi Heavy Industries.

This project will model the characteristics of molten slag from Victorian brown coal under gasification to enable the future use of entrained flow gasifiers for brown coal-fired power generation. Gasification is capable of producing coal-fired electricity more efficiently and with reduced CO₂ emissions; thereby lowering generation costs. The project will develop commercially-applicable models for prediction of the slag behaviour of Victorian brown coals including slag formation, slag viscosity and trace element emissions while also making preliminary assessment of coal reactivity under entrained flow gasifier conditions. The measurement of slag viscosity under gasification will be undertaken in a state-of-the-art viscometer (one of only two operating in Australia) to be built at Monash University. The project is an international collaboration combining Monash University's expertise in brown coal gasification research and Mitsubishi Heavy Industries' experience with commercial scale coal gasifiers.

- ▶ \$525,000 funding for '*Improved handling of lignite-based products*'; submitted by Monash University. Project participants include Environmental Clean Technologies Ltd; LawrieCo; Keith Engineering (Australia) Pty Ltd.

Dried or de-watered lignite (brown coal) is prone to spontaneous combustion following exposure to air, making lignite-based products notoriously difficult to handle and transport. This project has the potential to open up significant new domestic and global markets for Victorian brown coal through improved control of the composition and particle size distribution of lignite products. The first part of the project will seek to identify processing methodologies that can significantly reduce the tendency of lignite to spontaneously combust. This will involve an investigation of the physical (structural) and chemical features of lignite which correlate with the low temperature, heat-releasing oxidation processes that result in combustion. The second part of the project will investigate and establish optimum conditions for the granulation of lignite and lignite-derived fertilisers. This research will be used to develop an integrated granulation and drying process for lignite using superheated steam.

- ▶ \$500,000 funding for '*Next Generation Lower Emissions Gasification Systems R&D - Power and Products*'; submitted by HRL Technology Pty Ltd in association with Monash University and CO2CRC.

This research project will investigate options for high-efficiency, low-cost, advanced integrated drying and gasification systems for the production of power and high-value products from brown coal. Use of integrated drying and gasification technology for combined-cycle power generation has the potential for a significant improvement in plant efficiency, and consequent reduction in CO₂ emissions, compared with existing brown coal-fired power plants. Integrated drying and gasification is believed to be an economical means of producing syngas from brown coal suitable for further processing into high-value products such as liquid fuels, hydrogen, fertilisers, chemicals and advanced power systems utilising, for example, fuel-cells. The research project will investigate various existing and emerging process options that could be employed in the future. One of the key outcomes of this project will be the identification of further laboratory and pilot-scale work required to develop next generation lower emissions gasification system options utilising integrated drying and gasification technology.

- ▶ \$450,000 funding for '*Coal-derived additives: a green option for improving soil carbon; soil fertility and agricultural productivity?*'; submitted by Monash University. Project participants include Clean Coal Victoria; International Power; LawrieCo; Exergen Pty Ltd and Environmental Clean Technologies.

This project will evaluate the merits of using Victorian brown coal and its derived products for improving soil health and plant yields and increasing carbon capture from the atmosphere. The study will involve glass house and field plot trials to determine the best performing brown coal derived materials, specifically humic/fulvic acid containing materials and char, for plant growth, soil health and soil carbon capture. Additionally, the project will compare char from brown coal with existing commercial char products and evaluate phosphorous fertilisers coated in a brown coal derived humate to determine improvements in soil health and associated increases in carbon uptake. The research plan will incorporate a life-cycle assessment of brown coal products for agricultural applications including all aspects of the supply chain, transport and distribution.

For more information:

Media inquiries: BCIA Communications Manager, Mandy Frostick,
Tel: +61 (0) 419 546 245 or Email: mandy.frostick@messageworks.com.au

Funding inquiries: BCIA Chief Executive, Dr Phil Gurney
Tel: + 61 (0) 438 539 647 or Email: info@bcinnovation.com.au