Perspectives

ON BROWN COAL

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CEO'S UPDATE

How do we build an integrated low emission energy and manufacturing economy in the 21st century?

Brian Davey
BCIA Chief
Executive Officer

The challenge for all world economies is to ensure their citizens have access to the cheapest, most reliable and lowest emission energy possible. In the case of Victoria, that challenge is magnified by the transition that is occurring in the manufacturing sector as demonstrated by the closure of the car industry. Often the objectives of low emissions energy and manufacturing requiring low costs and reliability appear to be at cross purposes. This does not need to be the case as renewable energy, low emission energy from carbon resources and a manufacturing industry based on a high quality carbon resource is entirely possible.

Our recent seminar that showcased the potential for the Latrobe Region's low cost, high quality carbon resource – whether from the coal, paper or timber sector, demonstrated a potential pathway to the future.

The recent debate about high emissions from the former Hazelwood Power Station has unfortunately been translated incorrectly to the resource itself, which in reality is a very high quality deposit of carbon, water and oxygen with exceptionally low levels of impurities and which can be mined at very low cost without emitting any greenhouse gas, unlike black coal.

The resource is delinked from the world commodity market which means that long term stable pricing can be assured for the raw material. It is a world-class deposit that can, and should be, utilised in an emission constrained economy. Ironically it is the water component that causes the high emissions when used in the traditional open boiler technology that is now being transitioned out of the electricity generation mix.

However, the carbon in the deposit underpins all the modern technologies that are being used to achieve a sustainable society. These range from production of carbon fibre used to make energy efficient trams, trains, wind turbine blades, planes and cars; carbon based fertilisers that lower the emission profile of traditional fertilisers and require less chemical fertilisers to be applied to achieve the same yield; manufacture of wind and solar renewable energy technologies; iron and cement production; activated carbon for water and air pollution control; pharmaceuticals and foodstuffs; and liquid fuels.

Two significant emerging opportunities are the production of hydrogen to fuel the future hydrogen economy and graphene which is a high value, essential component of the existing and emerging battery technologies, and also a critical element for the new big data network underpinning traffic control and other large projects requiring carbon based sensor technology.

The majority of the new technologies being developed can be integrated with the new energy economy and if coupled with carbon capture, utilisation and storage may even provide negative emissions for the environment.

A sensible approach to using the brown coal resource could position Victoria as a world leader in carbon technologies and generate wealth from an estimated $1 Trillion natural resource asset (based on these alternative products). The Carbon Nexus hub in Geelong is an example of what can be achieved in this space and there is every reason to believe that this success can be replicated in the Latrobe Valley on a much larger scale.

This issue of Perspectives provides an insight into the significant work that is being undertaken to ensure that mine rehabilitation occurs in line with community expectations. The independent Latrobe Valley Mine Rehabilitation Commissioner is charged with leading and facilitating community and stakeholder engagement activities related to mine rehabilitation in the Latrobe Valley. The Commissioner is independent and will lead and coordinate planning and improvements to mine rehabilitation in the Latrobe Valley. He will also provide advice on the development of policy, legislation and regulation relating to mine rehabilitation in the Latrobe Valley.

The recent seminar on carbon to products was exceptionally successful with more than 150 people and 70 organisations represented on a day that saw some of the potential for the carbon resource in the Latrobe Region.

As always, I trust that you will find the articles in this issue of Perspectives of interest. If you have a story on the work you are doing, please get in contact - we are always interested to hear from those undertaking work on brown coal developments, whether in Australia or internationally.

LATROBE VALLEY BROWN COAL MINES: PLANNING FOR REHABILITATION AND CLOSURE

Background to the role and responsibilities of the Mine Rehabilitation Commissioner

By Professor Rae Mackay, Latrobe Valley Mine Rehabilitation Commissioner

Latrobe Valley Mine Rehabilitation Commissioner

The Commissioner's role is to monitor and assist the planning for rehabilitation of the existing mines and to engage and support the community and all stakeholders in contributing to the planning process to deliver strong outcomes for the region. The function was a key recommendation of the Hazelwood Mine Fire Inquiry (HMFI) in 2015.

Since the HMFI, planning for rehabilitation and closure of the three Latrobe Valley brown coal mines has gathered pace rapidly. All recommendations of the HMFI Board detailed in Volume 4 of their report were accepted by the Victorian Government and are embedded in the 2016 *Hazelwood Mine Fire Inquiry: Victorian Government Implementation Plan*.

In addition to creation of the legislation for the Latrobe Valley Mine Rehabilitation Commissioner, two key contributions to the early phases of the implementation plan were:

- establishment of the Latrobe Valley Regional Rehabilitation Strategy Project
- implementation of an Integrated Mines Research Group

The Latrobe Valley Regional Rehabilitation Strategy (LVRRS) project is a joint project between the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) and the Department of Environment, Land, Water and Planning (DELWP).

The LVRRS project team are tasked with assessing the feasibility of pit lake rehabilitation options for the mines. The Inquiry assessed pit lake based land forms to be the most viable for rehabilitation, although several knowledge gaps were identified by the Inquiry that required resolution before any conclusions about their appropriateness is reached and a rehabilitation strategy developed.

The Integrated Mines Research Group (IMRG) is a mine operator led initiative to collectively undertake studies and research to improve knowledge of rehabilitation and closure planning and to examine the technical basis for alternative rehabilitation options.

Hazelwood open cut brown coal mine

A step change in mine-based planning activity levels occurred with the decision by ENGIE to cease coal mining at the Hazelwood Open Cut at the end of March 2017. The end of mining at Hazelwood has increased the urgency of all investigations.

All parties are concerned with ensuring that the rehabilitated mines are safe, stable and sustainable. The community is further concerned with ensuring that the rehabilitated mines are accessible, productive and not a burden to the local economy.

The conditions that make opening and developing a brown coal mine relatively easy are exactly the conditions that make closing a mine hard. The material on top of the coal is thin and the coal seams are thick. The coal is light, soft, easily mined and transported to the adjacent power stations. While groundwater and surface waters have to be managed to ensure ground stability, the volumes of water pumped each year are relatively low and can be used productively. Hydrologically, evaporation exceeds rainfall for much of the time. Chemically, the issues of contamination and pollution are few. The high water content of the coal limits its thermal value but the power stations that use the majority of the coal have been designed to cope with this. However, this means that the coal required to produce each megawatt is much more than in a black coal station, hence the need to mine more on an annual basis to meet electricity demand.

All these factors have meant that the three mine pits are now very large by international standards (collectively greater than three billion cubic metres) with far too little overburden available locally to backfill the pits.

The pits cannot be left open without continuous surface water and groundwater management for stability and management of fire risks. Coal's low density makes it highly susceptible to movement on the interseam clays below the coal due to differential groundwater pressures. Exposed coal under the right conditions can be ignited spontaneously at depth and at surface by external ignition source as evidenced by the Hazelwood Mine fire.

The closeness of significant infrastructure, property and people to these mines demands complete control of stability and fire prevention. The proposals by all mines to implement pit lakes are based on these requirements. Using water to fill the mines improves stability, provides substantial fire protection and has the potential to create an attractive and valuable landscape.

Pit lakes do not come without their pitfalls. The water resources of the Latrobe Valley are good, but they are not great; rainfall is good but evaporation is high and the remaining water is largely allocated to other uses.

The water currently allocated to the power stations and the discharges of groundwater for the purposes of pit stability might be allowed to be used for pit lake filling, but this allocation alone may not allow for rapid filling. Requirements for long term management prior to closure and long times before repurposing of the mining area for beneficial uses may be necessary under these circumstances, but not desirable.

The LVRRS project is expected to provide answers to questions of water availability, use and impact on other users and the environment in the next two years. The LVRRS is also exploring the regional ground movements induced by mining and groundwater management on infrastructure.

Other questions addressed by the IMRG and various university research teams, including the Geotechnical and Hydrogeological Engineering Research Group at Federation University, consider:

- the covering of coal above the final pit lake water level
- the longevity of the drainage boreholes in the coal needed for long term stability
- pit lake water quality

Beyond these questions lie many others that also need answering prior to making decisions about the best way forward. Some of the questions will be answered soon, but many will require longer timeframes, in some cases, stretching over many years.

Four questions are often asked by the community.

1. ***Does rehabilitation and closure prevent future mining of brown coal?***
   The simple answer is no, mining can be restarted if appropriate coal use justifies further expansion of a mine. Also new mines can be opened in the future.

2. ***Why can't the mines be left empty and the land on the floor of the mine be used productively?***
   To leave a mine empty requires continual management of groundwater for stability and the management of fire risk. Both are possible, but there is a preference by many stakeholders, including the mine operators, to avoid leaving a permanent legacy of long-term management of the pits to future generations.

3. ***Will the lakes in the mines be usable and provide beneficial outcomes?***
   This question is still being examined but early indications are that the lake waters will be good enough for recreational use as well other water uses, including aquaculture and drought mitigation for the region's agriculture.

4. ***Are there other rehabilitation options being considered other than filling each of the pits with water?***
   The LVRRS and the IMRG are not directly exploring other options at the present time. However, if during the feasibility studies of the LVRRS it is identified that an alternative to filling the pits with water might be potentially viable then adjustments would likely need to be made to the future program of work to address such an option.

This snapshot of the current status of planning for rehabilitation and closure of the Latrobe Valley coal mines shows it has come a long way since 2015. However, it also indicates the magnitude of the investigations yet to be undertaken to ensure that the final rehabilitated land form and the land uses that follow are sustainable into the future.

As the studies and activities proceed they will be reported extensively and widely. All community members and stakeholders are encouraged to be engaged at all stages and to contribute now to the major changes that face the Valley in the next 50 years.

Further information and links to other stakeholder websites are available at: www.lvmrc.vic.gov.au

CO_2-FREE HYDROGEN PRODUCTION FROM BROWN COAL FOR THE JAPANESE MARKET

The coming "hydrogen society" in Japan

By Hirofumi Kawazoe, Assistant Manager, Hydrogen Energy Chain Promotion Section 2
Kawasaki Heavy Industries

Kawasaki
Powering your potential

The transition to a new energy economy is a vast and challenging task and requires the commitment and vision of a nation. Japan has this challenge in the wake of the significant environmental and economic requirements of the 21st century.

The Great East Japan Earthquake of 2011 triggered profound changes in Japan. In the aftermath of the huge tsunami and the resulting Fukushima nuclear accident, a fundamental re-evaluation of Japan's energy strategy was required. It was necessary to develop a new energy policy that ensured stable energy supply while reducing greenhouse gas emissions overall. One of the solutions proposed by the Ministry of Economy, Trade and Industry (METI), in its '*Strategic Energy Plan'* of 2014, was to introduce measures to efficiently convert available energy into electricity and heat, which it considered could best be achieved through a transition to a "hydrogen society" in Japan.

In a hydrogen society, hydrogen fuel cells replace conventional solutions to produce electricity and heat, and would be used to power vehicles as well. Since the only waste product from hydrogen fuel cells is water, development of the hydrogen society will help Japan meet its greenhouse gas reduction targets. Hydrogen is 'energy dense' and is seen as an ideal supplement to traditional renewable energy sources.

In December 2017, the Government of Japan released its Basic Hydrogen Strategy, which provides a roadmap for the development of the hydrogen society.

The roadmap indicates that three sources of hydrogen will be used over time:

a) Fossil fuel derived hydrogen (Industrial by-product, steam methane reforming) from the present time through the 2030s, with a global hydrogen supply chain established during the 2030s;

b) Establishment of hydrogen production technology from renewables in Japan during the 2030s; and

c) Utilisation of CO_2-free hydrogen (brown coal with carbon capture and storage, renewables) post-2030s.

The Government of Japan has forecast that the hydrogen society will contribute more than one trillion yen (AU$11 billion) annually to its economy by 2030 and 8 trillion yen by 2050. It is aiming for 5.3 million households, or roughly one in 10, to have hydrogen fuel cells by 2030, both in households and in vehicles. Toyota and Honda already produce hydrogen fuel cell cars, and there are plans to have some 40,000 fuel cell vehicles in operation by 2020, increasing to 800,000 by 2030. It is anticipated that the number of refuelling stations will increase from about 80 in 2016 to 160 by 2020. The Japanese market for hydrogen is anticipated to be 4,000 tonnes in 2020 rising to 300,000 tonnes in 2030, and 10 million tonnes p.a. or more beyond that. This will create an international market for low cost CO_2-free hydrogen.

THE HYDROGEN ENERGY SUPPLY CHAIN PROJECT

Kawasaki Heavy Industries, Ltd (KHI) is taking a leading role in development of the supply chain needed to bring affordable CO_2-free hydrogen to Japan. It is working with private sector consortium partners in Japan and Australia, with the Commonwealth and Victorian Governments and with Japanese Government, to progress the planning of its Hydrogen Energy Supply Chain (HESC) Project.

While still in the early stages of planning and development, the HESC project will see reputable and highly experienced Japanese and Australian companies collaborating and co-investing in the development of a new and exciting energy technology.

While still subject to various negotiations and rigorous approvals, the Australian components of a pilot supply chain would include (1) the conversion of brown coal to hydrogen gas in the Latrobe Valley, (2) the liquefaction of the gas in the Port of Hastings area and (3) storage and loading of the liquefied hydrogen onto a special-purpose built carrier for shipping to Japan. [*1]

The HESC Project team must first prove that the integration of these various hydrogen supply chain elements can be successfully demonstrated before moving on to a larger commercial-scale operation.

The HESC Project has the potential to create a world-first innovative hydrogen energy supply chain to produce hydrogen from brown coal in the Latrobe Valley for export to Japan – this is an exciting opportunity for Victoria and Japan to partner for mutual benefit and to work towards creating an environmentally sustainable energy solution.

To date, the HESC project team has completed the Front End Engineering and Design work and is liaising with the relevant parties to establish a successful pathway for the project. Carbon Capture and Storage technologies are critical to the future of the Hydrogen Energy Supply Chain and are being investigated with local experts.

KHI is committed to working with local communities and integrating environmental, safety and social considerations from the outset and for the long-term. It has undertaken to release project details throughout 2018 for consideration and consultation.

To support the HESC Project, KHI is undertaking complementary project activities in Japan. In partnership with the Kobe city government, KHI is building Japan's first facility to store and supply hydrogen on land near Kobe Airport. KHI will install its proprietary offloading technology and storage tanks, establishing a base for importing low-cost hydrogen. This facility is expected to be operational in 2020-21.

In addition, KHI has developed a 1,000kW turbine-driven power plant for operation with hydrogen. The first unit has been installed in Kobe and is currently being tested with mixtures of hydrogen and natural gas, to identify the most efficient fuel blend. This facility is the first in the world to produce electricity from hydrogen power generation to users in an urban area. [*2]

BENEFITS OF THE HYDROGEN SOCIETY

Japan's Prime Minister Shinzo Abe is a strong supporter of the hydrogen society, and has discussed the Hydrogen Energy Supply Chain concept with Australia's Prime Minister, Malcolm Turnbull, on two occasions. Both Prime Ministers expressed support for hydrogen cooperation and a hydrogen supply chain in both the Memorandum of Cooperation on Innovation and the Joint Meeting Outcomes, following PM Abe's visit to Australia in January 2017. In January of 2018, both leaders met in Tokyo for the annual Japan-Australia summit meeting. In a joint press statement, Prime Ministers Abe and Turnbull expressed support for ongoing collaboration.

The hydrogen society will have benefits for both Japan and Australia. It will allow Japan to diversify its energy resource base while meeting its greenhouse gas reduction targets. By actively pursuing this opportunity, Japan is rapidly becoming the world's leading fuel cell market and leader in hydrogen transmission infrastructure. This will lead to the creation of new products and new export opportunities.

Only certain countries – like Australia – have the capacity to produce large amounts of hydrogen. Australia's large brown coal reserves, such as those in Victoria's Latrobe Valley, have the potential to create a new hydrogen export industry. As well, installation of CO_2 storage infrastructure will be a catalyst for development of new low-emissions industries in the Latrobe Valley. New hydrogen fuel cell technologies will be available for use in Australia, allowing efficient electricity production and low-emissions transport. As in Japan, hydrogen fuel cell technology could play a vital role in reducing national greenhouse gas emissions.

KHI, in conjunction with its partners in Japan and Australia, is turning the vision of a hydrogen society into a practical and economic opportunity for both countries that will make a significant contribution to reducing greenhouse gases globally.

**1 Brown coal gasification, liquefied hydrogen carrier and unloading base in Japan in a pilot supply chain are subsidized by NEDO (New Energy and Industrial Technology Development Organisation), Japanese Governmental Organisation.*

**2 The 1,000kW turbine-driven power plant in Kobe is subsidized by NEDO.*

RESEARCH PROJECT UPDATE

New insights into the impact of fly ash on CO_2 capture system degradation

By Rahul Reza Chowdhury, PhD Student, Carbon Technology Research Centre
Federation University

Rahul Reza Chowdhury joined the Carbon Technology Research Centre in March 2015 as a PhD student. Before joining CTRC, he had a diverse research experience in the field of Solid Oxide Fuel Cell and Particle-laden flow. His PhD project focuses on heterogeneous reactions in amine absorbents during Post-combustion capture of CO_2. This article follows on from initial findings published in the February 2017 issue of Perspectives.

Post combustion capture (PCC) of CO_2 remains a key strategy for mitigating greenhouse gas emissions. Scrubbing flue-gas from coal combustion with aqueous amines is the most mature technology and used locally in the PICA project at AGL Loy Yang in Victoria.

Coal-fired power stations in the Latrobe Valley use electrostatic precipitators to remove fly ash from flue gases, but are typically only 95% effective. There is a concern that fugitive ultrafine fly ash will contaminate any amine solvents used for PCC, potentially leading to reduced solvent life and increased operating expenses. Solvent degradation is linked to fly ash contamination in PCC plants overseas but has not yet been investigated in Australia. Brown coal fly ash is very different in its properties and composition to those from black coals and my project is investigating how these differences might impact on amine degradation.

Brown coal fly ash comprises soluble salts, amorphous inorganic materials, char, quartz and other minerals in various ratios depending on coal feed and boiler operation. This article investigates the impact of fly ash (as received) and its individual components on the degradation of a model amine solvent (5M MonoEthanolAmine, MEA) under accelerated oxidative PCC conditions (120°C, 0.1 mol oxygen, 0.1 mol CO2, 1.25 mol MEA, 175 g water and 250 mg of an ash fraction) using 500 mL pressure reaction vessels.

To separate fly ash into individual components, fly ash was obtained from AGL Loy Yang and leached with 30% MEA or 10% hydrochloric acid solutions. A subsample of the acid insoluble ash components was then heat-treated to remove unburnt carbon. These processes yielded three solid ash fractions:

1. MEA insoluble minerals and inorganics
2. acid insoluble minerals and inorganics
3. char-free acid insoluble minerals and inorganics.

To represent the char fraction, fine char was collected from AGL power station's ash system and screened to <212µm. Light-microscope images of these ash fractions presented in Figure 1 confirms that the fine char fraction was similar in size and morphology to the char present in the parent (as received) fly ash. Figure 1 also shows that the heat treatment was effective at removing unburnt char from the acid-leached ash.

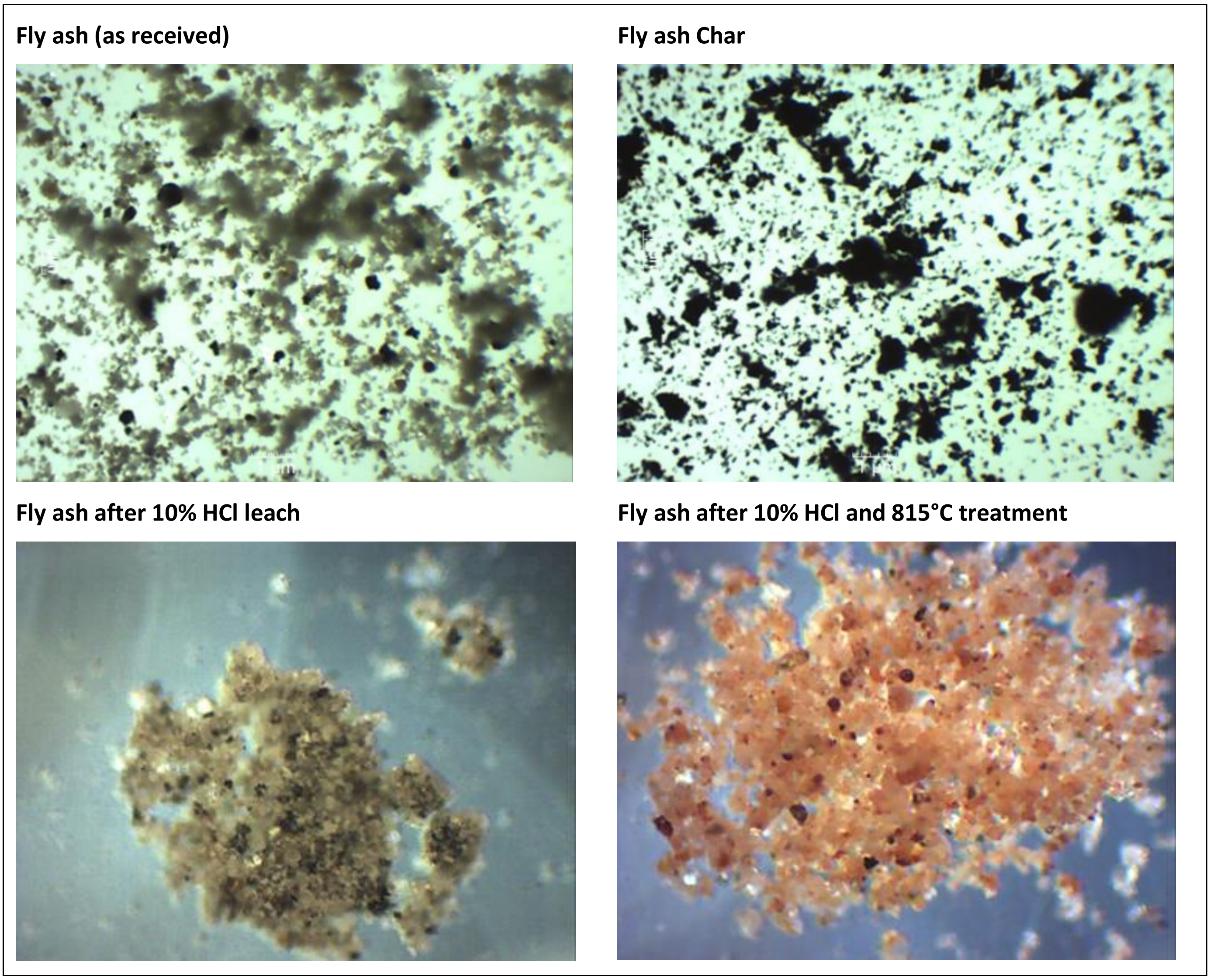

Figure 1: Light microscopy revealing the differences in colour and texture between the parent fly ash and its main fractions - pieces of char are identified by orange circles.

MEA degradation in the pressure vessels was monitored both visually and using UV-vis spectroscopy over a 4-day period; the darkening colour (from initial pale-straw color to a dark orange-brown) in Figure 2 clearly shows increasing degradation of MEA in the absence of any ash fraction. Importantly, the rate and severity of MEA oxidation (confirmed by production of organic acids) is influenced by the addition of ash fractions. Absorption spectrographic data for the time-course of the degradation reactions are shown in Figure 3.

Contact time series				**Solid Fly Ash Additive**
Day 1	Day 2	Day 3	Day 4	
				No additives
				Untreated ash (as received)
				Ash leached by MEA
				Ash leached by 10% HCl
				Ash leached by 10% HCl and heat treated at 815°C for 12 hours
				Char

Figure 2: Photos illustrating the progressive increase in MEA colour during 4-day accelerated degradation reactions (0.1 mol oxygen, 0.1 mol CO2, 250 g 5M MEA and 120°C) in presence of various fly ash components

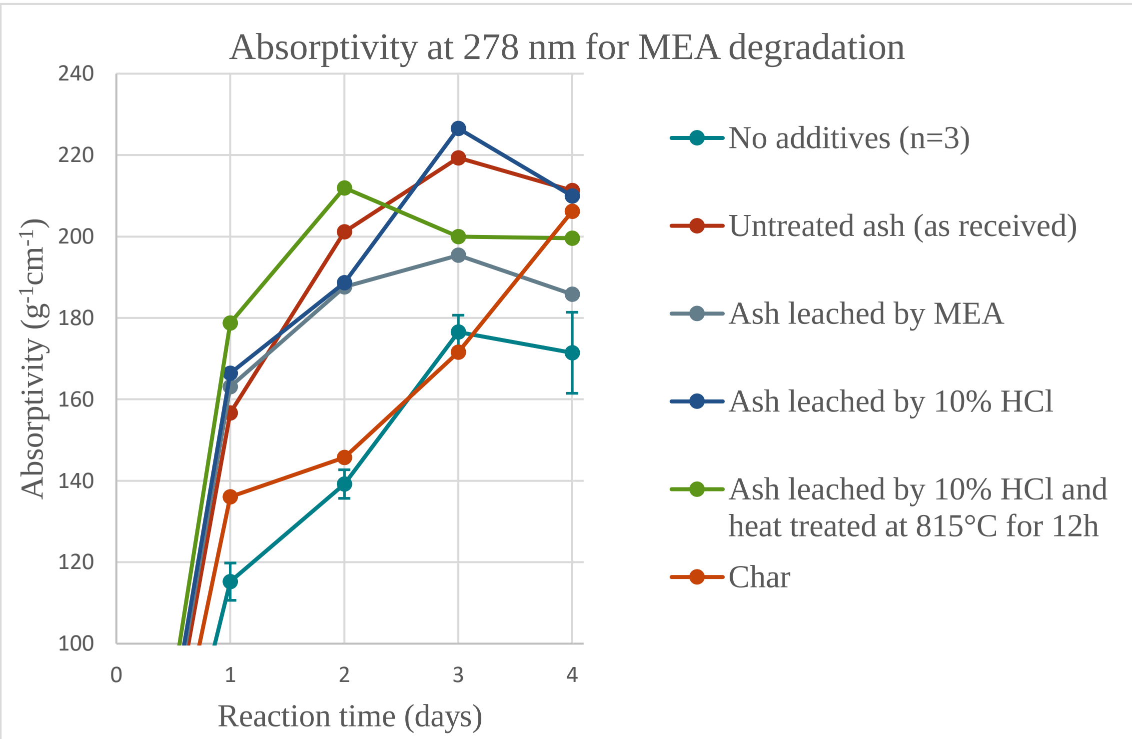

Figure 3: Changes in UV-vis absorptivity (278nm) of the MEA solution during 4-day accelerated degradation reactions (0.1 mol oxygen, 0.1 mol CO2, 250 g 5M MEA and 120°C) in presence of various fly ash components. Error bars represent one mean deviation of triplicate experiments.

Triplicate reactions with no additives (MEA baseline) show that the reaction system yields repeatable results, with 2-6 relative percent difference (RPD) for each data point. Figure 3 reveals the expected overall increase in MEA degradation with contact time. The char and baseline (no additive) experiments typically produced consistent degradation rates over the first three days (Figure 3) whilst ash (with or without pre-treatment) significantly increased degradation rates ($p<0.05$ for each of the four days, assuming unequal variance).

The reaction conditions were chosen to facilitate sampling during active MEA degradation on days 1 and 2, while allowing the reaction to approach equilibrium on days 3 and 4. These two reaction zones are clearly evident in Figure 3, particularly for the baseline case (no additive). Although the degradation of MEA in the presence of char appears to continue beyond the 4-day period of this study, this will be confirmed with more targeted analysis. Surprisingly, the MEA degradation in the presence of fly ash (with or without pre-treatment) reached equilibrium much more rapidly than any other condition.

The severity of MEA degradation at equilibrium increased by approximately 25% by the addition of untreated ash or ash leached by HCl and 10-15% by the addition of ash leached with MEA or ash that had been leached by HCl and heat-treated.

The close agreement of MEA degradation in the presence of ash with and without acid extraction is strong evidence that fly ash components that are insoluble under laboratory conditions have a significant and important impact on MEA degradation. Further information about the impact of insoluble fly ash components on MEA degradation (including the quantitative measurement of MEA degradation products and solubilisation of ash during the MEA oxidation reactions) will soon be available.

These results demonstrate that acid insoluble, heat-stable minerals present in fly ash from brown coal play an important role in oxidative degradation of MEA. This implies that there will be a need for deep ash particulate removal from flue gases prior to capture of CO2 by amines in new low-emission industrial processes utilising Victorian brown coal.

SPOTLIGHT ON BCIA

Carbon to Products Seminar – *pathway to a sustainable future*

BCIA and Federation University hosted a public seminar on "Carbon to Products" on 7 February in the Latrobe Valley. The event was exceptionally well attended with 155 delegates from more than 70 companies and organisations representing the renewable energy sector, industry, research and community organisations from across the Latrobe Valley and further afield, including Japan and the USA.

The seminar was opened with a keynote address from Prof. Leigh Sullivan, Deputy Vice-Chancellor (Research and Innovation), Federation University. Guest speakers were leaders in their fields with Prof. Robin Batterham, Kernot Professor of Engineering, University of Melbourne; Prof. Bronwyn Fox, Swinburne University of Technology; and Mike Holmes, Vice President R&D, Lignite Energy Council in the US, only some of the superb presenters on the day.

Above: Mike Holmes from Lignite Energy Council talks about additional value opportunites for lignite

The topics covered included but were not limited to:

- The utilisation of carbon in the agri sector space, brown coal in particular
- Research on hydrogen production from brown coal and renewable resources
- High value products from Victorian brown coal
- Next generation carbon based materials
- Can Carbon Capture and Storage work for the Latrobe Valley?
- The Hydrogen Potential
- Progress in CO_2 capture and utilisation - a Latrobe Valley perspective
- Pyrolysis – A sustainable option for Victorian Brown Coal

The agenda and presentations are available on BCIA's website https://www.bcinnovation.com.au

The day was structured to demonstrate developments in the research sector and also what was happening in the commercial space. Of particular note was the level of engagement by the audience with keen questioning of the speakers about what the opportunities were for carbon to products other than electricity. The picture that emerged was that there is a significant opportunity for the Latrobe Region in developing low emission, multi-faceted carbon based industries. It will take commitment at all levels of society – local, state and federal for it to be realised, however if the energy and interest displayed on the day is any indication the potential is certainly there.

A panel session including representatives from the community, renewable energy sector, industry, media, local government and the research sector was held at the end of the day. The number of people who stayed right until the end showed the measure of interest.

Above (Panel from left): Regional Development Australia chair Richard Elkington, Australian Paper general manager corporate development David Jettner, Latrobe City Council mayor Darrell White, Swinburne University of Technology director, manufacturing futures Research Institute Prof. Bronwyn Fox, Gippsland Solar managing director Andrew McCarthy and the then Committee for Gippsland chief executive officer Mary Aldred discussed what needs to be done to develop a new carbon economy for the LV.

The challenge moving forward is to turn this potential into real projects and this will be the focus of industry and the research sector over the coming period. BCIA and Federation University are collaborating on a proposal to develop a Carbon Innovation Centre that will enable industry and researchers to scale projects developed in the laboratory at a much lower amount than if undertaken on a standalone basis. If successful, this will lead to lower costs to industry to bring new technologies to market. It is expected that the feasibility study for this initiative will commence soon.

We would like to thank CO2CRC, Regional Development Australia and Latrobe City Council who supported this event.

Advantages of a BCIA Membership

BCIA is committed to driving a low-emissions future for Australia's world-class brown coal resource. Being a member-based organisation, BCIA facilitates stakeholders to actively participate in the acceleration of technologies for emissions reduction and the development of high-value products derived from brown coal.

BCIA MEMBER
Positioning brown coal for a low-emissions future

BCIA members encompass a broad range of stakeholders within industry, government, research and education, and international coal technology organisations, who are involved in the conversion of brown coal to value-added products and services operating in the brown coal sector.

BCIA membership enables stakeholders to work with like–minded organisations to drive the future of the brown coal sector through active participation in BCIA skills, networking and R&D programs to ensure brown coal is heading for a sustainable future.

BCIA has rapidly established a reputation for our authority as a trusted source of independent research information and analysis, significant investments in world-class R&D and leadership in skills development and innovation.

For more information about BCIA membership please visit bcinnovation.com.au/Membership. If you are interested in becoming a BCIA member, call us on +61 3 9653 9601 or email info@bcinnovation.com.au.

Key benefits of a BCIA membership

- **Commissioned research reports** including intelligence gathering and in-depth analysis of global activities and R&D on the sustainable use of brown coal.
- **Research reports and symposiums** with the ability to inform and identify focus areas for BCIA sponsored PhD projects.
- **Seminars and published reports** on BCIA's extensive research program including development and demonstration projects.
- **Access to a wide-ranging expertise** in government, industry and research and development with assistance and strong advocacy from BCIA at all levels, including access to our MEMBERS only web portal.
- **Establish linkages with ANLEC R&D, CO2CRC** – via BCIA – and other key stakeholder organisations in the brown coal and innovation sectors.
- **Participation in BCIA's skills development activities**, international linkages and networks and community forums.
- **Recognition of each member** organisation's commitment to a low-emissions future for brown coal with opportunity to promote member organisations through the BCIA newsletter *Perspectives* and website.
- **BCIA support** with management of your research programs - saving you on administrative and legal costs associated with contract/research management.
- **Leverage research** with funds from the State and Commonwealth where possible, often resulting in costs for individual research programs being less than half if undertaken independently.
- **Collaboration** (at your discretion) with other members on areas of joint interest.
- **An arm's-length industry voice** to raise areas of interest in the public and government forums

Brown Coal Innovation Australia current 2018 Members

SPOTLIGHT ON BCIA MEMBER

Lignite Energy Council

Lignite Energy Council's primary objective is to maintain a viable regional lignite coal industry and enhance development of America's lignite coal resources for use in generating electricity, synthetic natural gas and valuable byproducts.

Based in North Dakota, members of the Lignite Energy Council include mining companies, major users that use lignite to generate electricity, synthetic natural gas and other valuable byproducts, and businesses that provide goods and services to the lignite industry.

At the heart of the Lignite Energy Council's efforts are programs covering four separate areas:

- Government action
- Research & Development
- Education
- Public Relations & Marketing

Through these programs, the Council provides timely, accurate information that enables elected officials, government leaders and the public to make sound, informed decisions on lignite issues.

The R&D program is a joint venture between industry and the State of North Dakota. The program helps maintain jobs, increase economic activity and tax revenue to the state and local government entities. As regulations are implemented to reduce emissions from existing power plants, research and development activities that lead to new novel technologies become increasingly important.

For more information, please visit www.lignite.com

CALENDAR OF EVENTS

16 – 17 May 2018
CO2 Reuse Summit
Location: Zurich, Switzerland
The CO2 Reuse Summit will bring together major stakeholders from the industry to highlight latest developments related to carbon utilization. It will look at key challenges and opportunities when it comes to technology, economics or policy. The Summit involves two days of interactive presentations, case studies and networking sessions.
For further details visit: https://reuseco2.com/

17 – 18 May 2018
ICCCTCPPC 2018 : 20th International Conference on Clean Coal Technologies, Coal Pollution and Pollutant Control
Location: Paris, France
This conference aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Clean Coal Technologies, Coal Pollution and Pollutant Control. It also provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Clean Coal Technologies, Coal Pollution and Pollutant Control.
For further details visit: https://waset.org/conference/2018/05/paris/ICCCTCPPC

3 – 8 June 2018
Clearwater Clean Energy Conference
Location: Clearwater Beach, USA
This conference is a must for those involved in all aspects of power generation who must meet the competitive pressures and environmental concerns in the 21st century. Through the Technical Sessions, Short Courses, and Panels, cutting-edge developments dealing with technical solutions to problems; specific strategies; projects; innovations; industry trends; and/or regulatory compliance will be offered.
For further details visit: http://clearwatercleanenergyconference.com/322-2/

12 – 14 September 2018
2017 Mid-Atlantic Biomass Energy Conference and Expo
Location: Philadelphia, USA
Organised by the Mid-Atlantic Bioenergy Council (MABEC), this event will showcase multiple program tracks, an expo floor, and networking opportunities that make MABEX a popular and growing event for industry, government, and the general public to expand their knowledge and opportunities in the bioenergy sectors.
For further details visit: http://www.mabex.org/

3 – 4 October 2018

All-Energy Australia Exhibition & Conference 2018

Location: Melbourne Convention & Exhibition Centre

All-Energy Australia is Australia's biggest and highest quality clean and renewable energy conference. Free to attend, the conference features over 200 industry speakers across 7 session streams over two days.

For further details visit: http://www.all-energy.com.au/conference/

15 – 18 October 2018

The 35th Annual Pittsburgh Coal Conference 2018

Location: Xuzhou, Jiangsu Province, China

By providing an open forum for discussion, The International Pittsburgh Coal Conference wishes to promote research activities that advance the economic benefits of coal technologies while greatly reducing their environmental impact. Sessions for this conference include Gasification Technologies, Clean Coal Demonstration and Commercial Projects, Combustion Technologies, Clean Coal and Gas to Fuels, Carbon Management, Coal Science, Coal Mining, Coal Bed and Shale Gas, Power Plants, Sustainability and Environment, Rare Earth Elements (REE) in Fossil Fuel Derived Solids and Liquids, Coal Ash Management and Value-Added Products from Coal.

For further details visit: http://www.engineering.pitt.edu/Sub-Sites/Conferences/PCC/_Library/2018-Conference-Docs/2018-Conference/

15 – 16 November 2018

6th World Clean Coal Conference

Location: Beijing, China

With the dual streams focusing on "Coal to Fine Chemical" and "Wastewater Treatment & Automation", crafted sessions would be set to decode initiative and regulation trends, identify the best solutions for coal clean utilization and accelerate modern coal chemical development.

For further details visit: http://china.worldcleancoal.org/