

PEOPLE AND  
PROJECTS  
REPORT 2013

**ACARP**

The Australian Coal Association Research Program (ACARP) was established in 1992 through a Memorandum of Understanding between the Australian Coal Association Executive and the Federal Government. It is funded by a levy of 5 cents per tonne of product coal paid by all Australian black coal producers, who voluntarily cooperate to develop technologies and solutions that help meet their obligations to the community, while maintaining the industry's position as

a world leader in a highly competitive global market. This cooperation allows producers to combine their expertise and resources and share both the risks and the benefits to the industry as a whole.

Sustainable production of coal on all levels has been embraced as a core business value by Australian coal companies. Major regional issues such as water resource management and impact of noise and dust on local

communities are all of primary importance, as are safety and productivity in all aspects of mine site operation.

This publication documents how the ACARP industry levy has been invested during 2013 to assist the Australian coal industry develop and adopt world leading sustainable mining practices through collaboration.



Open Cut Committee Proposal Selection meeting

PEOPLE

The people listed through this report fall into 3 categories.

Firstly, those who are undertaking the project (the Researchers).

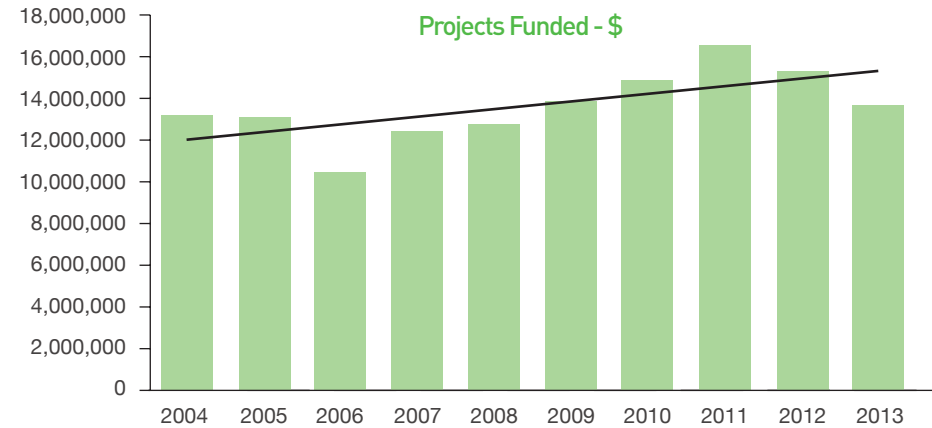
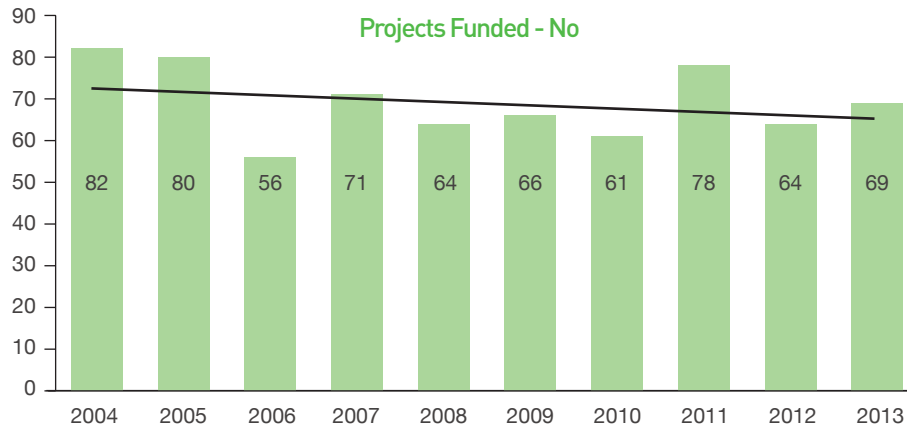
Secondly, those who recommend the project be funded, being the industry members of the 5 technical committees. The accompanying graph highlights the increasing involvement of committee members over the past decade.

Thirdly, one or more industry representatives who are appointed to act as Industry Monitors for each project. The Monitors are charged with providing technical guidance and ensuring any advances are actioned across the whole industry.



PROJECTS

This report highlights all the projects that were current during 2013 together with the new series of projects that is about to start. The overview summarises the challenges being addressed and the approach being taken. The general increase in project funding highlighted in the following graphs maintains real value when discounted for inflation.



# ACARP PEOPLE AND PROJECTS

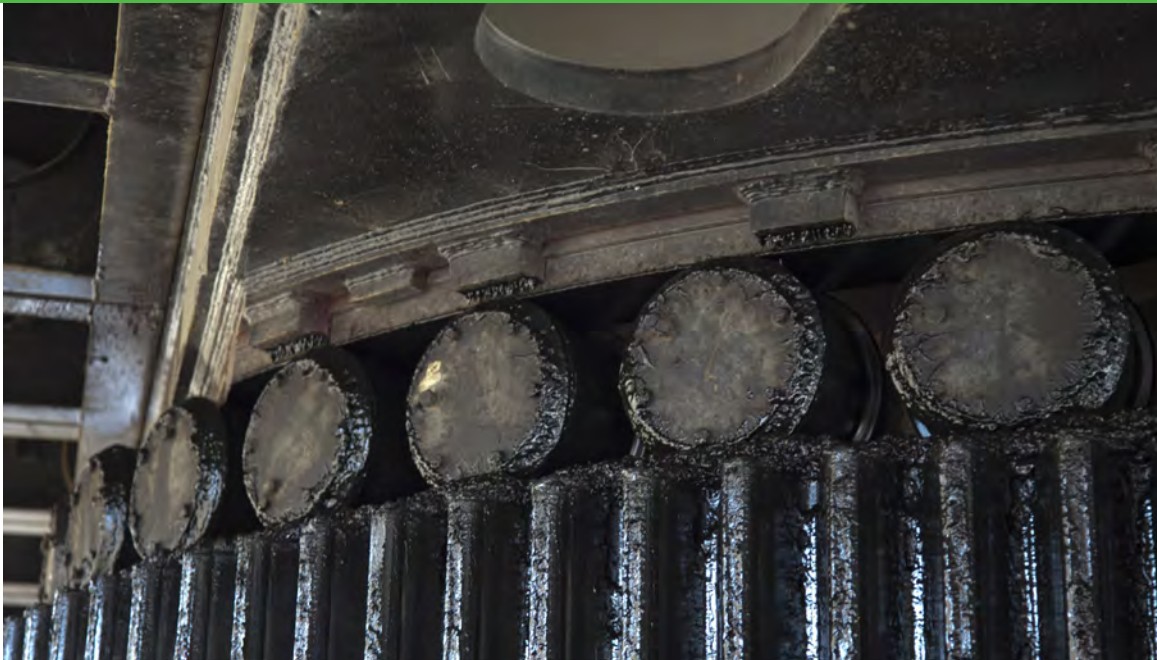
## FUNDING APPROVED 2013

The resultant leverage = Total funding ÷ ACARP Funding = 1.93 times

Category	No of Projects	ACARP Funding	Total Funding
Major Projects	1	\$485,000	\$740,500
Underground	20	\$4,780,342	\$10,524,373
Open Cut	18	\$4,320,731	\$7,634,739
Coal Preparation	14	\$1,973,450	\$4,247,096
Technical Market Support	12	\$1,409,979	\$1,969,933
Mine Site Greenhouse Mitigation	4	\$687,516	\$1,207,512
	<b>69</b>	<b>\$13,725,867</b>	<b>\$26,465,492</b>

## PROJECTS UNDER MANAGEMENT 2013

Category	No of Projects	ACARP Funding
Major Projects	1	\$3,594,733
Underground	63	\$22,945,292
Open Cut	57	\$19,226,096
Coal Preparation	30	\$6,628,282
Technical Market Support	23	\$4,819,015
Mine Site Greenhouse Mitigation	9	\$2,771,536
Scholarships	7	\$2,165,000
	<b>190</b>	<b>\$62,149,954</b>



This category has been established to capture larger projects that are likely to impact on a number of technical areas of the industry.

**FUNDING APPROVED 2013**

Year	No of Projects	ACARP Funding	Total Funding
2013	1	\$485,000	\$710,500
2012	2	\$2,198,140	\$2,723,140
2011	1	\$1,215,000	\$1,615,000

**PROJECTS UNDER MANAGEMENT 2013**

Category	No of Projects	ACARP Funding
Major Project	1	\$3,594,733

PROJECT RESEARCHER

ACARP FUNDING

INDUSTRY MONITORS

OVERVIEW

**MAJOR PROJECT APPROVAL AND UNDER MANAGEMENT 2013**

**RISKGATE C20003**

University of Queensland  
Philipp Kirsch

485,000  
New

3,594,733  
Existing

Occupational Health and Safety  
Task Group

Tony Egan, Glencore

RISKGATE is an online body of knowledge built by the Minerals Industry Safety and Health Centre (MISHC) using coal industry expertise – thousands of hours of mining professionals’ input collected during a series of guided workshops. It is designed to help coal industry personnel understand and control selected major incidents and connects them to information about event-specific controls. It will help them find gaps in their own controls based on systematic consideration of incidents, including their causes and consequences. RISKGATE currently provides information about 11 high-consequence risk areas across coal mining operations: tyres; isolation; collisions; strata control; ground control; fires; explosives (underground); explosives (open cut); explosions; manual tasks; and trips, slips and falls. An additional six topics – hazardous chemicals, outburst, coal burst and bumps, interface (controls and displays), tailings dams and inrush – will be completed in 2013. The 2014 funding will expand RISKGATE to cover fitness for work controls, and will address drugs (legal and illegal), alcohol, fatigue, physical wellbeing and psychological wellbeing.

### COMMITTEE MEMBERS

The primary goal of the underground research program is to achieve a sustainable record of zero fatalities. This is reflected in the occupational health and safety program; strengthening ventilation and gas management technology, minimising risks from fires and explosions, advancing emergency response technologies and addressing workplace health risks.

The second goal is to assist operators to adopt new and innovative technologies that offer lower operating costs, along with improved exploration methods and better management of the risks associated with ground control. A major focus remains the industry's determination to improve roadway driage rates.

The environmental impacts of mining must be minimised and managed to the satisfaction of the community. Priorities include discharge management and improved reliability of subsidence predictions. The program recognises the importance of continuous improvement in this area to ensure the coal industry maintains broad community support.

<b>Brad Elvy</b>	Manager of Projects and Studies (Co Chair, Underground Committee)	BHP Billiton Illawarra Coal
<b>Jim Sandford</b>	Project Manager, Coal Assets Australia (Co Chair, Underground Committee)	Glencore
<b>Gary Brassington</b>	Manager Approvals	BHP Billiton Illawarra Coal
<b>Greg Briggs</b>	Group Engineering & Supply Manager	Centennial Coal
<b>Peter Brisbane</b>	General Manager Technical Services	Bandanna Energy
<b>Steve Burgess</b>	General Manager Projects and Engineering	Centennial Coal
<b>John Grieves</b>	Project Manager – Minyango	Caledon
<b>John Hempenstall</b>	Chief Risk Officer	Centennial Coal
<b>Mick Kelly</b>	Senior Manager - Directional Studies	BMA
<b>Bernie Kirsch</b>	Regional Environmental Manager West	Centennial Coal
<b>Brad Lucke</b>	Senior Electrical Engineer	Glencore
<b>Adrian Moodie</b>	Technical Services Manager	Austar Coal
<b>Paul O'Grady</b>	Group Manager - Technical Services (North)	Glencore
<b>Dan Payne</b>	Manager Geotechnical Services	BMA
<b>Richard Porteous</b>	Manager Projects	Glencore
<b>Peter Smith</b>	General Manager HSEC	Centennial Coal
<b>Trevor Stay</b>	General Manager Gas & Carbon	Anglo American Metallurgical Coal
<b>Russell Uhr</b>	Manager - Kestrel North Underground Operations	Rio Tinto
<b>Geoff Watson</b>	Study Manager – Underground	Peabody Energy Australia
<b>Andy Willson</b>	Regional Manager, Resource Assessment	Anglo American Metallurgical Coal

## FUNDING APPROVED 2013

Year	No of Projects	ACARP Funding	Total Funding
2013	20	\$4,780,342	\$10,524,373
2012	23	\$5,682,364	\$9,276,683
2011	26	\$5,180,421	\$7,754,483

## PROJECTS UNDER MANAGEMENT 2013

Category	No of Projects	ACARP Funding
Detection and Prevention of Fires and Explosions	8	\$4,450,053
Environment - Subsidence and Mine Water	5	\$1,271,371
Exploration	5	\$1,243,847
Maintenance	4	\$1,892,370
Mining Technology and Production	11	\$2,703,692
Occupational Health and Safety	6	\$1,433,452
Roadway Development	7	\$5,872,157
Strata Control and Windblasts	9	\$1,845,020
Ventilation, Gas Drainage and Monitoring	8	\$2,233,330



PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECT APPROVALS 2013</b>			
<b>Detection and Prevention of Fires and Explosions</b>			
<b>Underground Environmental and Physical Effects of the Inertisation Process used for Managing an Outbreak of Heating, Fire or Explosion C23006</b> Simtars Martin Watkinson Tilman Rasche	191,303	Geoff Watson, Peabody Energy Australia Russell Uhr, Rio Tinto	During their operational and seal up phases, mined out areas in underground coal mines are routinely actively inertised to render the mines safe against risks of spontaneous combustion, methane ignitions and/or explosions. GAG inertisation is one method. However, there has been no known research on the effects of the GAG inertisation on the underground mine atmosphere, the equipment or strata within the mine. This project will study the efficiency, applicability and effects of the high volume GAG inertisation product and approach in an underground coal mining environment, under real conditions. The Queensland Mine Rescue Service's GAG unit and Simtars' mobile laboratory will be used to monitor gas distribution underground at Kestrel mine in Central Queensland as well as other atmospheric indicators such as pressure differential, temperature and humidity.
<b>Exploration</b>			
<b>In-seam Wireless Drill String Communications System C21019</b> CRCMining Eddie Prochon	50,000 New	Brad Elvy, BHP Billiton Illawarra Coal	The Mecca system is generally used in underground in-seam drilling for communications and directional drill control. However this system is very expensive, non retrievable and does not enable geological wireline tools to be pumped down the inside. In this project CRCMining are building on successful past work to develop an alternate technology. The project is further developing an electro magnetic telemetry system called in-seam wireless drill string to facilitate real time bidirectional telemetry between the drill and the bottom hole assembly. The technology will provide a wireless data rate of 1000 bits per second, thereby enabling transmission of high resolution navigation data, drill control messages and geosensing data in real time.
Eddie Prochon	212,400 Existing	Peter Brisbane, Bandanna Energy Jim Sandford, Glencore	
<b>Coal Quality From Geophysical Logs for Enhanced Resource Estimation C23015</b> CSIRO Binzhong Zhou	225,240	Barry Lay, BMA Patrick Tyrrell, New Hope Group	Coal quality parameters such as ash content, density, volatile matter and insitu moisture are important to the coal mining industry from mine planning, design, extraction and beneficiation through to utilisation. These parameters are traditionally obtained through laboratory analysis of drill core samples. This process is expensive and time consuming. This project will deliver a new methodology prototype software for deriving coal quality parameters through analysis of routinely acquired wireline data and documented trials of conventional and advanced statistical methods for improved parameter correlation and estimation.
<b>Maintenance</b>			
<b>Big Tyre: Non Pneumatic Non Solid Wheel C18020</b> Big Tyre Bruce Louden	135,000 New	Barry Moore, Centennial Coal Keith Cardew, Peabody Energy Australia	In a number of applications the coal industry utilizes solid tyres, however they come with some negative OH&S impacts. This project will develop a non-pneumatic wheel specifically designed for underground mining that will overcome a range of inherent disadvantages associated with pneumatic tyres, foam-filled tyres, and solid wheels. The research contractor has committed to develop and supply underground mines with the first production wheels - meeting or exceeding load and torque capacities of comparable tyres, with the following beneficial outcomes over conventional tyres and wheels: improved safety, improved productivity and reduced machine maintenance costs.
Bruce Louden	420,000 Existing	John Corben, Glencore	
<b>Use of Plastic Metal in Underground Coal Mines for Minor Repair on Flameproof Equipment C23005</b> Simtars David Turner	81,715	Mark Spinks, Anglo American Metallurgical Coal Mark Lydon, Glencore	Repairing flameproof equipment insitu underground presents a safety hazard. This project aims to provide a solution that eliminates the need to weld underground and maintains a safe mine without compromising production. The project will assess a range of 'plastic' metals and will provide an independent report into the appropriate use of these plastic metals on certified flameproof equipment. The aim is not to replace welding altogether, as the certified equipment must be maintained as per OEM specification, but to provide a safer option for an interim repair.



PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECT APPROVALS 2013</b>			
<b>Fatigue Life Determination of DN20 D-section 420 Stainless Steel Staples C23011</b> BMT WBM Russell Smith	55,000	Trevor Hartley, Centennial Coal	A standard longwall hydraulic system includes several lineal kilometres of hosing and thousands of fittings. A common fitting used in longwall systems is the staple lock, available in many sizes from numerous manufacturers. Staple fatigue is a risk in this environment. However, information available from manufacturers is insufficient to assess staple fatigue in different applications. This project will scientifically establish the fatigue performance characteristics of a specific type of stainless steel staples, characterise the relationship between working pressure and fatigue life, and compare the fatigue life of two types of staples to determine which has a superior lifespan.
<b>Mining Technology and Production</b>			
<b>Towing Force Measurement of Various Mining Equipment C23012</b> BMT WBM Daniel Carpenter	36,000	Graeme Relf, BHP Billiton Illawarra Coal Anthony Livingstone, Centennial Coal	Heavy and light equipment is towed frequently at open cut coal mines. The principle risks involved with the failure of towing components include uncontrolled release of energy when components fail and unplanned movements or loss of control when components fail. Regulators have recommended that all mines review their towing, pulling and snagging operations. The project aims to measure the towing forces using strain gauged and calibrated equipment and data logging equipment for a range of machinery and towing equipment in a true mining environment. This data will be processed to identify the key variables required for the design and specification of safe towing equipment.
<b>Waterjet Cable Bolt Drilling Tool Development and Field Demonstration C23020</b> CRCMining Scott Adam	350,171	Brad Elvy, BHP Billiton Illawarra Coal Peter Brisbane, Bandanna Energy Jim Sandford, Glencore Peter Corbett, Centennial Angus Place	Current rock bolt drilling techniques and equipment present an operational risk in underground coal mines. A field tested water jet drilling tool prototype capable of meeting safety, hole quality and productivity requirements for cable bolt drilling will be developed in this project. The water jet system will be capable of continuously drilling holes of different lengths using high pressure water jets without requiring the manual addition of individual rods during the drilling process and will improve drilling productivity. The first commercial version is expected to include the prototype attached on the end of a flexible high pressure hose.
<b>Occupational Health and Safety</b>			
<b>IS and Non Invasive Detection of Pressure in Hydraulic Hoses Underground C21009</b> Custom Fluidpower Graeme Vennell Neil Martin	151,000 New 243,320 Existing	Barry Moore, Centennial Coal Keith Cardew, Peabody Energy Australia	In the coal industry the risk of workplace injuries involving fluid under pressure is very high. These incidences often relate to fluid injection and severe body injuries from contact with fluid under pressure. High pressure fluid/oil in hydraulic systems is lethal if a fluid line connection point is opened or hose failure occurs. In the four years proceeding commencement of this project there were been 161 fluid injection injury claims lodged across the NSW coal industry. With the support of an earlier ACARP project, Custom Fluidpower developed a prototype device that can inform operators if there is pressure in a hydraulic hose. This project is reworking the device to ensure it is intrinsically safe and suitable for use in underground coal mines.
<b>Reducing Diesel Particulate Matter in Underground Mines by Optimising Design and Operation of Diesel Exhaust Systems C23013</b> Monash University Daya Dayawansa	275,000	Trevor Hartley, Centennial Coal	Diesel machinery in underground coal mines elevates diesel particulate levels. This project aims to help reduce diesel particulate matter (DPM) levels in Australian underground coal mine environments. This will be achieved by investigating the performance of existing diesel engine systems. The project will investigate improvements that can be made to the overall diesel exhaust system, including the scrubber, filter and other components in order to reduce DPM levels.

PROJECT/RESEARCHER      ACARP FUNDING      INDUSTRY MONITORS      OVERVIEW

## UNDERGROUND PROJECT APPROVALS 2013

### Roadway Development

<b>CM2010 Roadway Development Improvement - Project Support C17010</b> Patchwork Mining Gary Gibson	132,325 New  788,650 existing	Roadway Development Task Group	The coal industry's Roadway Development 2020 strategy is focused on developing the enabling technologies and systems for an engineered, integrated, high-capacity roadway development system – one with hazards engineered out and improved availability, reliability and performance engineered in. This project will support the roll-out of the strategy, the staging of the 2014 Roadway Development Operators' Workshop and a diverse range of roadway development improvement initiatives.
<b>Automated Bolt and Mesh Handling C17018</b> University of Wollongong Stephen Van Duin Ian Porter	75,000 New  3,161,526 existing	Roadway Development Task Group	Automated bolt and mesh handling on a continuous miner is in the final stage of development. Researchers have progressed automation technology to a level which provides the industry with a viable alternative to manual handling and installation of strata support materials on a continuous miner. This extension to this project will enable the unplanned technical challenges associated with the refurbishment of a donated multi-bolter platform to be overcome.
<b>Polymer Based Alternative to Steel Mesh for Coal Mines: ToughSkin C20041</b> University of Wollongong Ernest Baafi	342,123 New  1,160,066 Existing	Roadway Development Task Group	A prototype ToughSkin product has now been developed that can replace steel mesh for strata reinforcement and confinement in underground coal mines. The product can be remotely applied, thereby eliminating the need for personnel in the immediate face area when used in conjunction with automated bolting systems. In this extension project, ToughSkin will undergo formal regulatory testing, an underground application methodology and parameters will be developed, geotechnical characterisation of the product will be completed and an associated geotechnical design model will be developed.
<b>Gateroad Development Continuous Haulage System C23017</b> Premron E-BS Mick Whelan	690,000	Roadway Development Task Group	Shuttle cars remain the principal method of coal clearance from behind the continuous miner despite the ageing technology and ongoing inadequacies. The continuous miner cannot mine continuously as it must stop and wait for the next shuttle car which can have a cycle time of up to five minutes. The Premron continuous haulage system uses the Premron enclosed belt system, which has been proven in aboveground installations worldwide. This system will be used to remove coal from the face and transport it to the panel belt, thereby removing the need for shuttle cars and providing the Australian coal industry with a safe and continuous coal haulage system. To minimise risk and ensure acceptance by the mining industry, further aboveground testing is needed using a simulation of an underground gateroad 'S' bend. The simulation will ensure the collection of more accurate data and further performance tests of the trolley tram and conveyor system.
<b>HiTrack -ICS Phase 2 C23018</b> Scott Technology Australia Sean Starling	511,055	Roadway Development Task Group	A significant impediment to increasing development metres per operating hour in underground coal mines is the current reliance on shuttle cars as the interface between the continuous miner and the face and panel conveyor. ACARP is funding research into continuous haulage systems. The HiTrack – ICS system was selected as a system worthy of further research. This project addresses some of the key risks that would prevent this system from being used underground.

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
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### UNDERGROUND PROJECT APPROVALS 2013

#### Strata Control and Windblasts

<p><b>New Testing Procedure for the Assessment of Resin Performance for Improved Encapsulated Roof Bolt Installation C21011</b></p> <p>University of Wollongong Najdat Aziz</p>	<p>60,000 New</p> <p>130,000 Existing</p>	<p>Dan Payne, BMA Rae O'Brien, Glencore Brian Vorster, Glencore Roger Byrnes, BHP Billiton Illawarra Coal Ismet Canbulat, Anglo American Metallurgical Coal</p>	<p>In underground coal mining, the resin bond between the rock bolt and the strata is one of the critical elements of roof bolting, yet the Australian coal industry does not have an agreed standard test procedure. This project is developing one, enabling comparisons to be made fairly across a growing range of resin products.</p>
<p><b>Improving Roof Control on Longwall Faces through the Incorporation of Reliable Convergence Monitoring Data Into Load Cycle Analysis Software C21013</b></p> <p>Golder Associates Bob Trueman</p>	<p>349,225 New</p> <p>347,400 Existing</p>	<p>Adrian Moodie, Austar Coal Peter Corbett, Centennial Angus Place Dan Payne, BMA</p>	<p>Most Australian coal mines now have shield leg pressure monitoring in real time to aid the identification of potential roof control problems. However, there has been a critical load cycle feature missing, which has limited the usefulness of the monitoring. The CSIRO tilt sensor technology will be used at two mines to develop reliable precursors to cavity formation, supplementing those already existing from leg pressure monitoring. The technology will also be used to determine whether cavity prediction in longwall operations can be determined much more accurately from leg pressure, shield convergence data and canopy tilt data combined compared with leg pressure data alone.</p>
<p><b>Definition of Coal Mine Roof Failure Mechanisms C23008</b></p> <p>SCT Operations Winton Gale</p>	<p>430,000</p>	<p>Brian McCowan, Glencore Roger Byrnes, BHP Billiton Illawarra Coal Mambwe Kasangula, BMA</p>	<p>The stability of coal mine roadways is dependent on the mechanism of failure of the roof strata and the reinforcement system used. Roof instability and falls of ground can occur if the reinforcement system is inappropriate for the actual mechanism of roof failure. In this project an existing database of coal mine roof failures will be extended to include a wider range of mining environments so that the reinforcement systems can be implemented with greater understanding of the roof deformation mechanisms. State of the art monitoring equipment and analysis methods will be used to assess roadway stability and deformation mechanics.</p>
<h4>Ventilation, Gas Drainage and Monitoring</h4>			
<p><b>Improved Efficiency of Gas Capture From Boreholes Under Active Longwall Panels C23009</b></p> <p>SCT Operations Winton Gale</p>	<p>380,000</p>	<p>David Webb, Glencore Brad Elvy, BHP Billiton Illawarra Coal</p>	<p>The effectiveness of gas drainage boreholes during longwall operations is essential to the productivity and viability of underground coal mines. Downholes are used to intersect gas migration from the coal seams below the seam prior to it reporting to the goaf and face area. This requires an understanding of the fracture permeability, stress redistributions, gas sources, the fracture connectivity to the goaf or boreholes, and borehole stability. The aim of this project is to determine the permeability of the fracture zones, the stability of the boreholes, the flow networks established and the gas pressures at various depths in the interburden between the goaf and the lower seam/s. This information is essential to develop better systems of gas capture.</p>
<p><b>Outburst Risk Determination - Data Review and Analysis Component C23014</b></p> <p>Sigra Jeff Wood</p>	<p>261,185</p>	<p>Brad Elvy, BHP Billiton Illawarra Coal Bharath Belle, Anglo American Metallurgical Coal Andrew Lewis, Glencore</p>	<p>The objectives of this project are to provide the Australian coal industry with new guidelines for determining outburst risk by using an energy approach. The intention is to provide parameters additional to the conventional gas content and gas composition measurements to allow a more informed appraisal of the real risk of outbursting in particular scenarios. A review of Australian and international outburst experience will be undertaken to determine key outburst related parameters. These critical parameters will be applied to determine energy release mechanisms and a methodology will be developed to apply a range of measurements to the outburst risk management process.</p>

PROJECT/RESEARCHER      ACARP FUNDING      INDUSTRY MONITORS      OVERVIEW

## UNDERGROUND PROJECTS UNDER MANAGEMENT 2013

### Detection and Prevention of Fires and Explosions

<p><b>Active Explosion Barrier C14027</b> SkillPro Services David Humphreys</p>	<p>1,652,000</p>	<p>Jim Sandford, Glencore Guy Mitchell, Guy Mitchell Consulting</p>	<p>This project set out to develop the design parameters required for an active explosion barrier under a range of conditions before proceeding to a final stage of full-scale validation testing. The final stage tested the prototype explosion barrier. The testing was undertaken at the Kloppersbos facility in RSA.</p>
<p><b>Investigation of the Aging Effect of Electronic Components in Power Supplies C16006</b> Simtars Andre De Kock</p>	<p>175,000</p>	<p>Greg Briggs, Centennial Coal</p>	<p>The Spark Test Apparatus (STA) was introduced in 1968 to test equipment for certification as Intrinsically Safe. Unfortunately, it is neither reliable nor repeatable. This project tested the STA against repeatability and against the effect of aging power supply components. This should quantify the problem as an important step toward replacing the testing procedure.</p>
<p><b>Airo-Dust - Parameter Testing C20002</b> Mining Attachments (Qld) Matt Ryan</p>	<p>1,339,085</p>	<p>Peter Brisbane, Bandanna Energy Jim Sandford, Glencore Steven Winter, Glencore</p>	<p>Coal dust explosions occur when a cloud of coal dust is raised into suspension and ignited, usually by a methane explosion. The coal industry must combat this risk by applying stone dust onto the roof and sides throughout mine roadways. The incombustible stone dust dilutes the concentration of combustible coal dust to form an inert cloud. A new method of applying stone dust as foam has been trialled and tested under project C16014. The applied material is a mixture of water, stone dust, compressed air and Airo-Dust™ additive which forms a highly vesicular foamed product when sprayed onto the roadways. The process significantly reduces air-borne dust generation allowing coal production to occur in parallel with the application of stone dust. Additional testing is being undertaken through this project to achieve acceptance of the process for use in underground coal mines in Australia.</p>
<p><b>New Forms of Fire Suppression and Hydrocarbon Absorption Materials to Underground Coal Mines: Scoping Study C21015</b> SkillPro Services David Humphreys</p>	<p>50,000</p>	<p>Bharath Belle, Anglo American Metallurgical Coal Jim Sandford, Glencore</p>	<p>Managing fires in underground coal mines has typically relied on some form of inertisation which involves specialised equipment and long deployment times. This project examined the application of alternative forms of fire suppression and gaseous hydrocarbon encapsulation in underground coal operations. These materials were originally developed for fire suppression through improving the wetting characteristics of water. They also have the ability to absorb gaseous and liquid hydrocarbons thereby removing them as potential fuel sources.</p>
<p><b>Cheaper and More Effective Inertant Than Stone Dust C21016</b> SkillPro Services David Humphreys</p>	<p>470,000</p>	<p>Peter Brisbane, Bandanna Energy</p>	<p>This project will refine and test a recently invented water adsorbent polymer that aims to replace traditional stone dust. The polymer, which is a more effective inertant, can be hydrated underground; vastly reducing the material handling mass and thereby reducing costs. Stakeholder engagement with mines inspectorates and unions will be conducted under this project. The polymer will be tested at the large scale explosion testing facility at Kloppersbos in South Africa.</p>
<p><b>Potential Lightning Impacts on Underground Coal Mines C22003</b> University of Queensland David Cliff</p>	<p>460,000</p>	<p>Brad Elvy, BHP Billiton Illawarra Coal Greg Briggs, Centennial Coal Peter Henderson, Glencore Jim Sandford, Glencore</p>	<p>Concern over the potential for lightning to cause harm in the underground coal mining environment has been generated from the findings of the SAGO mine disaster in 2006 in the USA. The MSHA investigation report identified another twelve instances where lightning is the most likely ignition source of explosions within sealed areas since 1986. The objective of this research is to develop and apply computer models to evaluate the potential lightning impacts on underground coal mining. These models can then be utilised to assist in the design of effective controls.</p>

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
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### UNDERGROUND PROJECTS UNDER MANAGEMENT 2013

<b>Frictional Ignition Testing High Tensile Steel Combined with Copper C22006</b> Innovative Engineering Products Myles Wylie	88,568	Tom Nicholson, Centennial Coal Bharath Belle, Anglo American Metallurgical Coal	The project's main objective is to mitigate the well known frictional ignition risk associated with mechanical cutting picks encountering high quartz rock in underground coal seams. Frictional ignition experiments will be conducted using test samples manufactured from both high tensile steel and high thermally conductive metal (copper). This method of merging these two types of metal into one body has never been tested and may reduce the likelihood of ignition in a flammable gas atmosphere. It is also expected to enhance the safety and efficiency of mechanical cutting.
<b>Active Explosion Barrier: Refinement of CFD Model and Application of Real Development Panels C22007</b> BMT WBM David Humphreys David Proud	215,400	Peter Brisbane, Bandanna Energy Jim Sandford, Glencore	The current project and a series of related earlier projects set out to develop the design parameters required for an active explosion barrier under a range of conditions before proceeding to full-scale validation testing. This extension will refine the computational fluid dynamics (CFD) model of the suppression system using the physical test data obtained from the 2012 trials at Kloppersbos so that it better replicates the actual barrier performance. It will also provide design parameters for explosion suppressions systems and clarify the impact of complex mine roadway layouts on the development of pressure and flame passages. Extinguishing methane only explosions will also be explored.
<b>Environment - Subsidence and Mine Water</b>			
<b>Effects of Geology on Upsidence and Closure Movements and Impacts in Valleys C18015</b> Mine Subsidence Engineering Consultants Don Kay	300,000	Gary Brassington, BHP Billiton Illawarra Coal	There is increasing expectation from government that more and more rigorous assessment of groundwater interaction will be undertaken and that the aquifer interference will be licensed. The work will produce a better understanding of the various mechanisms affecting mining induced valley movements and impacts of these ground movements and provide an improved method for predicting upsidence and closure movements and impacts. Including the effects of geology should significantly improve the accuracy and confidence in future upsidence and closure predictions and impacts. The project will assist all underground mines proposing to extract coal near or under valleys.
<b>Measurement of Dust Sampling in Australian Coal Mines C20007</b> University of Wollongong Ting Ren	119,500	Darren Nicholls, Glencore Bharath Belle, Anglo American Metallurgical Coal	The coal industry is seeking to develop a work program that will generate a more consistently reliable and relevant airborne dust sampling technique.
<b>Standardised Subsidence Information Management System C20038</b> NSW Department of Trade and Investment Gang Li	480,000	Phil Enright, Centennial Mandalong Dan Payne, BMA	Subsidence, its prediction and management, remains a key to maintaining access to future coal reserves. The results of past subsidence engineering and risk assessment will have a direct impact on the efficiency of resource recovery and outcomes of subsidence management practices. This project is developing a subsidence information management system that transfers the existing subsidence data, into an organised information resource to create new knowledge in subsidence engineering as well as effective risk management tools. In doing so it will create a standardised communication platform between all industry users to facilitate industry's shared use of the subsidence information.
<b>Monitoring Surface Condition of Landscape Features Subject to Mining Subsidence with Very High Resolution Imagery C20046</b> University of Queensland Andrew Fletcher Peter Erskine	278,191	Edwina White, Centennial Coal Mary-Anne Crawford, Centennial Coal Bernie Kirsch, Centennial Coal Gary Brassington, BHP Billiton Illawarra Coal	Stakeholders require increasing levels of confidence in the reporting of mining impacts. Remote sensing provides a means of rapidly gathering information on surface conditions but the scale of ground sampling available generally results in a large error. This project makes use of an unmanned aerial vehicle to allow temporal and spatial resolution to achieve individual plant feature extraction in combination with concurrent ground observation based on quantitative measures of plant condition. The project is developing an integrated ground and remotely sensed metrics capable of detecting vegetation condition. This work is addressing the core question that prevents the effective use of remote sensed data for monitoring vegetation condition, "What spatial and temporal resolution is required to provide effective and early indication of mining impact on vegetation condition and composition?".

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<b>Impact of Mine Subsidence on Threatened Ecological Communities C22019</b> Eco Logical Australia Paul Frazier	93,680	Nardia Keipert, Peabody Energy Australia Carl Grant, Anglo American Metallurgical Coal Gary Brassington, BHP Billiton Illawarra Coal	Longwall mine subsidence is recognised by state and federal governments as a process that threatens to impact surface environments. Current approval requirements for impact monitoring vary from site to site. A standard monitoring methodology may assist industry to meet approval requirements and streamline the monitoring process. This project will use quantitative means to assess the impact of longwall mine subsidence on bluegrass and Brigalow communities across several longwall mining areas. In addition, an integrated monitoring method that combines targeted field survey with remote sensing analysis will be developed and tested over several mine areas to lead industry best practice.
<b>Exploration</b>			
<b>Advanced Logging Tool C16018</b> CRCMining Dave Cusack	440,322	Mike Armstrong, BHP Billiton Illawarra Coal Andy Willson, Anglo American Metallurgical Coal	An advanced borehole logging tool was developed to improve geological definition and geotechnical assessment of coal deposits. The tool contains upwards and downwards looking directional natural gamma and density sensors. It samples at 80 millimetre intervals to provide a high-resolution data set that can be interpreted to determine the seam profile and define geological and sedimentary structures. The tool logs to memory and is deployed inside the drill string. In this extension the logging tool will be reconfigured to reduce the risk of losing the gamma radiation source down the borehole, and two additional geophysical logging tool modules will be added. The new modules will be suitable for certification as intrinsically safe for use in underground mines.
<b>CQDX Laboratory to Customer Data Transfer C21014</b> acQuire Technology Solutions Federico Arboleda Jared Armstrong	230,650	John Terrill, Glencore Jim Sandford, Glencore Andy Willson, Anglo American Metallurgical Coal	Coal sampling and coal quality data are the primary data sets that underpin reliable resource estimates. All subsequent decisions, activities, coal seam models and mine planning estimations rely on this information. However, handling this data is problematic due to the absence of appropriate standards. This project is developing an industry data exchange standard, thereby reducing the cost and increasing the reliability of resource estimates.
<b>In-seam Wireless Drill String Communications System C21019</b> CRCMining Eddie Prochon	212,400	Brad Elvy, BHP Billiton Illawarra Coal Peter Brisbane, Bandanna Energy Jim Sandford, Glencore	The Mecca system is generally used in underground in-seam drilling for communications and directional drill control. However this system is very expensive, non retrievable and does not enable geological wireline tools to be pumped down the inside. In this project CRCMining are building on successful past work to develop an alternate technology. The project is further developing an electro magnetic telemetry system called in-seam wireless drill string to facilitate real time bidirectional telemetry between the drill and the bottom hole assembly. The technology will provide a wireless data rate of 1000 bits per second, thereby enabling transmission of high resolution navigation data, drill control messages and geosensing data in real time.
<b>Enhancing Small Fault Detection by Seismic Diffraction Imaging C22016</b> CSIRO Binzhong Zhou Peter Hatherly	240,475	Andy Willson, Anglo American Metallurgical Coal	Modern underground coal mining requires certainty about geological faults and other structural features. While locating faults with throws greater than 5-10 metres has been generally accepted for seismic surveys, the ability to resolve the more subtle faults, shears and features is still a challenge. New techniques for enhancing small fault detection by imaging the diffractions often associated with fault structures will be developed, thereby improving the efficiency and effectiveness of detecting anomalies and discontinuities ahead of mining.

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<b>Borehole Data Standard for the Australian Coal Industry - Phase 2 C22017</b> GeoCheck Brett Larkin David Green	120,000	Patrick Tyrrell, New Hope Group Ken Preston, Rio Tinto Coal Australia Andy Willson, Anglo American Metallurgical Coal	There are currently a large number of coal exploration data formats and dictionaries being used in the Australian coal industry which lead to inefficiency and data transfer costs when geologists move between projects and companies. A set of standards for geological, geotechnical and geophysical logging of exploration data has been developed. Under this extension project, CoalLog will be revised and updated with photographs, formation and seam codes, lithology plotting symbols and a format for the addition of metadata to downhole geophysical data (LAS) files. A standard training manual for geological and geotechnical logging of Australian coal industry boreholes will also be developed.
<b>Maintenance</b>			
<b>Reducing the Risk of Hydraulic Hose Assembly Failures on Longwall Systems: Ext - Longwall Hydraulic System Over Pressurisation Hazards Prevention C17020</b> Monash University Henry Bartosiewicz	991,020	Jarrod Sampson, Glencore Scott Wyborn, Centennial Coal Trevor Hartley, Centennial Coal Brian Owers, Centennial Coal Peter Crossland, Anglo American Metallurgical Coal	Hose assembly failures are particularly prevalent on aging supports that have been in service for several years. An American survey indicates that more than 60% of longwall operations with shields in service for 4-6 years developed significant problems. In Australia the incidence of serious injury from hydraulic assembly failures is increasing. A previous project investigated the factors contributing to premature longwall system hose assembly failures. Additional work will be undertaken to investigate the pressure spikes seen in a Queensland underground circuit. Hydraulic system and operational data monitoring programs will be expanded to encompass other underground longwall faces with different aged equipment from different hydraulic OEMs. The root cause of over-pressurisation issues will be established and the effectiveness of possible remedial solutions/actions to eliminate pressure spikes will be identified and verified.
<b>Extending the Life of Disposable Exhaust Filters in Vehicles Operating in Underground Coal Mines C21017</b> Monash University Damon Honnery Daya Dayawansa	259,250	Trevor Hartley, Centennial Coal	More than 90% of underground mine vehicles use a wet scrubber to lower the exhaust temperature then a particulate filter to reduce diesel particles. Filters can need replacing every four hours despite the suppliers' advice that they have a 40 hour operating life. Operators have speculated that short filter life could be a consequence of scrubber water penetrating the filter, altering the structure of the fibre. This project investigated the accelerated filter degradation and assist in developing strategies that will lead to an improved filter life.
<b>Cutterhead Reliability Assessor for Underground Coal Mining C22013</b> CSIRO Xing Li	222,100	Tom Nicholson, Centennial Coal Graeme Relf, BHP Billiton Illawarra Coal	Continuous miner cutterheads are complex systems. The drum is one of the most critical components that affects cutterhead reliability and picks are key components of the drum. This project will analyse the effect of pick tip material property, pick attack angle, drum rotational speed and tram speed on pick reliability. As a result, engineers and operators will be able to assess the risk of pick failure under various mining conditions and develop maintenance strategies to improve reliability and productivity.
<b>Mining Technology and Production</b>			
<b>AFC Pan Stability Investigation C19016</b> BMT WBM Fidel Gonzalez John Vazey	100,000	Bill Short, BHP Billiton Illawarra Coal Brian Owers, Centennial Coal	Armoured face conveyor (AFC) pans lift and ride through the cut coal rather than follow the floor of the cut during normal operation thereby reducing productivity and requiring significant manual machine operation. This project designed a method of controlling the trajectory of the AFC pan during the push, review retrofit consumables to minimise pan lifting or toes digging and found the relevant variables that affect pan stability during operation. In addition, it developed tools for assessing the performance of AFC pan designs with a higher degree of confidence than the current state of the art techniques.

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<p><b>Development of a Safer Underground Explosive C20033</b> University of New South Wales Andres Castro Duncan Chalmers</p>	<p>323,500</p>	<p>Brad Elvy, BHP Billiton Illawarra Coal John Hempenstall, Centennial Coal</p>	<p>Underground mines resort to the use of explosives to break extremely hard materials that intrude into coal seams. Since there is no longer P5 explosive available for delay firing, mines resort to using type 1 explosive. Confusion arises as to how these explosives can be safely used. Currently permitted explosives are being used outside the recommended guidelines as published by the Buxton Testing Authority in the UK. In order that they can be used safely, mines are conducting risk assessments to manage the incendive hazard that possibly could be created by a cut off shot and additionally managing the deflagration hazard with the same risk assessment when using P1 explosives. This project is developing an alternate test regime that adequately assesses the deflagration risk of an explosive. The information gained from this testing will provide additional data to change the testing regime for permitted explosives.</p>
<p><b>Fibre Optic Conveyor Monitoring System C21012</b> CRCMining Saiied Aminossadati</p>	<p>147,000</p>	<p>Brad Lucke, Glencore Peter Brisbane, Bandanna Energy Jim Sandford, Glencore</p>	<p>Heavy duty conveyor belts are commonly used in underground coal mines for transporting materials. The conveyor belts, their drive systems and support rollers suffer substantial damage if they are being overheated during operation. The early detection of overheating is a critical safety control. This project is developing a real time hazard monitoring system that continuously monitors temperature variation on conveyor idlers. The system is to be based on a fibre optic based distributed temperature sensing system.</p>
<p><b>Water Jet Cable Bolt Drill Investigation C21018</b> CRCMining Dihon Tadic</p>	<p>89,527</p>	<p>Brad Elvy, BHP Billiton Illawarra Coal Peter Brisbane, Bandanna Energy Jim Sandford, Glencore</p>	<p>One of the major limitations of current systems for drilling long cable bolt holes is the complex and, at times, manual handling of multiple drill rods which can expose operators to an unsafe operating environment. This project is investigating the potential of a drilling system that uses a high pressure water jet cutting head to continuously drill rock bolt holes of varying lengths, eliminating the need to add or remove drill rods. This technology should eventually provide a more productive and safer process for cable bolt installation.</p>





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<b>Full Panorama View (360) Video and Laser Flameproof Enclosure C21021</b> CSIRO Ron McPhee Zak Jecny	251,760	Mark Perry, Centennial Coal Brad Lucke, Glencore Peter Henderson, Glencore	The use of laser and video instrumentation underground is limited by the absence of a safe flameproof enclosure that is functional and intrinsically safe. This project is addressing the design, construction and certification for a novel design of a flameproof enclosure to accommodate full panorama laser and video viewing. The enclosure will deliver improved performance in many areas of underground machine automation including creep-retreat monitoring, collision avoidance, equipment and personnel recognition, pillar and panel locations and many of the future safety related systems integral to the development of autonomous underground equipment.
<b>New Manufacturing Technique for Radio Transparent (Dielectric) Flameproof Enclosures C21022</b> CSIRO Ron McPhee	196,980	Mark Perry, Centennial Coal Brad Lucke, Glencore Peter Henderson, Glencore	Although there are numerous practical underground applications for radio transparent flameproof enclosures, these applications have not been fully developed because there is no suitable non metallic flameproof enclosure technology. Some exciting applications on the development horizon for radio frequency instruments include collision avoidance, identification of resource boundaries using one of the many forms of radar sensing, and local communications portals using Wi-Fi systems. This project is developing the fundamental techniques required to produce radio frequency, transparent flameproof enclosures using combinations of metallic and non metallic materials and the latest selective laser sintering techniques.
<b>Continuous AFC Chain Tension Feedback System C21024</b> CRCMining Dave Cusack	200,000	Bill Short, BHP Billiton Illawarra Coal	CRCMining's system is currently the most direct and accurate armoured face conveyor (AFC) chain tension measurement technology suitable for use in Australian underground coal mines. This system measures chain tension using strain gauges attached directly to the AFC chain, with an intrinsically safe (IS) data logger and IS battery pack mounted inside a flight bar. While the data is of high quality and resolution, this system is unsuitable for permanent installation in its current form because it has limited battery life, it logs rather than transmits data and it is unreliable. This project is developing and trialling an IS system to measure, transmit and receive AFC chain tension data that is suitable for condition monitoring and controlling the AFC and other longwall components. Chain tension will be continuously measured over the whole length of the AFC and miniature electronic components developed by the University of Aachen (Germany) will be housed within a customised chain link. The system will be IS certified for use in underground coal mines.
<b>Continuous Conveyor System - Premron E-BS C22009</b> Premron Mick Whelan	100,000	Roadway Development Task Group	Roadway development has not kept pace with the industry advances in longwall productivity, such that the industry finds it difficult to provide the next block of coal as needed. After six years of targeted roadway development investigation, it is apparent that continuous haulage, as opposed to shuttle car haulage, has the potential to produce a step change in productivity and development rates. This brief project will identify the barriers to introducing a specific innovative continuous haulage system into an underground coal operation. The project is expected to scope out a major work program that should lead to the eventual commercialisation of a suitable continuous haulage system.
<b>Continuous Conveying System - HiTrack - ICS Phase 1 C22011</b> Bulk Solutions Michael Pietsch	99,870	Roadway Development Task Group	Roadway development has not kept pace with the industry advances in longwall productivity, such that the industry finds it difficult to provide the next block of coal as needed. After six years of targeted roadway development investigation, it is apparent that continuous haulage, as opposed to shuttle car haulage, has the potential to produce a step change in productivity and development rates. This brief project will identify the barriers to introducing a specific innovative continuous haulage system into an underground coal operation. The project is expected to scope out a major work program that should lead to the eventual commercialisation of a suitable continuous haulage system.

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<b>Automated Mining Horizon Control Using Real Time Coal Seam Sensing C22014</b> CSIRO Jonathon Ralston	268,800	Roadway Development Task Group Dion Pastars, BMA	Achieving effective mining horizon control is critical for safety and productivity in underground roadway development and longwall mining. Automation is seen as a way to improve horizon control performance. However, a major issue preventing its widespread introduction is the lack of reliable instrumentation to sense where cutting horizons are relative to the seam roof and floor during mining. This project will develop a new prototype sensing system designed to measure the coal thickness to roof and floor rock, together with a report including comprehensive system performance measurements. It will be non-intrinsically safe and deployed using antennas which directly contact the roof or floor.
<b>CM Self Guidance: System Hardening and Underground Deployment C22015</b> CSIRO David Reid	926,255	Roadway Development Task Group	The goal of the CM2010 initiative is to demonstrate an integrated, remotely supervised, high capacity roadway development system. A major component of this initiative is the development of a navigation and control system to realise a practical self steering continuous miner. This technology will also provide real-time machine position and operational information essential for the integration of support and haulage components. In this project, the technology outcomes demonstrated on the Phoenix in C18023 will be made more robust so they can be installed on an operational continuous miner underground.
<b>Occupational Health and Safety</b>			
<b>Analysis of Industry Data to Enable Quantitative Control Effectiveness Assessment C18021</b> University of Queensland Gul Kizil	145,000	Gary Brassington, BHP Billiton Illawarra Coal	There is a growing demand within the mining industry for genuine quantitative risk analysis, but because the data to support this risk analysis is sparse, the industry has frequently made do with semi-qualitative methodologies. Project C17014 that used the Risk-Cost-Benefit RCB approach has both proved valuable and identified a number of gaps which will be addressed in this project. The three areas to be addressed through this project are: surface subsidence, underground collision avoidance and an electrical category related investigation.
<b>Emergency Response: Mine Entry Data Management C19010</b> Queensland Mines Rescue Service Darren Brady Steve Tonegato	300,000	Bharath Belle, Anglo American Metallurgical Coal John Grieves, Caledon	Strategies, systems and hardware, which have the potential to provide the information decision-makers need during or following an underground coal mine incident, were identified in previous projects. A proof-of-concept software tool was developed to help determine whether mines rescue teams could enter/re-enter a mine. The aim of this extension project is to identify existing and future strategies and hardware which have the potential to protect underground infrastructure such as tube bundle sample lines and data/communication cables which deliver samples and information required in emergency situations.
<b>Safety Case For Electrical Isolation C19015</b> University of Queensland Derek Griffiths Gul Kizil	175,000	John Hempenstall, Centennial Coal Dave Mellows, Glencore	The Queensland mining industry has highlighted isolation as an important area that requires greater awareness, understanding and control. In Queensland there have been 32 fatalities related to accidental contact with electricity over the past 23 years. This project is building on the most recently developed advanced MISHC risk management methodologies and developing an 'innovative new integrated safety case methodology' that will define the leading practice in electrical isolation. A safety case is a collection of documents that describes the processes adopted to identify major hazards, the controls implemented to prevent major incidents from occurring, and how the effects of potential incidents can be minimised.

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<b>DPM Risk Factors C20036</b> SkillPro Services Dale Howard Terry O'Beirne Zoran Ristovski	458,607	Trevor Hartley, Centennial Coal Peter Brisbane, Bandanna Energy	Diesel particulate matter (DPM) consists of elemental carbon onto which toxic organic compounds condense. While comprising only a small amount of particle mass, the organic compounds have a critical role in particle toxicity. In underground mines where exhaust must be cooled as a safety measure, organic compounds are concentrated even more onto elemental carbon particles, which makes the exhaust more toxic than it might be if the exhaust was not artificially cooled and freely vented as on the surface. The size of these particles also plays a critical role in their toxicity, with non-sized particles able to deposit deep in the lung. The final stage of this project delivered a new method and instrumentation for testing DPM emissions that will more realistically reflect health risks based on what underground mine workers breathe, rather than the current practice of measuring the mass of DPM in raw exhaust, which is sub-optimal.
<b>Proximity Detection Device Open Specification C22012</b> CSIRO Mark Dunn	111,525	Adam Selby, BHP Billiton Illawarra Coal Bruce Davies, Centennial Coal Brad Lucke, Glencore	There are many proximity detection systems on the market, each one with its own proprietary operational system. The fundamental incompatibility between proprietary systems is slowing the uptake of proximity detection technology within the mining industry. This project will introduce an open specification for underground proximity detection systems which includes a relevant set of hardware, software or communication platforms to be integrated by system manufacturers.
<b>Roadway Development</b>			
<b>Rapid Advance Conveyor C20034</b> Oregate John Bremhorst	384,959	Roadway Development Task Group	Within the coal industry underground gateroad conveyors are constructed and dismantled by manual handling. This has led to a high injury frequency with attendant lost time injuries as a consequence of the heavy lifting required. This project is developing the Rapid Advance Conveyor (RAC) to remedy the high frequency of worker injuries caused by the construction of underground conveyors. The RAC is an extending, retracting concept conveyor that has the potential to modernise longwall gateroad conveyances by limiting the need for workers to manually handle conveyor structure.
<b>Automated Monorail Extension System for Roadway Development C20035</b> University of Wollongong Scott Jensen Stephen Van Duin	176,806	Roadway Development Task Group	Extension of current monorail systems during roadway development requires the manual installation of monorail infrastructure from the side of a continuous miner, with an advancing continuous miner requiring regular reoccurring manual activities to erect and extend the monorail system. These tasks become more onerous as mining heights increase, with operators facing increasing ergonomic risk as they lift monorail segments into place at height. This project is identifying the technology, hardware and systems required to achieve automated monorail installation and extension, with a concept design being developed during an initial 12-month phase.
<b>Continuous Conveying System - Co-Axial Pipe Conveyor Plus SAM C22005</b> Remedy Mining Group Tony Scott	100,000	Roadway Development Task Group	Roadway development has not kept pace with the industry advances in longwall productivity, such that the industry finds it difficult to provide the next block of coal as needed. After six years of targeted roadway development investigation, it is apparent that continuous haulage, as opposed to shuttle car haulage, has the potential to produce a step change in productivity and development rates. This brief project will identify the barriers to introducing a specific innovative continuous haulage system into an underground coal operation. The project is expected to scope out a major work program that should lead to the eventual commercialisation of a suitable continuous haulage system.

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<p><b>10 MPOH Continuous Haulage System for Longwall Gateroad Development C22018</b></p> <p>Patchwork Mining Gary Gibson</p>	<p>100,150</p>	<p>Roadway Development Task Group</p>	<p>Roadway development has not kept pace with the industry advances in longwall productivity, such that the industry finds it difficult to provide the next block of coal as needed. After six years of targeted roadway development investigation, it is apparent that continuous haulage, as opposed to shuttle car haulage, has the potential to produce a step change in productivity and development rates. This brief project will identify the barriers to introducing a specific innovative continuous haulage system into an underground coal operation. The project is expected to scope out a major work program that should lead to the eventual commercialisation of a suitable continuous haulage system.</p>
<p><b>Strata Control and Windblasts</b></p>			
<p><b>Update of Stress Concentration Effects about Longwall Panels for Improved Mine Planning C20031</b></p> <p>SCT Operations Winton Gale</p>	<p>165,000</p>	<p>Roger Byrnes, BHP Billiton Illawarra Coal John Grieves, Caledon</p>	<p>A key factor in longwall layout design is optimising the stability of maingate roadways during retreat which is largely influenced by the horizontal stress concentrations about the gate ends. In order to optimise mine stability, stress concentration factors which relate to a mine layout have been developed and are used throughout the coal industry. These stress concentration factors are based on extensive stress monitoring case studies conducted during the mid 1980s and early 1990s by SCT Operations. It is now necessary to update the guidelines with the likely changes which may occur in the shallower new mines and in the deep proposed mines which may have different horizontal stress ratios. This project is undertaking field mapping in association with mine geotechnical staff as a means of transferring the techniques and understanding of stress concentration effects about mine excavations.</p>
<p><b>Dynamic Response of Longwall Systems and their Relationship to Caving Behaviour C20032</b></p> <p>PDR Engineers David Hoyer Peter Hatherly Terry Medhurst</p>	<p>250,000</p>	<p>Roger Byrnes, BHP Billiton Illawarra Coal Ismet Canbulat, Anglo American Metallurgical Coal</p>	<p>The interaction between longwall supports and the surrounding strata is a complex phenomenon. At present neither empirical nor numerical models can adequately capture the critical factors required to predict strata response. However, recent advances in the ability to analyse longwall monitoring data such as that developed by Longwall Visual Analysis provide a potentially large and valuable data source to quantify time related factors. It also provides a means by which to assess how operational practice can influence shield behaviour. This project is analysing various longwall operations using the Geophysical Strata Rating (GSR) to characterise the strata, assess the likelihood of weighting and then correlate this with the various outputs that can be provided by LVA. The project utilises GSR estimates to provide a practical means to identify features that affect caving behaviour, such as massive strata, weak roof, etc.</p>
<p><b>New Testing Procedure for the Assessment of Resin Performance for Improved Encapsulated Roof Bolt Installation C21011</b></p> <p>University of Wollongong Najdat Aziz</p>	<p>130,000</p>	<p>Dan Payne, BMA Rae O'Brien, Glencore Brian Vorster, Glencore Roger Byrnes, BHP Billiton Illawarra Coal Ismet Canbulat, Anglo American Metallurgical Coal</p>	<p>In underground coal mining, the resin bond between the rock bolt and the strata is one of the critical elements of roof bolting, yet the Australian coal industry does not have an agreed standard test procedure. This project is developing one, enabling comparisons to be made fairly across a growing range of resin products.</p>
<p><b>Improving Roof Control on Longwall Faces through the Incorporation of Reliable Convergence Monitoring Data Into Load Cycle Analysis Software C21013</b></p> <p>Golder Associates Bob Trueman</p>	<p>347,400</p>	<p>Adrian Moodie, Austar Coal Peter Corbett, Centennial Angus Place Dan Payne, BMA</p>	<p>Most Australian coal mines now have shield leg pressure monitoring in real time to aid the identification of potential roof control problems. However, there has been a critical load cycle feature missing, which has limited the usefulness of the monitoring. The CSIRO tilt sensor technology will be used at two mines to develop reliable precursors to cavity formation, supplementing those already existing from leg pressure monitoring. The technology will also be used to determine whether cavity prediction in longwall operations can be determined much more accurately from leg pressure, shield convergence data and canopy tilt data combined compared with leg pressure data alone.</p>

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<b>Real Time Seismic Roof Condition Mapping Ahead of Longwall Mining C21020</b> CSIRO Xun Luo	331,620	Roger Byrnes, BHP Billiton Illawarra Coal Ismet Canbulat, Anglo American Metallurgical Coal Peter Corbett, Centennial Angus Place	CSIRO has developed a passive seismic tomographic technology which can use the longwall shearer as the seismic source to image roof conditions – stress and degree of fracturing – ahead of the advancing face. This allows mines to proactively respond to difficult roof conditions. This project is using recently developed intrinsically safe geophones to conduct a full scale demonstration for real time monitoring ahead of mining at selected longwall panels. The project is providing the mining industry with an easy to use tool to obtain information, in real time, about the distribution of stress and geological anomalies across a broad area ahead of the longwall face.
<b>Optimisation of Roof Bolt Length Based on Improved Resin Performance C21023</b> Mine Advice Russell Frith	200,000	Gavin Lowing, Peabody Energy Australia Rae O'Brien, Glencore Dan Payne, BMA	New roof bolt resins developed in the United States are being introduced into the Australian coal industry. This project is evaluating the resins then demonstrate the potential for reducing roof bolt length without affecting geotechnical risk. Unlike the less viscous Australian resins, the US resins do not appear to suffer from mixing problems in the upper 300 millimetres to 600 millimetres of a roof bolt.
<b>Practitioners Handbook on Managing Geotechnical Risk in Underground Coal Mining C22004</b> Galvin and Associates Jim Galvin	119,000	Dan Payne, BMA Paul O'Grady, Glencore	This project is a continuation of project C14014 to develop a textbook in 2 volumes to assist coal operators in developing their strata management plans and bring together a reference document to support those responsible for strata management. The project is partially supported by the Minerals Council of Australia.
<b>Roadway Roof Support Design using the Geophysics Strata Rating C22008</b> PDR Engineers Terry Medhurst	152,000	Gavin Lowing, Peabody Energy Australia Roger Byrnes, BHP Billiton Illawarra Coal Ismet Canbulat, Anglo American Metallurgical Coal	Roof falls still occur in underground coal mines and are the result of a complex interaction between roof characteristics, support type and installation, stress and geometry. Wider spans, weak roof and stress are key issues. In this project, existing roof monitoring data and a geophysics-based model of strata conditions will be analysed to assess roadway roof design. An analytical model will be developed to quantify stress-related impacts and strain/displacement.
<b>Optimising the Selection of Fully Grouted Cablebolts in Varying Geotechnical Environments C22010</b> University of New South Wales Paul Hagan	150,000	Peter Corbett, Centennial Angus Place Dan Payne, BMA Paul O'Grady, Glencore	Increasingly cable bolts are being relied upon to maintain the integrity of roof strata and provide a safe work environment in difficult mining conditions. However the mechanisms by which cable bolts interact with roof strata to provide support is not widely known. This project will establish an Australian axial and shear pull testing standard for fully grouted cable bolts. The impact of the different components in the cable bolting system on load transfer will be determined by studying the effect of cable geometry, grout strength, grout stiffness, grout additives, rock strength, hole size and hole profile on anchorage performance. The performance of the two main types of cable bolts being used in the industry will be assessed in situ. These results will help decision makers select the most appropriate cable bolt designs for a range of Australian mining conditions.

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## UNDERGROUND PROJECTS UNDER MANAGEMENT 2013

### Ventilation, Gas Drainage and Monitoring

<p><b>Application of Numerical Outburst Model for Outburst Management C16016</b></p> <p>CSIRO Xavier Choi</p>	<p>210,000</p>	<p>Mike Armstrong, BHP Billiton Illawarra Coal</p>	<p>The risk of outburst has been brought under control in Australia by the introduction of in-seam gas drainage ahead of mine development and production. Drainage to meet safe gas content threshold values is carried out in all mines assessed as at risk. Mining can only proceed if the gas content has been drained to below certain threshold values depending on gas composition. There is evidence, that the current threshold values might have been too stringent for some cases. Over a series of ACARP projects this research group has developed a numerical model that includes the many parameters known to be associated with outburst events. As new findings have come to light and relationships between the parameters determined, they have been included. This project will continue to refine the model and apply it to field problems, especially in mining through difficult areas.</p>
<p><b>Tools to Simplify the Coiled Tube Drilling System C17017</b></p> <p>CRCMining Paul Lever Tim Meyer</p>	<p>296,500</p>	<p>Mick Loney, BHP Billiton Illawarra Coal  Peter Brisbane, Bandanna Energy</p>	<p>Predrainage drilling is frequently required to degas a seam prior to mine development. Recent technology has been focused on surface to in-seam drilling which not all mines can utilise. The requirement for gas drainage drilling is likely to grow with increased production rates and the trend towards higher gas content, lower permeability reserves. In-seam drilling costs can equate to around 3 per tonne of coal mined. BHP Billiton - Illawarra Coal has initiated investigations into Coiled Tubing Drilling (CTD) for application to in-seam gas drainage. This project developed sufficient understanding of the operation and design of CTD to reduce the risk associated with undertaking a field trial which could be undertaken by a mine operator.</p>
<p><b>Information Dissemination for the Management of Spontaneous Combustion C18013</b></p> <p>University of Queensland Darren Brady David Cliff</p>	<p>109,000</p>	<p>John Grieves, Caledon</p>	<p>Following the Moura No 2 mine disaster in 1994 ACARP funded the development of educational resources to improve the understanding of the management of spontaneous combustion. These resources included the “green” – Spontaneous Combustion in Australian Underground Coal Mines, “red” – Spontaneous Combustion in Australian Underground Coal Mines – A handbook for Mine Workers, and “blue” books – Spontaneous Combustion in Australian Underground Coal Mines – A Manual for Mine Personnel. Since the time these resources were developed much has changed, including legislation, and there have been many advances in research. The way spontaneous combustion is managed has also developed significantly. This project will overhaul these documents as well as provide other mechanisms such as web based information packages to encourage best practice spontaneous combustion management. By adopting a multi media approach the ability to disseminate the information is optimised. The project aims to prevent complacency from setting in and to reinvigorate the attention to the management of spontaneous combustion in Australian underground coal mines.</p>
<p><b>Development of an Alternative Electronic Spark Test Apparatus C20006</b></p> <p>CRCMining Ian Gregg, Paul Lever, Scott Adam</p>	<p>983,477</p>	<p>Greg Briggs, Centennial Coal Peter Henderson, Glencore</p>	<p>Two recent projects using a spark test apparatus (STA) to check intrinsically safe (IS) electrical circuits have found that the STA is unreliable and unrepeatable. This current project will take the experimental design and research prototype developed in a previous project to a pre-commercial prototype. An improved electronic spark tester (incorporating the latest spark model) and several reference power supplies will be developed and manufactured, and the operational performance of the tester will be validated.</p>
<p><b>Geophysical Estimation of Concentration and Composition of Gas In Place in Unmined Coal Seams C20012</b></p> <p>Curtin University of Technology Mark Lwin</p>	<p>244,753</p>	<p>Mike Armstrong, BHP Billiton Illawarra Coal  Andy Willson, Anglo American Metallurgical Coal</p>	<p>The industry needs to more accurately predict the concentration and composition of Gas In Place (GIP) within a borehole from geophysical logs and laboratory measurements on core samples. The increased understanding of the in situ elastic and electrical properties of fluid saturated coal resulting from this project work will allow experts to assess the readiness of seismic methodologies for a real prediction of concentration and composition of GIP in unmined coal seams. Ultimately the capacity of seismic methods to provide a real coverage will represent a major advance in this field, allowing GIP to be estimated with a reduced need to extract cores, less boreholes and greater certainty.</p>

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
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**UNDERGROUND PROJECTS UNDER MANAGEMENT 2013**

<b>Fibre Optic Based Methane Sensor C20014</b> CRCMining Saeid Aminossadati	148,500	Patrick Booth, BHP Billiton Illawarra Coal Peter Brisbane, Bandanna Energy Jim Sandford, Glencore	The accurate and timely measurement of gas emissions from underground coal mines is critical if the industry is to manage its gas with respect to safe operating practice and greenhouse gas measurement and abatement. New fibre optic technologies offer a means to achieve accurate gas measurement. Tapered optical fibres and photonic crystal fibres, in particular, will enable cheap, fast and easy to install optic multipoint methane sensors. Initial research indicates that these technologies will measure methane concentration at similar accuracies to the current infrared systems.
<b>Controlling Heatings and Gas Leakage Using Innovative Polymer Gel - Pilot Plant Scale Testing C20039</b> CSIRO Sheng Xue	226,100	Ken Lewthwaite, Anglo American Metallurgical Coal Peter Brisbane, Bandanna Energy	Heatings and gas leakage are two of the major safety issues in coal mines. If not managed they can result in production delays and ultimately mine explosions. Unfortunately slurries and foams used to limit gas flow are of limited effectiveness and inertisation is only applicable in the early stages of a heating. Polymer gels are known to be more effective in this environment and will be further developed through this project. The success of this project will lead to a commercial application of the polymer gels, their preparation and delivery systems in the Australian coal industry. The gels should lead to enhanced mine safety and improvement in the technique for timely and rapid intervention to spontaneous combustion, excessive gas leakage and explosions. This project is building upon a substantial body of work undertaken by CSIRO in spontaneous combustion and gas control.
<b>Outburst and Gas Management Seminars C21001</b> Outburst Seminar Committee Bob Kininmonth	15,000	Underground Committee	Outburst and gas management remain a high priority safety concern for the industry. This project provides support for the running of information sharing seminars that will continue to bring together operators and those with expertise in the area.



Safety, productivity and the right to operate are concerns that will continue to direct research in the open cut area. Each seems to grow in importance as the broader community and mine owners' expectations increase. Mines must achieve zero fatalities and ongoing reductions in lost time injuries if they are to continue to enjoy a right to operate.

A recently supported project receiving a third tranche of funding is seeking to develop an automated swing loading system for electric shovels targeted at improving productivity of key mining equipment. This substantial project will help to enhance a shovel operator's ability to focus on the complex digging decisions whilst automating aspects of the machine operation.

Given the large areas impacted upon by open cut mines, it is critical that research addresses the science of rehabilitation and the minimisation of mining impacts on neighbouring communities. This priority area will continue to consume a significant component of the open cut research budget. The management of water remains a significant component of this work.

### COMMITTEE MEMBERS

<b>Tony Egan</b>	Manager, Project Governance, Coal Assets Australia (Co Chair, Open Cut Committee)	Glencore
<b>Hans Hayes</b>	General Manager Open Cut Mining Excellence (Co Chair, Open Cut Committee)	Anglo American Metallurgical Coal
<b>Chris Agosto</b>	EME Procurement Superintendent	Mt Arthur Coal
<b>Steve Amor</b>	Principal Engineer – Studies	Anglo American Metallurgical Coal
<b>Heather Bone</b>	Group Manager Sustainability	Downer EDI Mining
<b>Shaun Booth</b>	Manager, Resources & Infrastructure Development	Glencore
<b>Keith Cardew</b>	Principal Maintenance Engineer	Peabody Energy Australia
<b>Wayne Clement</b>	Group Manager, Global Equipment	Glencore
<b>Brett Domrow</b>	Chief Mining Engineer	New Hope Group
<b>David Drew</b>	Technical Improvement Superintendant	Wesfarmers Curragh
<b>Lindsay Ford</b>	Project Manager	Glencore
<b>Carl Grant</b>	Regional Manager - Environment	Anglo American Metallurgical Coal
<b>Don McNeil</b>	Principal Advisor - Mine Operations Improvement	Rio Tinto Coal Australia
<b>Brian Neilsen</b>	Manager Mine Planning	Peabody Energy Australia
<b>Troy O'Reilly</b>	Risk, Safety & Compliance Advisor	Stanwell Corporation
<b>Simon Orton</b>	Manager Open Cut Operating Performance	BMA
<b>Ken Preston</b>	Manager Resource Assessment	Rio Tinto Coal Australia
<b>Stuart Ritchie</b>	Manager – Environment	Rio Tinto Coal Australia
<b>Greg Sheppard</b>	Project Manager	Wesfarmers
<b>Amanda Tucker</b>	Manager Safety Improvement	BMA
<b>Kane Usher</b>	Manager Asset Performance	Rio Tinto Coal Australia
<b>Noel Zahra</b>	Manager – Maintenance Strategy	BMA



## FUNDING APPROVED 2013



Year	No of Projects	ACARP Funding	Total Funding
2013	18	\$4,320,731	\$7,634,739
2012	15	\$4,021,797	\$5,293,328
2011	23	\$5,202,742	\$9,963,649

## PROJECTS UNDER MANAGEMENT 2013

Category	No of Projects	ACARP Funding
Drilling and Blasting	2	\$712,380
Environment	26	\$6,632,410
Geology	7	\$2,192,175
Maintenance and Equipment	9	\$7,145,885
Mining and the Community	2	\$244,443
Occupational Health and Equipment Safety	7	\$1,558,781
Overburden Removal	4	\$740,022

## OPEN CUT PROJECT APPROVALS 2013

### Drilling and Blasting

<p><b>Improved Blast Outcomes by Integrating Structural and Blast Modelling C23028</b></p> <p>University of Queensland George Poropat Sarima Kanchibotla</p>	<p>255,007</p>	<p>Vishwa Bhushan, Rio Tinto Coal Australia Steve Simmons, Anglo American Metallurgical Coal David Drew, Wesfarmers Curragh</p>	<p>The performance and safety of drill and blast operations could be improved if this project to produce a prototype software tool is successful. The objective of this project is to produce improved blast induced fragmentation through better blast design, based on more accurate representation of rock mass structures in blast analysis software and improved prediction and management of blast related hazards, such as face bursts.</p>
<p><b>Alternative and Sustainable Explosive Formulations to Eliminate Nitrogen Oxide Emissions C23029</b></p> <p>CRCMining Italo Onederra</p>	<p>352,527</p>	<p>Vishwa Bhushan, Rio Tinto Coal Australia Steve Simmons, Anglo American Metallurgical Coal David Drew, Wesfarmers Curragh</p>	<p>Government directives to stop blasting activities due to nitrogen oxide (NOx) fume incidents have led to costly delays in production. The aim of this project is to develop and evaluate the detonation performance of explosive formulations that could provide higher levels of control against the NOx fume hazard. This will include an improved formulation that adequately matches the breakage requirements of soft and saturated ground conditions and an explosive formulation that substitutes the use of ammonium nitrate as the main oxidising agent in order to completely eliminate the potential of NOx by products.</p>

### Environment

<p><b>Salinity Tolerance of Freshwater Organisms from the Southern and Western Coalfields C23010</b></p> <p>University of Queensland Sue Vink</p>	<p>177,000</p>	<p>Ryan Kinnealy, BMA Bernie Kirsch, Centennial Coal Gary Brassington, BHP Billiton Illawarra Coal</p>	<p>Mine water releases are regulated by salinity (measured as electrical conductivity), pH and concentration limits for a number of other constituents, including heavy metals. Local guidelines should be developed from tests conducted using locally collected organisms and tests solutions that have a composition similar to natural stream waters. The overall objective of this work is to produce toxicity datasets for the Southern and Western coalfields in New South Wales that can be used to develop local salinity guidelines. The work will be conducted using field caught and laboratory reared organisms tested with artificial mine water solutions diluted with artificial creek waters. This method will remove the confounding effects of other constituents that may be toxic and present in mine water solutions.</p>
<p><b>Quantification of PM2.5 Particulate Emission Rates from Mining Operations C23021</b></p> <p>Air Noise Environment Claire Richardson</p>	<p>277,359</p>	<p>John Watson, Glencore Jason Fittler, Anglo American Metallurgical Coal Bruce Foster, Rio Tinto Technology &amp; Innovation</p>	<p>The control of dust has been a fundamental part of mine environmental management plans for many decades. This extension project builds on previous work that confirmed the validity of a PM2.5 dust fraction sampling methodology and developed an initial database of PM2.5 emission rates. The overall objective of this project is to determine reliable particulate emission rates for the PM2.5 dust fraction for a range of coal mining activities. The initial dataset will be extended by completing additional field work.</p>
<p><b>Industry based Rehabilitation and Closure Knowledge Management System: Scoping Study C23023</b></p> <p>University of Queensland Corinne Unger</p>	<p>75,000</p>	<p>Ryan Kinnealy, BMA Bernie Kirsch, Centennial Coal Stuart Ritchie, Rio Tinto Coal Australia</p>	<p>There is a lack of tangible evidence of successful rehabilitation and regulatory sign off of coal mining tenure, despite many anecdotal case studies of successful mature rehabilitation at coal mines in Central Queensland. This scoping study will evaluate existing tools and database systems to determine the best method for incorporating an informal knowledge base, a discussion based forum and a portal for identifying and accessing available rehabilitation tools via one regionally based system. This process aims to ensure vital but unpublished information is retained, that appropriate tools are used for storage and management of knowledge, and that these are used to improve environmental and rehabilitation performance.</p>
<p><b>Coal Pit Lake Closure by River Flow Through: Risks and Opportunities C23025</b></p> <p>Edith Cowan University Mark Lund</p>	<p>362,714</p>	<p>Scott Diggles, Rio Tinto Coal Australia Digby Short, Premier Coal</p>	<p>Many Australian coal mines have pit lakes that will increase in salinity over time due to evapo concentration. Increased catchments and river diversions may offer opportunities for these saline pit lakes to reduce or maintain their salinities. One way of substantially increasing the pit lake's catchment is to connect the lake to a river or stream. This scenario was field demonstrated at Lake Kepwari, where benefits to biodiversity and water quality as a result of a river breach were noted. In addition to assessing the environmental impacts of this process, the project will develop a national standard protocol for monitoring seasonal rivers that could be applied by the coal industry to manage river flow throughs (either accidental or planned), as part of a mine closure strategy.</p>

PROJECT/RESEARCHER ACARP FUNDING INDUSTRY MONITORS OVERVIEW

**OPEN CUT PROJECT APPROVALS 2013**

<p><b>Reducing Analytical and Water Quality Monitoring Costs Using Diffusive Gradients in Thin Film (DGT) Technique C23027</b></p> <p>University of Queensland Sue Vink</p>	163,000	<p>Ryan Kinnealy, BMA Claire Cote, Anglo American Metallurgical Coal John Merritt, Burton</p>	<p>Environmental authorities of Bowen Basin mines require considerable investment in manual water sampling and analysis for dissolved heavy metals and arsenic. Water sampling for analysis of metal and metalloid concentrations is required upstream and downstream of the mine during water releases. This project aims to evaluate a new time integrated approach to assessing water quality in the Fitzroy catchment. The novel in situ sampling technique – diffusive gradients in thin (DGT) films – could potentially replace numerous water samples and will provide a far more representative view of in steam concentrations over the deployment period.</p>
<p><b>Collaborative Performance Trajectories for Diversion Licence Relinquishment C23030</b></p> <p>Alluvium Consulting (Queensland) Rohan Lucas</p>	196,210	<p>Ryan Kinnealy, BMA Claire Cote, Anglo American Metallurgical Coal John Merritt, Burton Scott Diggles, Rio Tinto Coal Australia</p>	<p>Currently there are no clear river/creek diversion criteria that enable the mining industry, regulators and stakeholders to track diversion conditions and understand the measures required to achieve licence relinquishment. Researchers will work with the mining industry and the Queensland Department of Natural Resources and Mines to develop a process and terms of reference for stakeholder involvement in diversion licence relinquishment, to establish physical form and vegetation criteria, and trial a combined social and scientific approach to defining and assessing outcomes for diversions at licence relinquishment.</p>
<p><b>Pilot Scale Integrated Forward and Reverse Osmosis System for Mine Water Reuse C23031</b></p> <p>CSIRO Ramesh Thiruvengkatchari</p>	258,237	<p>John Watson, Glencore Nardia Keipert, Peabody Energy Australia Carl Grant, Anglo American Metallurgical Coal Claire Cote, Anglo American Metallurgical Coal</p>	<p>This project offers the coal industry a novel, cost effective desalination technology that produces higher water recovery and reduction in mine site brine storage volumes. A laboratory scale, osmotically driven process (the driving force for water transfer across a membrane is osmotic instead of hydraulic pressure) has been integrated with a reverse osmosis unit to treat mine affected water, producing a steady stream of reusable quality water, thereby eliminating extensive pre treatment steps that are generally required for reverse osmosis. This project will develop a pilot scale, integrated treatment system that can process 1m<sup>3</sup> of water per day and will complete a preliminary technical and economic assessment of the technology.</p>
<p><b>Real Time Mine Specific Upper Air Data For Use In The Management of Mine Noise, Dust, Blast Fume and Overpressure C23032</b></p> <p>Todoroski Air Sciences Aleks Todoroski</p>	165,160	<p>John Watson, Glencore Bruce Foster, Rio Tinto Technology &amp; Innovation</p>	<p>Real time, upper air data is needed at coal mines because standard onsite weather stations cannot provide the necessary data on upper air weather conditions which affect the transport of emissions or the propagation of noise from mine sites. Useful real time and predictive systems cannot be developed without such data. This project will verify whether upper air data soundings in a central location can be used to provide accurate, real time upper air weather data specific to each mine in a region. If so, a framework will be provided to roll out cost effective, real time and predictive systems in any region.</p>
<p><b>Study of Sustainability and Profitability of Grazing on Mine Rehabilitated Land in the Upper Hunter C23053</b></p> <p>NSW Department of Primary Industries Lester McCormick</p>	200,000	<p>Nigel Charnock, Glencore Bill Baxter, Rio Tinto Coal Australia</p>	<p>The grazing capacity of rehabilitated pastures is not yet fully known and, in many cases, results and grazing benefits have not been fully documented. This project aims to address the community concerns through a grazing study on two mine sites in the Upper Hunter Valley. The mines will provide two areas which have been mined and rehabilitated and two analogue (native) pasture sites. The four sites will be fenced to allow grazing by four herds of weaner steers (10 head per site). The data collected will be used to analyse the sustainability of the study area and will be compared with data collected from the analogue sites. Animal health and weight will be a significant focus of the project. Stakeholders and regulators are involved in the development and implementation of the study.</p>

**Geology**

<p><b>Non Destructive Characterisation of Borehole Coal Samples using X CT Technology C23024</b></p> <p>University of Queensland Anh Nguyen</p>	200,000	<p>Patrick Tyrrell, New Hope Group Shaun Booth, Glencore Richard Ruddock, Rio Tinto Coal Australia Jeremy Byrnes, Glencore Joan Cowburn, Anglo American Metallurgical Coal</p>	<p>Exploration and development of new coal mines and mine plan strategies depend exclusively on the characterisation of borehole coal samples. This project will develop a novel nondestructive technique to characterise borehole coal samples using x-ray computed tomography, which is safe, environmentally friendly, fast and cost effective.</p>
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PROJECT/RESEARCHER      ACARP FUNDING      INDUSTRY MONITORS      OVERVIEW

## OPEN CUT PROJECT APPROVALS 2013

<p><b>Rockfall Hazard Matrix For Risk Reduction in Mine Sites C23026</b></p> <p>University of Newcastle Anna Giacomini</p>	<p>259,590</p>	<p>Andrew Johnstone, BMA Ashley Creighton, Rio Tinto Coal Australia Shaun Booth, Glencore</p>	<p>Rock falls represent a serious hazard in open cut mines, threatening human lives, machinery and portal structures for underground entry located at the toe of highwalls. A set of tools specifically designed for coal mining environments will be developed to provide practitioners with more rigorous guidance on rock fall management strategies. The procedure will incorporate field observations (historical records), mitigation measures, established analytical and numerical tools (empirical run outs estimates, rock fall trajectory simulation), and the latest research developments in rock fall hazard assessment and zoning (3D photogrammetry, block modelling and intensity frequency matrix). This work should help mine personnel to generate hazard zoning maps that can be regularly updated and site specific matrices of mitigating measures.</p>
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## Maintenance and Equipment

<p><b>Automated Swing Loading System for Electric Mining Shovels C16031</b></p> <p>CRCMining Ross McAree</p>	<p>295,467 New</p> <p>4,514,440 Existing</p>	<p>Steve Amor, Anglo American Metallurgical Coal Wayne Clement, Glencore Tony Egan, Glencore Hans Hayes, Anglo American Metallurgical Coal Simon Orton, BMA Greg Sheppard, Wesfarmers Kane Usher, Rio Tinto Coal Australia</p>	<p>The fourth phase of this project will further develop and demonstrate an automated digging system for electric mining shovels, building on work completed already in the shovel load assist project (SLAP). Conceived as truck loading 'at the press of a button', the project will use terrain mapping technology and a digging and multi-pass loading control system that will plan and execute digs that are efficient, safe and robust. The system will also quantify shovel performance in terms of machine productivity, dipper payloads, shovel cycle times and achieved load distribution in the truck.</p>
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## Mining and the Community

<p><b>Approval and Planning Assessment of Black Coal Mines in NSW and Qld: A Review of Economic Assessment Techniques C23016</b></p> <p>The Hunter Valley Research Foundation Simon Deeming</p>	<p>35,000</p>	<p>Stuart Ritchie, Rio Tinto Coal Australia Bernie Kirsch, Centennial Coal Bret Jenkins, Glencore Julie-Anne Braithwaite, Rio Tinto Coal Australia</p>	<p>The techniques and methodology used in the economic assessment process for coal mine approvals are becoming an area of increasing contention. This research aims to provide a comprehensive understanding of the methodologies that have been employed in the economic assessment of past applications for new mining projects and substantial mine extensions. It will summarise the available methodologies and identify their limitations and advantages. A robust economic assessment of a coal mine proposal is expected to provide proponents with greater confidence in the process.</p>
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## Occupational Health and Equipment Safety

<p><b>Site, Corporate and Specialist Methods for Selection and Optimization of Critical Controls C23007</b></p> <p>University of Queensland Chris Doran Jim Joy</p>	<p>250,000</p>	<p>John Hempenstall, Centennial Coal Tony Egan, Glencore</p>	<p>The coal industry has reached a point where further reduction of health and safety risk may require substantial new capital and operating costs. The industry's traditional 'trial and error' approach to investigating new engineering controls is costly and potentially inefficient for selecting complex controls. This project will develop generic control effectiveness analysis methods that can be applied at three levels – site, corporate and specialist – to match the specific risk reduction requirements for new control technologies. The method aims to optimise the safety outcomes and cost benefit of major investments intended to reduce risk.</p>
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PROJECT/RESEARCHER ACARP FUNDING INDUSTRY MONITORS OVERVIEW

**OPEN CUT PROJECT APPROVALS 2013**

<p><b>Managing Whole Body Vibration at Surface Coal Mines C23022</b></p> <p>University of Queensland Robin Burgess-Limerick</p>	149,100	<p>Amanda Tucker, BMA Troy O'Reilly, Stanwell Corporation</p>	<p>Operators of surface mining equipment are exposed to whole body vibration through the seat. Prolonged exposure to high amplitude whole body vibration causes serious long term health effects, particularly back disorders. The objectives of the project are to validate a simple and cost effective whole body vibration measurement device suitable for use by mine health and safety staff and to demonstrate and evaluate the implementation of the device as part of a comprehensive whole body vibration management program to reduce vibration exposure associated with surface coal mining equipment.</p>
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**Overburden Removal**

<p><b>Dragline Automation System: Optimal Excavation Sequencing C23033</b></p> <p>CRCMining Ross McAree</p>	649,360	<p>Kane Usher, Rio Tinto Coal Australia Steve Amor, Anglo American Metallurgical Coal Simon Orton, BMA Greg Sheppard, Wesfarmers</p>	<p>Improving dragline performance through automation is the overall objective of this project. It will focus on the development and implementation of a dig sequence technology that identifies the optimal sequence of dragline operations and movements that most efficiently excavate a block of material. This operator assist technology provides operators with instantaneous position, digging and dumping guidance and should result in faster average cycle time and positioning time, a higher degree of compliance to the desired final pit geometry, a reduction in rework and rehandling of material, and pre warning of potential pit issues such as spoil bound scenarios.</p>
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**OPEN CUT PROJECTS UNDER MANAGEMENT 2013**

**Drilling and Blasting**

<p><b>RAB Drill Rig Top of Coal Detection While Drilling C21005</b></p> <p>CRCMining Ian Gregg</p>	459,340	<p>Andrew Denman, BMA Kirk Henderson, Peabody Energy Australia John Hoelle, Anglo American Metallurgical Coal Ken Preston, Rio Tinto Coal Australia</p>	<p>Accurately detecting the top of a coal seam before blasting is integral to efficient coal recovery. Currently coal is mapped using geophysical methods from an exploration drill rig ahead of mining which is expensive and resource intensive. A prototype measurement while drilling system is being constructed that can search for and detect the presence of the coal seam while routinely drilling blast holes. This project is fully characterising the prototype and test its performance in the field. By knowing where the top of the coal is and having full knowledge of the surrounding geological conditions, blast engineers can then design the blasts to reduce coal damage.</p>
<p><b>Real Time Detection of Moisture Content and Rockmass Structures for Fume Mitigation and Improved Cast Blasting Operations C22024</b></p> <p>CSIRO Shiva Karekal</p>	253,040	<p>Steve Simmons, Anglo American Metallurgical Coal</p>	<p>Ultra-cast blasting is commonly used in open cut mines to move overburden greater distances and with better rock fragmentation suitable for dragline operation. However, orange clouds of toxic nitrogen oxides can be produced when moisture in the hole reacts with the explosives. This also reduces the energy effectiveness of the explosives. Currently there are no instruments that can effectively measure the moisture content in blast holes and map the structures surrounding the hole. In this proposal, custom radar and a dielectric probe will be adapted to suit a blast hole survey to identify regions of high moisture content along the blast hole length and to map wider fractures/ crevices/joint planes around the boreholes. This technology may also enable real-time identification of water seepage in the blast hole.</p>

**Environment**

<p><b>Emissions from Blasting in Open Cut Coal Mining C18034</b></p> <p>CSIRO Stuart Day</p>	276,000	<p>Andrew Speechly, Rio Tinto Coal Australia</p>	<p>Atmospheric emissions of pollutants from blasting at open cut coal mines are of considerable concern to nearby communities such as in the upper Hunter Valley. Although these emissions must be estimated and publicly reported each year through the National Pollutant Inventory (NPI), recent research has shown that the estimates are subject to considerable uncertainty. Furthermore, it has been shown that toxic species can be carried considerable distances downwind of the blasts. However, the extent to which local populations are affected by the emissions is unknown and remains to be determined. This project used continuous spectroscopic monitoring to determine the concentration of NO<sub>2</sub> at the boundary of a large open cut coal mine. The results were then used to quantitatively determine the contribution of blasting to ambient NO<sub>2</sub> concentrations in surrounding districts. In addition, hydrocarbon emissions from blasts were sampled and analysed to determine the range of compounds released.</p>
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PROJECT/RESEARCHER      ACARP FUNDING      INDUSTRY MONITORS      OVERVIEW

## OPEN CUT PROJECTS UNDER MANAGEMENT 2013

<p><b>Guidelines for Establishing Ecologically Sustainable Discharge Criteria in Seasonally Flowing Streams C19024</b></p> <p>University of Queensland Sue Vink</p>	<p>238,000</p>	<p>Nardia Keipert, Peabody Energy Australia Carl Grant, Anglo American Metallurgical Coal Stuart Ritchie, Rio Tinto Coal Australia</p>	<p>Recent reports have highlighted the lack of appropriate data and analysis in assessing local and cumulative impacts of saline mine site discharges on the aquatic environment in the Bowen Basin. This project will improve the understanding of the impact saline water discharged from mine sites has on seasonally flowing streams and their ecosystem function. In particular it is focussing on the processes that control the movement of salts in these streams and assess the impacts of salts on the fundamental ecological processes driving ecosystem function.</p>
<p><b>Risk Assessment Tools to Support End Use Decisions for Mined Land of the Bowen Basin C19028</b></p> <p>University of Queensland Bob Maczkowiack Carl Smith</p>	<p>250,000</p>	<p>Craig Lockhart, Peabody Energy Australia Bernie Kirsch, Centennial Coal</p>	<p>In the past the focus of returning mined land to a sustainable end use has focused on grazing but grazing is not always appropriate and other land uses may need to be considered. However there is currently no formal method to understand and assess risks associated with alternative end uses (such as forestry, recreation, military or Indigenous use). This project developed a framework/approach for assessing risks of post-mining land uses that is acceptable to the industry and the Queensland government regulator. Assessment models for evaluating risks associated with several proposed end uses for mined land in the Bowen Basin were also developed.</p>
<p><b>Soil Organic Matter and Green Carbon in Rehabilitation: Their Role in the Carbon Balance C19029</b></p> <p>University of Queensland Thomas Baumgartl</p>	<p>253,200</p>	<p>Nardia Keipert, Peabody Energy Australia Bernie Kirsch, Centennial Coal</p>	<p>Successful rehabilitation is commonly associated with the successful establishment of vegetation. One way to compare vegetation is through the accumulation and storage of plant carbon, recently referred to as green carbon. Decomposition of organic matter originating from green carbon will add to organic carbon stored in soils and is a key parameter for soil formation. Decomposed organic carbon is incorporated and accumulated in the soil over space and time as soil organic matter (SOM). This project is quantifying the rate of accumulation of SOM on rehabilitated sites over time and the contribution of different types of vegetation and land management on increasing SOM in soils.</p>
<p><b>Environmental Offsets: Maximising Ecosystem Services from Biodiversity Conservation C19033</b></p> <p>University of Queensland Damian Barrett</p>	<p>261,750</p>	<p>Carl Grant, Anglo American Metallurgical Coal Stuart Ritchie, Rio Tinto Coal Australia Bernie Kirsch, Centennial Coal</p>	<p>Environmental offsets are management instruments that compensate for the potential impact of resource development on natural ecosystems or alternate land uses. Compensation can be in the form of replacement biology values, water, carbon sequestration and other 'green' credit. This project assessed the potential for environmental offsets to compensate for ecosystem services on land disturbed by mining and associated activities, ensuring the integrity of ecosystem services, and assessing the uncertainties and risks of using environmental offsets.</p>
<p><b>Sustainable Management of Plantations for Rehabilitation, Carbon and Wood Products C20015</b></p> <p>Industry &amp; Investment NSW Georgina Kelly</p>	<p>187,068</p>	<p>John Hindmarsh, Rix's Creek Bill Baxter, Rio Tinto Coal Australia</p>	<p>Since 1999 a number of replicated research trials have been established on mine lands in the Hunter Valley, to assess the viability of tree plantations as a post mining land use and to assess the economic and environmental benefits of buffer land planting. This project will quantify the benefits of early thinning (year 10) and maximise the long term survival and health of these trials. It will also provide data mid rotation (15 years), at which stage final growth projections are much more reliable. The growth data will allow longer term yields to be estimated, ensuring that mines have a sound basis upon which to make decisions on species, location and management of future stands.</p>
<p><b>Minimise Fume Generation from Blasting C20016</b></p> <p>CSIRO Alastair Torrance</p>	<p>240,000</p>	<p>Steve Simmons, Anglo American Metallurgical Coal Andrew Speechly, Rio Tinto Coal Australia</p>	<p>Post blast fume generation is a concern in open cut mining operations. The fumes produced can have significant health implications and potentially, serious environmental and financial impacts on the coal industry. The production of fumes is due to an oxygen positive reaction that is known to be dependent on a range of explosive related factors. Unfortunately the overall understanding of the mechanism for fume generation is not fully understood. This project provided a method to assess the potential production of fumes from blasting, utilising and applying some existing and novel measurement techniques.</p>

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<p><b>Criteria for Functioning River Landscape Units in Mining and Post Mining Landscapes C20017</b> Alluvium Consulting (Queensland) Rohan Lucas</p>	<p>255,280</p>	<p>Craig Lockhart, Peabody Energy Australia Stuart Ritchie, Rio Tinto Coal Australia</p>	<p>It has been a number of years since the original ACARP diversion criteria research. There is anecdotal industry evidence that the original research was successful, however this has not been tested. In addition there has been considerable developments in the river rehabilitation industry that can inform diversion design operation and monitoring. This research is refining and updating the previous work by reviewing the success or otherwise of diversions constructed using the ACARP design criteria. It is updating the criteria based on the outcomes of this work and recent research within the river rehabilitation industry. The project will identify the issues associated with diversions through spoil and set a pathway for their resolution.</p>
<p><b>Hydraulic Connectivity Between Mines and Adjacent River and Groundwater Systems in the Hunter River Valley C20022</b> University of Queensland Betlef Bringemeier Ling Li</p>	<p>377,810</p>	<p>John Watson, Glencore Andrew Speechly, Rio Tinto Coal Australia</p>	<p>This project will improve the understanding of the hydraulic connectivity between mines and adjacent river and groundwater systems in the Hunter River Valley and other Australian coal mining regions. It will also develop a set of criteria for assessing the mining impact on the rivers and aquifers. The work will combine mathematical modelling and field measurements of key hydrogeological and hydraulic parameters within the study area. A mathematical model is being developed to simulate the interactions between the mines and adjacent aquifer systems.</p>
<p><b>Improvement of Haul Road Dust Emission Estimation and Controls at Coal Mines C20023</b> Pacific Environment Operations Judith Cox</p>	<p>473,160</p>	<p>Craig Lockhart, Peabody Energy Australia</p>	<p>Traffic generated dust from haul roads represents a significant proportion of the total dust emitted from open cut coal mining operations. This not only has the potential to have a detrimental impact on local ambient air quality, but can create a safety hazard. Minimising dust emissions is critical to protecting ambient air quality. This project is determining the control effectiveness of various dust suppressants under varying site conditions and will provide the industry with a methodology to assess their efficiency.</p>
<p><b>Assessing Environmental Safety of In-pit Disposal of Tailings C20027</b> University of Queensland Thomas Baumgartl</p>	<p>268,600</p>	<p>Craig Lockhart, Peabody Energy Australia</p>	<p>Disposal of tailings into voids is considered beneficial due to the reduction of environmental risk compared to above ground storage. The successful use of voids for tailings requires guaranteed environmental safety. Concerns raised by in-pit tailings disposal relate primarily to the risk to local or regional ground water and surface water contamination and within the tailings to salt transport to the surface and its risk of mobilisation by runoff and dust. This project is investigating the long term environmental risk caused by in-pit tailings disposal by simulating the hydrological and geochemical behaviour of in-pit tailings for a number of different settings.</p>
<p><b>Live Noise Prediction Method for Mining Activities in Australian Conditions C21026</b> AECOM Peter Sanderson</p>	<p>73,496</p>	<p>Stephen Schaller, Rio Tinto Coal Australia Mahdi Mason, Caledon John Watson, Glencore</p>	<p>Noise from mobile plant at Hunter Valley coal mines is a source of complaint from neighbours, and mine operators have recognised the need to monitor these noise sources and predict the 'live' noise impact. This project developed a noise model that constantly predicts the noise impact at sensitive receivers based on up to date GPS information from mobile sources on site, current meteorological data and the operational status of fixed plant. This system could be used to determine compliance, assess complaints, and identify operational problems with specific plant items.</p>
<p><b>Tool to Assess Mining Impacts on River Condition C21031</b> Central Queensland University Claire Sellens</p>	<p>325,945</p>	<p>Craig Lockhart, Peabody Energy Australia Stuart Ritchie, Rio Tinto Coal Australia</p>	<p>The management of mining impacts on rivers and other aquatic ecosystems at a local and regional level is a key priority for the coal industry. The industry needs to be able to accurately monitor and assess its onsite and downstream impacts on water quality. Existing guidelines and predictive models for river health are not suitable for assessing mine site impacts because they are typically determined from steady state conditions. This project is developing a region specific tool for assessing the condition of temporary streams on Central Queensland mines. Changes to the macroinvertebrate communities during the wet and dry cycles are being examined to determine the effect of change on aquatic health assessments, a predictive modelling tool for assessing river health is being developed, and the feasibility of alternative approaches to assessing the health of streams is being explored.</p>

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<p><b>Modelling the Water, Energy and Economic Nexus C21033</b></p> <p>University of Queensland Alan Woodley</p>	194,750	<p>Stuart Ritchie, Rio Tinto Coal Australia</p> <p>Scott Diggles, Rio Tinto Coal Australia</p> <p>Claire Cote, Anglo American Metallurgical Coal</p>	<p>The coal industry is facing two major water and energy challenges – securing enough water and energy to meet an estimated 70% increase in demand over the next 10 years and improving its reputation in relation to water and energy management. Previous ACARP projects have developed tools (SiteMiser and WaterMiner) that allow mines to account for their water use, compare their water use with other sites, and report their use against a standard framework. The Centre for Water in the Minerals Industry has recently begun work on a hierarchical system model that expands water interactions to a regional level. This project is covering two other dimensions – energy and emissions, and the true value of water and energy – which will help sites better understand the risks and opportunities of strategic water and energy management.</p>
<p><b>Quantification of PM 2.5 Particulate Emission Rates from Mining Operations C21034</b></p> <p>Air Noise Environment Claire Richardson</p>	199,740	<p>Clinton Theil, BMA</p> <p>John Watson, Glencore</p> <p>Bruce Foster, Rio Tinto Technology &amp; Innovation</p>	<p>The control of dust has been a fundamental part of any mine environment management plan for many decades. The challenge for mining companies is to implement a dust management system that recognises and responds to the issue of dust emissions at all stages of mining from mine planning and operation through to mine closure. The ability to assess dust loadings in communities around open cut coal mines is problematic due to the absence of suitable PM2.5 emission data. This project addressed this issue by determining particulate emission rates for the PM2.5 dust fraction for a range of open cut coal mining activities.</p>
<p><b>Multiple Pollutant Analysis of Blast Plumes from Open Cut Mining Activities Using Differential Optical Absorption Spectroscopy (DOAS) C21035</b></p> <p>Simtars Mark Curtis</p>	361,283	<p>Steve Simmons, Anglo American Metallurgical Coal</p> <p>Vishwa Bhushan, Rio Tinto Coal Australia</p> <p>Andrew Speechly, Rio Tinto Coal Australia</p>	<p>Open cut mines rely extensively on the use of explosives to remove surface material covering coal seams. The emissions from the resultant explosions can contain toxic gases which have the potential to travel outside designated exclusion zones. Community perception of the risk, whether real or imaginary, can restrict the ability of operators to conduct their normal mining activities. To reliably assess the potential of workplace and community exposure, there is a need to accurately measure the cloud composition, or plume, from blasting operations. This project utilises differential optical absorption spectroscopy technologies to safely measure airborne emissions. This technique is regularly used for the remote measurement of stack emissions.</p>
<p><b>Physical and Detonation Characteristics of Bulk Explosives to Minimise Post Blast Fume Generation in Deep Hole, Soft Ground and Wet Conditions C21036</b></p> <p>JKTech Sarma Kanchibotla</p>	400,000	<p>Steve Simmons, Anglo American Metallurgical Coal</p> <p>Vishwa Bhushan, Rio Tinto Coal Australia</p> <p>Lindsay Ford, Glencore</p>	<p>Post blast fumes (NOx) from coal overburden blasting remain an industry concern. The generation of blast fumes is not well understood as many factors contribute to this process. There is however agreement that the conditions leading to NOx fumes are associated with fuel deficiencies or incomplete detonation of the explosive product. This project supplements the current developments of project C20016 and uses the instrumentation developed in this project to determine the physical and detonation characteristics of bulk explosives and its impact on fumes generation through field measurements.</p>
<p><b>Managing Mine Water Under Extreme Climate Variability C21037</b></p> <p>CSIRO Damian Barrett</p>	293,000	<p>Nardia Keipert, Peabody Energy Australia</p> <p>Stuart Ritchie, Rio Tinto Coal Australia</p> <p>Claire Cote, Anglo American Metallurgical Coal</p>	<p>The Bowen Basin coal mines operate in one of the most highly variable climates in the world and managing mine water resources is a major challenge to production, sustainability and profitability of mines. This project is developing a rigorous and objective technique for exploring management strategies, assessing risk and addressing the challenges of excess and insufficient water on mine sites. The use of a climate driven, landscape integrated, hierarchical model of a mine water system will be used. It will be embedded within an optimisation scheme capable of examining optimal onsite water management processes.</p>
<p><b>Enhancing Ecological Values of Coal Pit Lakes with Simple Nutrient Additions and Bankside Vegetation C21038</b></p> <p>Edith Cowan University Mark Lund</p>	182,575	<p>Digby Short, Premier Coal</p>	<p>Where more detailed pit lake closure criteria are provided by the regulators, they are typically based around ANZECC/ ARMCANZ (2000a) water quality guidelines as a proxy to the ecosystem value of pit lakes. However, it is difficult to determine which set of guidelines (irrigation, drinking water, aquatic ecosystem protection) is most appropriate. A significant management option that these guidelines offer is developing site specific trigger values for the operation's location. This project is examining whether pit lake ecosystem values rather than water quality could be considered by regulators as criteria for accepting pit lake closure and relinquishment back to the state.</p>



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<p><b>Demonstration Trials to Understand and Assess the Processes Required to Recover the Productivity of Cropping Soils After Mining C21039</b></p> <p>University of Queensland Thomas Baumgartl</p>	67,611	<p>Nardia Keipert, Peabody Energy Australia Carl Grant, Anglo American Metallurgical Coal Mahdi Mason, Caledon Ross Gooley, BMA Bruce Foster, Rio Tinto Technology &amp; Innovation Peter Roe, BMA</p>	<p>Future mine developments will be affected by the introduction of the Strategic Cropping Land (SCL) policy framework. The policy states that the use of SCL will only be permitted if users can demonstrate that the mined land can be rehabilitated to its pre mine productivity levels. The mining industry has considerable experience in rehabilitation of mined land in general, but very little experience Australia wide in the rebuilding of land to meet agricultural production targets as a measure of rehabilitation success. Research at an international level has shown that the rehabilitation of prime agricultural land is possible, but application of this knowledge will need to be adapted for the Australian environmental conditions and soil types. This project established demonstration trials to determine what is required to recover the productivity of cropping soils after mining. Proving the success of rehabilitation in the Australian environment with climatic extremes is a time dependent process and a long term commitment to monitoring and assessment is required to achieve confidence in the outcomes of the research.</p>
<p><b>Designing a Mine for Both Drought and Flood: A Vulnerability and Adaptive Capacity Study C21041</b></p> <p>CSIRO Jane Hodgkinson</p>	135,635	<p>Stuart Ritchie, Rio Tinto Coal Australia Mahdi Mason, Caledon Claire Cote, Anglo American Metallurgical Coal</p>	<p>During the recent prolonged drought, coal mines were encouraged to reduce their water use. Simultaneously, changes to the regulatory environment led many mines to start operating effectively under a zero discharge situation. This can be catastrophic in times of flood. Indeed, for the second time in three years, many Australian coal mines have ceased production due to the onset of flooding rains. This project aimed to minimise downtime and hazards resulting from extreme weather events by developing a tool that assists with resource allocation and planning priorities. The project tested the applicability of this method at a mine where the probability of cycling between extreme wet and extreme dry weather is highly likely. This type of method – which uses a multi criteria approach and pre existing data in a geographic information system – will allow mines to identify their vulnerabilities and priorities for action while considering their capacity to adapt with current resources.</p>
<p><b>Microclimate Revegetation Monitoring C21042</b></p> <p>CSIRO Christian Richter Darren Moore</p>	266,555	<p>Paul Veivers, Stanwell Corporation Troy O'Reilly, Stanwell Corporation</p>	<p>The Environmental Protection Act 1994 sets out the broad principles for rehabilitation and completion of a mining project. There is a requirement that mining companies provide the regulator with robust evidence that they are meeting their obligations for rehabilitation of mined areas. The Queensland Government Department of Environment and Resource Management requires adequate evidence that a project meets various indicators such as vegetation type, cover and density before certification of mine closure. This project is assessing the opportunity of coupling environmental data obtained through the state of the art wireless sensor network technology, biodiversity habitat attributes recorded through the BioCondition assessment method, and forest growth modelling using the Ecosystem Dynamics Simulator. The data will be used to provide a robust model that demonstrates early mine rehabilitation success by measuring trends in vegetation establishment.</p>
<p><b>Integrated Forward and Reverse Osmosis System for Mine Water Reuse C21043</b></p> <p>CSIRO Ramesh Thiruvengkatachari</p>	168,560	<p>Nardia Keipert, Peabody Energy Australia Carl Grant, Anglo American Metallurgical Coal</p>	<p>Managing the saline water generated during mining is becoming an important and costly exercise for the coal industry. Environmental constraints can prevent untreated mine water from being discharged. During heavy rain these conditions may be met and discharge can occur, however the build up of water on a mine site can occur at a faster rate than the discharge, requiring additional water storage facilities on site. During times of drought the saline water is a valuable resource. This project will integrate the non-pressure driven (hence less energy intensive) forward osmosis system into a widely applied reverse osmosis technology so that mine impacted water can be reused.</p>
<p><b>Real Time Monitoring and Prediction of Open Cut Blast Fumes C22025</b></p> <p>CSIRO Darren Moore</p>	356,880	<p>Steve Simmons, Anglo American Metallurgical Coal Paul Veivers, Stanwell Corporation</p>	<p>Toxic fumes can be produced through the use of ammonium nitrate fuel oil (ANFO) explosives for blasting in open cut coal mining operations. Knowledge of the behaviour of a blast plume is vital to the optimal management of a fume event. The aim of this project is to develop and demonstrate a system to better monitor and predict blast fume concentrations in open cut coal mines. Current fume and weather measurements and up to date plume predictions will be made available to mine operators in real time via a map based iPhone app and web interface.</p>

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<p><b>Managing Dig: Ensuring Currency in an Invaluable Resource C22026</b></p> <p>University of Queensland Melina Gillespie</p>	137,520	<p>Mahdi Mason, Caledon</p> <p>Ann Perkins, Rio Tinto Coal Australia</p>	<p>The Dig coal mine rehabilitation bibliographic database was developed to provide industry, government, researchers and other interested parties with reference information relevant to the rehabilitation of land after coal mining. In order to enable ongoing use and to maximise its value, continual updating, maintenance and improvements are necessary. This project will further improve the technology, features, searchability and provision of knowledge in the database, with ongoing emphasis on the uploading of new material and general maintenance.</p>
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<p><b>Australian Specific Dust Emission Factors for Coal Mines C22027</b></p> <p>Pacific Environment Operations Damon Roddis Judith Cox</p>	387,992	<p>John Watson, Glencore</p> <p>Bruce Foster, Rio Tinto Technology &amp; Innovation</p>	<p>Understanding the level of emissions from dust-generating activities (and the level of control that can be achieved) is critically important at the environmental assessment stage of a mine and for operational purposes. The ability to more accurately assess air quality impacts is particularly relevant to the Hunter Valley as annual average concentrations of PM10 are approaching the assessment criterion set by regulators. As a result there are parts of the Hunter Valley where even minor increments in PM10 concentrations of a few micrograms per cubic metre of air can result in the assessment criterion being exceeded. This project will update the emission factors used to estimate dust emissions from coal mines.</p>
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## Geology

<p><b>Characterisation of Overburden Rock Mass and Top Coal Delineation Using the Triaxial Drill Bit Vertical Seismic Profiling (VSP) Method C19020</b></p> <p>CSIRO Shiva Karekal Toshiyuki Toshi</p>	283,290	<p>Kirk Henderson, Peabody Energy Australia</p> <p>Andy Willson, Anglo American Metallurgical Coal</p>	<p>Characterising overburden rock mass and identifying the top surface of the coal help to improve coal recovery, drilling and blasting, and the design of stable highwall/pit slopes. This project is being undertaken in collaboration with scientists from the National Institute of Advanced Industrial Science and Technology in Japan. A new multi-component sensor is being lowered into the existing drill hole/blast hole to conduct subsurface measurements while drilling using drill bit noise as a source. If successful, this new technology developed by the AIST, has potential applications for characterising and delineating weak planes/joints/bedding planes/fracture planes in the immediate roof during exploration drilling.</p>
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<p><b>Implications of Self-Weight, Wetting-Up and Weathering-Induced Settlements of High Coal Mine Spoil on Stored Volume and Stability C19022</b></p> <p>University of Queensland David Williams</p>	427,000	<p>Nicole Tucker, BMA</p> <p>John Hoelle, Anglo American Metallurgical Coal</p> <p>Shaun Booth, Glencore</p> <p>Chris Agosto, Mt Arthur Coal</p>	<p>Australian open cut coal mines are extending to ever increasing depths. The economic viability of these deep open pits is dependent on the design, sizing, geotechnical stability assessment, and cost estimation of in-pit and out-of-pit high spoil piles. These elements, in turn, are influenced by the impact of bulking and subsequent self-weight, wetting up and weathering-induced settlements of the volume. This extension project will more fully investigate an extended range of spoil types and subject them to a greater range of laboratory testing, and add spoil settlement field monitoring data and any geological instabilities collected by participating mines. It will also further validate and calibrate the numerical predictive tools being developed.</p>
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<p><b>Reliable Geotechnical Stability Assessment for Very High Spoil Dumps C20019</b></p> <p>University of Newcastle John Simmons Stephen Fityus</p>	486,500	<p>Nicole Tucker, BMA</p> <p>Sarah Bligh, Thiess</p> <p>John Hoelle, Anglo American Metallurgical Coal</p> <p>Shaun Booth, Glencore</p> <p>Chris Agosto, Mt Arthur Coal</p> <p>Ken Preston, Rio Tinto Coal Australia</p>	<p>Existing procedures are inadequate for the design of very high dumps because they introduce significant uncertainties into risk assessments of instability hazards for life-of-mine plans. This project is providing geotechnical specialists with shear strength, groundwater pressure, and recommended stability assessment procedures for designing very high spoil dumps, greater than 120m, with adequate safety. These outcomes will be published and explained to practitioners at targeted workshops.</p>
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<p><b>Investigations for Open Pit Geomechanics Using Geophysical Logs C20025</b></p> <p>Coalbed Geoscience Peter Hatherly Terry Medhurst</p>	<p>269,400</p>	<p>Dan Stolberg, Thiess Glen Guy, Rio Tinto Coal Australia Ken Preston, Rio Tinto Coal Australia</p>	<p>With open cut mines increasing in depth, the need exists for an approach to geotechnical evaluation that allows effective characterisation of the rock mass so that certainty as to highwall stability can be achieved. The recent improvements to highwall stability monitoring systems, semi-automated mapping and other 3D modelling initiatives are all aimed at providing information on various aspects of features known to influence stability. These methods use extension strain as a failure criterion or the detection of movement over large areas of a highwall. An alternate approach was developed through this project based on the Geophysical Strata Rating (GSR). The GSR is based on geophysical logging data and provides a continuous record of both lithology and rock mass quality. GSR results were developed and integrated with conventional defect and acoustic scanner logs. Geotechnical models will be developed and compared to actual monitoring results. Planning will be improved and a basis for the assessment of highwall monitoring procedures will be established.</p>
<p><b>Energy Absorption Capacity of Muck Piles and their Status as Engineered Hard Barriers C21032</b></p> <p>University of Newcastle Anna Giacomini</p>	<p>257,935</p>	<p>Don McNeil, Rio Tinto Coal Australia Brett Domrow, New Hope Group Shaun Booth, Glencore</p>	<p>Many open cut mines use energy absorption safety barriers at dumping points, as windrows at the crest of highwalls, and as traffic separators on haul roads. Safety berms are currently designed using 'rules of thumb', such as height equal to half the maximum wheel diameter. There is some concern that this rule of thumb may not be adequate for the new generation of larger trucks. This project is developing guidelines for safety berm design. Through laboratory simulations, numerical analysis and field trials, the outcomes of the project will enable the dynamic impact of truck wheels and rock falls on safety berms to be estimated. This data will be used to evaluate the best construction materials as well as principal geometrical and mechanical characteristics for berm design.</p>
<p><b>Tertiary Volcanic Fields of Eastern Australia: Implications for Mining and Coal Quality C22023</b></p> <p>University of Queensland Charles Verdel</p>	<p>179,250</p>	<p>Greg Jones, JB Mining Kirk Henderson, Peabody Energy Australia John Simmons, SGRS Ken Preston, Rio Tinto Coal Australia</p>	<p>Tertiary volcanic fields cover significant portions of the coal basins in eastern Qld which has implications for coal production and exploration. These lavas and their intrusive equivalents impede seismic exploration, impact coal quality and create geotechnical challenges. This project aims to address these issues through field and laboratory work that concentrates on lavas and intrusions from mines in this region. Samples from mines, natural outcrops and drill core will be used.</p>
<p><b>Regional Stratigraphic Framework for the Rangal-Baralaba-Bandanna Coal Measures in the Bowen and Galilee Basins C22028</b></p> <p>University of Queensland Joan Esterle Renate Silwa</p>	<p>288,800</p>	<p>Donna Frater, BMA Patrick Tyrrell, New Hope Group Andy Willson, Anglo American Metallurgical Coal</p>	<p>The ACARP Supermodel 2000 project provided a regional context in which to develop predictive models for overburden geotechnical behaviour in mines operating in the Moranbah-German Creek coal measures. Mining conditions in the Rangal, Baralaba and Bandanna coal measures are varied and, in places, structurally complex. This project will develop a regional stratigraphic framework for the Rangal-Baralaba-Bandanna coal measures in the Bowen and Galilee basins. The links between gross sedimentary trends and geotechnical properties will be developed and catalogued, along with controls on the distribution of thick stacked coals, and type and degree of structure deformation. The output will be a 'go to' reference for the industry that will improve the understanding of the key aspects of Australia's coal basins.</p>
<p><b>Maintenance and Equipment</b></p>			
<p><b>DC Motor Duty Meter C16030</b></p> <p>CRCMining Galina Mirzaeva Terry Summers</p>	<p>551,066</p>	<p>Kane Usher, Rio Tinto Coal Australia Mark Spinks, Anglo American Metallurgical Coal Tony Egan, Glencore</p>	<p>The approach being taken through this project is different from most maintenance management in that rather than watching for a manifestation of deterioration and trying to locate the cause, this project is tracking possible "cause" and is maintaining a work record. The approach taken is to relate the motor condition to its duty rather than to faults, hence the title 'DC Motor Duty Meter'. This work should lead to motors being changed out when they need to be rather than when they are scheduled to be. The completed stage one of the project examined current distribution in the brushes and the magnitude of the load and its dynamics. This next stage the focus is on the digital drive, the commutator surface temperature and the mechanical vibration of the motor case and brush holders.</p>

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<p><b>Improved System for Dragline Rope Condition Monitoring C18031</b></p> <p>Bureau Veritas AIRS Adam Van Dyck</p>	<p>436,160</p>	<p>Shaun Booth, Glencore Tony Egan, Glencore</p>	<p>In the first stage of this project it was demonstrated that it is feasible to use Magnetostrictive Transducer technologies to generate ultrasonic energy in Dragline Pendant ropes of up to 120mm in diameter and for this energy to be transmitted through the rope and socketing assembly. The second stage conducted a field trial of a semi-permanently installed system on a dragline pendant rope assembly. This trial conducted in Parallel with the Radiographic Inspection regime and the results between these inspection methods was compared and contrasted.</p>
<p><b>Minimal Perception Requirements to Support Effective Remote Control of Bulldozers C20021</b></p> <p>CRCMining Ross McAree</p>	<p>392,093</p>	<p>Andrew Walker, Stanwell Corporation Simon Ponder, Anglo American Metallurgical Coal Peter Yates, BMA</p>	<p>A widely held vision is that bulldozer operators will work from teleoperation stations remote from the machine. These stations will provide an environment rich in feedback information that enables performance equal to that achieved with an operator on board. While elements of this vision are a reality, there remain gaps to be bridged. Where the operator relies on video feeds, performance has not yet matched the on board operator. This project defined operator requirements for the effective remote operation of dozers on coal stockpiles.</p>
<p><b>Powerlinkoz High Voltage Electrical Connection System (PLO) C20030</b></p> <p>Connec Mark Wells</p>	<p>450,000</p>	<p>Barrie Alley, Centennial Coal David Lincoln, Centennial Coal Tony Egan, Glencore</p>	<p>The existing high voltage cable plugs are prone to fault and connection failures and are difficult to handle. This project will improve the safety, reliability and operability of a part of the systems of cables, plugs and receptacles that provide electrical power to mining equipment. The proposed plugs will make greater use of alternative light weight materials in construction.</p>
<p><b>Robotic Manipulator for Dragline Jewellery Repair C21027</b></p> <p>University of Southern Queensland Peter Milani</p>	<p>366,800</p>	<p>Steve Amor, Anglo American Metallurgical Coal John Thomsen, Rio Tinto Coal Australia Troy O'Reilly, Stanwell Corporation Keith Cardew, Peabody Energy Australia</p>	<p>Dragline jewellery maintenance is recognised as a high risk exercise due to the weight of the jewellery and the number of strain and impact loading injuries that occur. This task is, therefore, suitable for the introduction of greater automation and reduced manual handling through the use of robotics. A multi degree of freedom manipulator with intuitive interface will be developed to reduce risks associated with the maintenance of heavy machinery. The research is also focusing on developing an intuitive interface that may be applicable to other machines. The outcome from the research will be an indepth study of innovative machine interfaces as well as pilot prototypes of both the interface and the manipulator.</p>
<p><b>Voltage Stabilisation Using Power Electronics C21030</b></p> <p>CRCMining Robert Betz</p>	<p>85,133</p>	<p>Mark Spinks, Anglo American Metallurgical Coal Tony Egan, Glencore Stephen Schaller, Rio Tinto Coal Australia Keith Cardew, Peabody Energy Australia</p>	<p>Voltage instability refers to the influence of electrical loading on the supply voltage magnitude. On mine sites close to the supply source, voltage instability is rarely an issue. However, even in this situation there can be circumstances resulting in voltage instability problems within the mine itself. More remote mine sites have an intrinsically weak supply and, therefore, experience larger voltage magnitude transients. This project investigated the use of power electronics to solve transient voltage instability problems for mines that are distant from their supply source.</p>
<p><b>AC Motor Duty Meter for Excavating Machines: Feasibility Study C21040</b></p> <p>CRCMining Galina Mirzaeva</p>	<p>55,193</p>	<p>Mark Spinks, Anglo American Metallurgical Coal Tony Egan, Glencore</p>	<p>Open cut mining has remained one of the last industries where direct current (DC) machines are more common than alternating current (AC) machines. However, the newly manufactured electric rope shovels are predominantly AC driven and AC technology is starting to be applied in dragline applications as well. AC machines are more robust than their DC counterparts and allow almost the same controllability as the DC machines due to the development of digital drive technology. Although the approach to measurement is similar between DC and AC machines, their failure mechanisms are significantly different. The University of Newcastle has achieved significant progress towards developing a DC motor duty meter to measure motor health. This project extended this work to develop condition monitoring tools for AC driven machines.</p>

PROJECT/RESEARCHER      ACARP FUNDING      INDUSTRY MONITORS      OVERVIEW

**OPEN CUT PROJECTS UNDER MANAGEMENT 2013**

<p><b>Synthetic Rope Prototype Development Program for Dragline Application C22022</b> AMOG Olaf Rutgrink</p>	295,000	<p>Shaun Booth, Glencore Tony Egan, Glencore</p>	<p>Opportunities may exist to improve dragline rope life, reduce rope mass, reduce dynamic loads on boom structures and use more economical and environmentally friendly consumables by using synthetic rope. Building on work done in C20026, this project will develop a quarter-scale prototype synthetic high modulus poly ethylene (HMPE) rope. Further testing at half-scale will be required.</p>
<p><b>Mining and the Community</b></p>			
<p><b>Cumulative Impact of Growth on Regional Transport Infrastructure C22021</b> Central Queensland University Susan Kinnear</p>	91,443	<p>Madeleine Verdich, Rio Tinto Coal Australia Mahdi Mason, Caledon</p>	<p>An effective transport network is essential to ongoing growth of the coal industry and regional sustainability. There is insufficient information available to support decision-making around workforce and non-coal freight movements within regional transport networks. This research will identify the key issues for regional transport systems arising from the cumulative impacts of resource sector growth in the northern Bowen Basin. Whole of region stakeholder consultation will be used to find strategic solutions to these transport issues.</p>
<p><b>Improving the Understanding and Management of the Cumulative Impacts of Coal Mining and other Land Uses in Regions with Diversified Economies C22029</b> University of Queensland Jo-Anne Everingham</p>	153,000	<p>Craig Lockhart, Peabody Energy Australia Carl Grant, Anglo American Metallurgical Coal</p>	<p>In the past decade a range of planning and policy instruments and new institutions have been introduced to manage the cumulative impacts of mining, but it is unclear how these could function to manage multiple industries. This project will investigate methods for operators, various levels of government and co-existing industries to more effectively manage cumulative impacts. Key deliverables will include models, recommendations and guidance that integrate the various tools being <b>used</b> into a systems approach to cumulative impacts governance; a framework that maps stakeholder roles; and a stakeholder engagement flowchart.</p>
<p><b>Occupational Health and Equipment Safety</b></p>			
<p><b>Using Acoustic Agglomeration to Reduce or Eliminate Dust Loading from Machine House on Draglines C18029</b> CSIRO Darren Bates David Hainsworth</p>	417,966	<p>Tony Egan, Glencore</p>	<p>In July 2006 a review of maintenance practices on service days at Peak Downs Mine was conducted in an attempt to streamline service being performed on their fleet of six draglines. During this review it became evident that the standard practice of blowing out the dragline house on a service day was creating dust levels in excess of 65 times greater than the minimum unprotected exposure limits as outlined in mining statutory regulations. Individuals were utilising personal protective equipment (PPE) deemed appropriate for environments that were experienced. This project developed and testing a pre-production scalable particulate filtering system to reduce particulate emissions by more than 90%. The prototype will use the acoustic agglomeration process during which sound is used to enhance agglomeration of fine aerosol particles. After acoustic treatment, particles become larger and can be effectively removed from air by conventional cyclones. The prototype will be demonstrated for an evaluation period of three months with the goal of consistently reducing dust loading.</p>
<p><b>Dragline Machine House Dust Control - Field Testing of Alternative Cartridge Technologies C19027</b> BMT WBM Bruce Manser</p>	192,800	<p>Tony Egan, Glencore</p>	<p>Dust is a major issue onboard draglines. If a dramatic change in dust filtration performance is to be achieved (particularly for fine dust particles), then a change in the filtration technology employed on draglines is needed. One option is Cartridge technology which has been successfully employed on P&amp;H 4100 XPB shovels. To make Cartridge technology more attractive to a dragline filtration system designer, research was needed that attempts to optimise the performance of the filters for the dragline application (the pressure drop versus flow characteristic needs to be minimised while still achieving adequate filtration performance and filter media strength needs to resist damage when reverse pulse cleaning). This will reduce the overall size, weight, pressure drop and fan power to practical levels.</p>

PROJECT/RESEARCHER      ACARP FUNDING      INDUSTRY MONITORS      OVERVIEW

## OPEN CUT PROJECTS UNDER MANAGEMENT 2013

<p><b>'Fit for Purpose' Tyre Maintenance Equipment and Management Practices for Non Earthmover Mining Vehicles - A Study to Improve Tyre Safety C21029</b></p> <p>Simtars Tilman Rasche</p>	<p>59,250</p>	<p>Matthew Sheather, Rio Tinto Coal Australia</p>	<p>The threats of poor tyre maintenance are becoming evident for many Australian mining operations that rely heavily on contractors and their mobile equipment fleets to assist with haulage of various materials – processed coal, ore concentrates and water – often over considerable distances and challenging terrain. This project identified tyre maintenance safety issues around non-earthmoving vehicles and mobile equipment, and demonstrated effective solutions such as better tooling, improved maintenance equipment, improved safe work practises, and other recommendations for safer work.</p>
<p><b>Study of Industry Health and Safety 'Voluntary Initiatives' C22042</b></p> <p>JKTech Jim Joy</p>	<p>60,000</p>	<p>Shane Hansford, QRC Kylie ah Wong, Glencore Andrew McMahon, NSWMC John Hempenstall, Centennial Coal</p>	<p>Zero harm is the goal of many mining companies. In terms of overall health and safety the industry has not yet attained that goal and, in many instances, may have plateaued at an improved but not zero harm level. Some industries have developed systematic industry-wide strategies – voluntary initiatives – for step changes in health and safety. A voluntary initiative involves an industry level organisation, as opposed to the government or an individual corporation, setting voluntary codes of conduct for member companies. This study suggests that examining the nature, outcomes and cost effectiveness of formal voluntary initiatives such as the Institute of Nuclear Power Operations, Responsible Care and others may provide useful information to help the coal mining industry efficiently and effectively move forward in the pursuit of zero harm.</p>
<p><b>Beyond Prescription: Strategies for Transitioning the Major Coal Industry Stakeholders (Regulators, Producers and Unions) to Risk Based Regulation C22043</b></p> <p>Gunningham and Associates Neil Gunningham</p>	<p>232,038</p>	<p>Shane Hansford, QRC Kylie ah Wong, Glencore Andrew McMahon, NSWMC John Hempenstall, Centennial Coal</p>	<p>Coal mining work health and safety (WHS) legislation and the mining industry have moved substantially from prescription to risk-based WHS regulation and management. However, recent research demonstrates that there remain substantial obstacles to the effectiveness of risk based regulation. This project will examine how the behaviour of mines inspectors, industry middle management and relevant trade unions can be transformed, the journey from prescriptive to risk based regulation and management can be successfully completed, and improved health and safety outcomes achieved.</p>
<p><b>Improving Onsite Health and Safety Communication C22044</b></p> <p>Cat.Dog Research and Creative Geoff Denman Jem Wallis</p>	<p>243,500</p>	<p>Shane Hansford, QRC Kylie ah Wong, Glencore Andrew McMahon, NSWMC Phillip Enderby, Glencore John Hempenstall, Centennial Coal</p>	<p>The coal industry invests significant funds in its various occupational health and safety (OHS) programs. Despite this investment and some obvious and sound improvements in OHS programs, the question still remains how to optimise OHS communication to maximise the return on investment. This project aims to improve the style and optimise the effectiveness of OHS communication. A communication audit and qualitative and quantitative research will be conducted at seven open cut and underground mines across Queensland and New South Wales. This will provide insights and hard numerical data to establish the current levels of awareness and retention of OHS communication and to develop new communication strategies. This approach is based on the same commercial model of research and development which has been used in the advertising industry for more than 30 years.</p>
<p><b>Working Well: Mental Health and Coal Mining C22045</b></p> <p>University of Newcastle Brian Kelly Robyn Considine</p>	<p>353,227</p>	<p>Shane Apps, Peabody Energy Australia Liam Wilson, Rio Tinto Coal Australia Shane Hansford, QRC Andrew McMahon, NSWMC</p>	<p>Mental health problems and their impact on workplace safety and productivity is a growing issue for the mining industry. There is some evidence of an association between mental illness and reduced productivity and injury at work. However, no methodologically sound studies have been conducted on these issues in the Australian coal mining industry. This project will determine the extent and impacts of mental health problems in the coal industry. It aims to identify the patterns of mental health problems among coal industry employees, the factors associated with these problems and the impact on employee health, workplace safety and productivity.</p>

## OPEN CUT PROJECTS UNDER MANAGEMENT 2013

## Overburden Removal

<b>Real Time Continuous Measurement of Blasted Dragline Overburden Bulk Density C20024</b> CRCMining Paul Lever	200,667	Andrew Denman, BMA Hans Hayes, Anglo American Metallurgical Coal	This project developed an online system for a dragline that will integrate blast material bulk density with the blast design to assess and improve blast performance. In doing so it will enable an operator to achieved improved diggability through better blast designs. This builds on the results of the real time bucket bulk density estimates of the dragline payload in an earlier project (C18035) by extending the system to accurately indicate in place bulk density of material in bench. The challenge was to register sensor data recorded from different dragline positions and fusing the information consistently.
<b>3D Scan Matching and Registration for Improved Mine Survey C20028</b> CSIRO Elliot Duff	295,855	Gary Robertson, BMA	Accurate and timely information is vital to effective decision making in the mining industry, where information about the location and state of assets (fleet management) and the height and state of the local terrain is critical to production. Traditionally, this information has been decoupled, with information concerning assets being used for fleet management and terrain used for planning. In this project, CSIRO 3D mapping technology provided a continuously updated, digital terrain map for the mine site and promote the use of inexpensive vehicle based scanners. The work is a step towards achieving a self mapping mine.
<b>Automated Design of Multi Pass Dragline Strips Using 3D-Dig C21028</b> Earth Technology Murray Phillips	115,000	Bridget Perkins, Anglo American Metallurgical Coal Lindsay Ford, Glencore Greg Sheppard, Wesfarmers	The well accepted 3D-Dig software has proven to be an effective tool for accounting for spoil transport and placement in dragline operations. It is able to very accurately predict prime and rehandle volumes, estimate spoil fit and communicate the resultant design. This project is extending the software and developing a system to automate the design of a complete, multi pass dragline strip. The system will allow for blast profiles and dozing as well as dragline operation. The auxiliary stripping requirements will be determined for each block prior the main strip simulation. A graphical interface will be provided to allow users to sequence the strip by blocks, passes and sub passes.
<b>Predictive Application of Advanced Dragline Performance Indices C21044</b> CRCMining Andrew Jessett Peter Knights	128,500	Lindsay Ford, Glencore Greg Sheppard, Wesfarmers	Dragline repositioning is a major source of loss of productive dig hours. A trade off exists between remaining digging at a particular location and repositioning in order to obtain more favourable dig conditions or swing angles. Previous work has examined this trade off by developing a cost function per horizontal bucket foot of movement. This project explored predictive applications of advanced dragline performance indices. In particular, it developed a predictive algorithm to provide dragline operators with advice on how to improve dragline dig sequencing. The predictive algorithm may suggest an early dragline reposition in order to avoid hoist limited cycles in subsequent moves.

### COMMITTEE MEMBERS

The coal preparation plant is an integral part of the total mine operation and seeks to minimise its contribution to environmental impacts, eg by minimising emissions, reducing water consumption and finding ways to use lower quality water without adversely impacting on process efficiency. It is also critical to maximise the yield of product quality coal at minimum cost.

The Coal Preparation Committee has established a medium term strategy with three key components of maintenance, improved recovery, and plant capacity while maintaining the current high standards of safety.

<b>Phillip Enderby</b>	Manager, Ravensworth CHPP (Co Chair, Coal Preparation Committee)	Glencore
<b>Jennifer Woodgate</b>	Principal Process Engineer, Integrated Planning (Co Chair, Coal Preparation Committee)	BMA
<b>Chris Andrews</b>	Asset Engineering	BMA
<b>Roy Brown</b>	Specialist Process Control – Kestrel Mine	Rio Tinto Coal Australia
<b>Jeremy Byrnes</b>	Process Engineer	Glencore
<b>Joan Cowburn</b>	Specialist Process Engineer - Projects	Anglo American Metallurgical Coal
<b>Rod Fox</b>	General Manager – Coal Handling & Processing	Whitehaven Coal
<b>Alistair Harriman</b>	Director – Process Engineering	Peabody Energy Australia
<b>Phil Howes</b>	CPP Engineer	BHP Billiton Illawarra Coal
<b>Steve Lempereur</b>	Specialist Process Engineer	Anglo American Metallurgical Coal
<b>Dion Lucke</b>	Manager Processing	Rio Tinto Coal Australia
<b>Frank Mercuri</b>	Director	Benefish
<b>Rod Nicholson</b>	Senior Process Engineer	Bloomfield
<b>Dave Osborne</b>	Coal Technology Manager	Xstrata Technology
<b>Paul Revell</b>	Regional Manager - Coal Processing Excellence	Anglo American Metallurgical Coal
<b>Colin Surawski</b>	Group Metallurgical Engineer - Technical Services	Vale Australia
<b>Andrew Sutherland</b>	Manager – Coal Processing Improvement	Rio Tinto Coal Australia
<b>Michael Young</b>	Principal Metallurgical Engineer Isa Mill	Glencore



## FUNDING APPROVED 2013

Year	No of Projects	ACARP Funding	Total Funding
2013	14	\$1,973,450	\$4,247,096
2012	9	\$1,579,489	\$2,270,696
2011	13	\$2,096,630	\$2,974,764

## PROJECTS UNDER MANAGEMENT 2013

Category	No of Projects	ACARP Funding
Dewatering	3	\$416,285
Environmental Improvement	1	\$228,000
Fine Coal	10	\$1,802,580
Gravity Separation	5	\$1,631,468
Major	1	\$728,000
Occupational Health and Safety	3	\$513,303
Process Control	4	\$709,740
General	3	\$598,906



PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECT APPROVALS 2013</b>			
<b>Dewatering</b>			
<b>Belt Press Filter Optimisation Handbook C23040</b> Quality Process Solutions Darren Mathewson	153,550	Alex Arredondo, Rio Tinto Coal Australia Jennifer Woodgate, BMA	Limited understanding of the key operational parameters that affect belt press filter performance can lead to increased operational expenditure and increased maintenance costs, and decreases in plant availability due to excessively high filter product moisture and equipment failure. The objective of this project is to provide the Australian coal industry with a useful, supplier independent handbook describing the performance of belt press filters under a range of operating conditions and providing practical techniques to optimise the design, operation and maintenance of these filter installations.
<b>Application of Screw Press Filtration to Tailings Dewatering C23041</b> Mechanical Advantage Stuart Whitton	303,314	Alistair Harriman, Peabody Energy Australia Jennifer Woodgate, BMA	The applicability and utility of a screw press to the dewatering of coal beneficiation plant tailings will be investigated during a field pilot plant trial. Dilution strata and tailings will be sampled in order to characterise those materials and run bench scale flocculation and filtration tests. This will be followed by an extended pilot trial in the field, sample collection and reporting. A pilot pressure filter and the screw press filter will be assessed during the trial to compare the effectiveness of the two technologies.
<b>Fine Coal</b>			
<b>Comparison of Column and Mechanical Flotation Technologies C23034</b> BA and BF Firth Bruce Firth	27,250	Justin O'Neill, Peabody Energy Australia Dave Osborne, Xstrata Technology	A comparison of the effectiveness of column and mechanical flotation technologies will be undertaken in this project to determine the best technology for fine coal processing, including the possibility of mixing the two technologies. The comprehensive final report will provide a set of conclusions that could guide the industry in technology selection, and a set of flotation project recommendations with clearly defined objectives which could be adopted by suitable research groups.
<b>Improved Flotation Recovery and Reduced Cost Via Adjusting Frother Chemistry and Froth Behaviour C23035</b> University of Queensland Liguang Wang	129,000	Rebecca Fleming, Rio Tinto Coal Australia Dave Osborne, Xstrata Technology	Coal flotation practice is expensive. A promising approach to reducing flotation costs is to use more effective chemical reagents, especially non ionic surfactants (frothers). This project will demonstrate the effectiveness of a novel frother for improving coal flotation performance and reducing reagent cost. A technique to measure the concentration of residual frother in process water will be developed and a real time diagnostic tool for maximising the separation efficiency of coal flotation will be evaluated.
<b>New Approach to Coarse Coal Flotation C23036</b> University of Newcastle Kevin Galvin	141,457	Rod Nicholson, Bloomfield Steve Lempereur, Anglo American Metallurgical Coal Phillip Enderby, Glencore Paul Revell, Anglo American Metallurgical Coal Brad Lucke, Glencore	There are significant coal losses from flotation due to oversized particles entering the flotation circuit by passing through worn screens and via the cyclone overflow. Conventional flotation fails to recover a significant fraction of these coarse particles. This laboratory scale project will provide an understanding of the coarse particle (up to two millimetres) flotation mechanism and the precise conditions required to succeed. The introduction of robust flotation technology could deliver an increase in plant yield of up to two per cent.
<b>Improving the Treatment of Clay Minerals in Coal Flotation in Saline Water - Plant Tests C23038</b> University of Queensland Yongjun Peng	253,176	Jennifer Woodgate, BMA Joan Cowburn, Anglo American Metallurgical Coal	Clay minerals commonly occur in coal deposits and decrease the combustible recovery in flotation while deteriorating the product quality. Flotation of high clay coal is currently not possible. Methodologies to mitigate deleterious effects from clay minerals were developed in a previous project and will be tested during plant trials at Oaky Creek and Peak Downs mines. The trials will provide the process information needed to specify and design the implementation in a full scale plant, and provide opportunities to study, define and optimise parameters that cannot be properly studied at a laboratory scale, such as the change of coal and water quality, recycle of reagents and the impact of downstream processes. The trial will also provide mine personnel who will commission future full scale plants with operating experience and training.

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
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### COAL PREPARATION PROJECT APPROVALS 2013

<b>Characterisation and Flotation of Oxidised Coal C23039</b> University of Queensland Yongjun Peng	168,600	Dave Osborne, Xstrata Technology Frank Mercuri, Benefish	A previous project clearly demonstrated that x-ray photoelectron spectroscopy (XPS) could be used to detect and quantify the non oxidised and oxidised areas on the coal surface, and new technologies could be developed to improve the flotation of coal with surface oxidation. In this project, a rigorous methodology will be developed using XPS to determine non oxidised and oxidised surfaces on coal obtained from different pits, stockpiles and flotation feeds, rejects and products. An oxidation index will also be developed to predict coal flotation behaviour.
<b>Improvement of Hydrodynamic Behaviours in Large Coal Flotation Cells C23044</b> CSIRO Shenggen Hu	194,865	Frank Mercuri, Benefish Paul Revell, Anglo American Metallurgical Coal	The objective of this project is to improve the hydrodynamic behaviours of Microcel columns and Jameson cells by designing and constructing simple and cost effective modifications to reduce undesirable hydrodynamic behaviours. The performance of modifications concepts for Jameson cells will be evaluated in laboratory scale tests and plant based experiments will be carried out to determine the effectiveness of modifications on Microcel columns. The low cost modifications should also improve product yield and flotation plant capacity, and enhance the understanding of the hydrodynamic characteristics of large flotation cells.
<b>Full Scale Trial of the Reflux Flotation Cell C23045</b> University of Newcastle Kevin Galvin	344,820	Rod Nicholson, Bloomfield Steve Lempereur, Anglo American Metallurgical Coal Phillip Enderby, Glencore Paul Revell, Anglo American Metallurgical Coal Dion Lucke, Rio Tinto Coal Australia	The objective of this project is to investigate the performance of the Reflux Flotation Cell at full scale and, in turn, commercialise the technology. The focus will be on the scale up achieved, the efficiency of the separation and the quality of the product. This full scale trial will process high quality flotation product from a single stage, two metre diameter Reflux Flotation Cell, using feed throughputs more typical of conventional flotation; that is, 200m <sup>3</sup> per hour.
<b>Gravity Separation</b>			
<b>CPP Feed Washability Prediction from Small Topsize Samples C18041</b> QCC Resources Andrew Swanson	95,528 New 582,160 Existing	Chris Andrews, BMA Jeremy Byrnes, Glencore Dion Lucke, Rio Tinto Coal Australia	Preliminary research has shown that it is possible to totally change the way in which coal is characterised for a wide range of purposes, including washability prediction, using coal grain analysis. Coal grain analysis will be evaluated to determine whether it can predict washabilities of different coal sections (different seam/plies) based on full characterisation of a shallower or deeper ply by using further samples from a large diameter borecore testing program.
<b>Affect of G Force on Banana Screen Efficiency C23037</b> CSIRO Mike O'Brien	36,200	Phillip Enderby, Glencore Yasantha Eleperuma, Anglo American Metallurgical Coal	Large, multi sloped screens, particularly screens over four metres in width, are subject to failure. The time between failures and the extent of the failure depends on the screen duty and use. This project will determine the effect of reducing the G force on the performance of a large, multi slope banana screen. If successful, the resulting reduction in force may influence the frequency of screen failures and extend the life of screen components and support structures.
<b>Economic Effect of Low Non Magnetic Material in Correct Medium C23046</b> CSIRO Mike O'Brien	60,652	Phillip Enderby, Glencore Penny Walker, Rio Tinto Coal Australia Frank Mercuri, Benefish	The amount of non magnetic material in the correct medium is an important variable that affects the efficient operation of the dense medium cyclone at low correct medium densities. This project will provide coal producers with detailed cost estimates of low, non magnetic material in the correct medium over a broad range of coal washabilities and plant operating procedures as a result of stoppages or control strategies.

PROJECT/RESEARCHER      ACARP FUNDING      INDUSTRY MONITORS      OVERVIEW

## COAL PREPARATION PROJECT APPROVALS 2013

### General

<p><b>Impact of Sample Preparation Procedure on CGA Result C23042</b></p> <p>QCC Resources Bruce Atkinson</p>	35,202	Dion Lucke, Rio Tinto Coal Australia	Different laboratories use different forms of grinding mills and the concept of generating minimum fines is operator dependent. This project will evaluate whether the variability of sample preparation will have an impact on coal grain analysis data. Researchers will assess the different methods of sample preparation typically employed by commercial laboratories to identify any impact on coal grain analysis in terms of the coal grain maceral and mineral distribution, assess different means of sample preparation to identify any impact on grain size distribution, and provide a recommendation for sample preparation methods for subsequent coal grain analysis testing, if any material impact is identified.
<p><b>Product Coal Loss Due to Inappropriate Focus on Ep C23043</b></p> <p>QCC Resources Bruce Atkinson</p>	29,836	Colin Surawski, Vale Australia Dion Lucke, Rio Tinto Coal Australia	The coal preparation fraternity is used to focussing on Ep(75/25) values when people consider separation equipment performance. However, Ep only describes a small part of the picture, and in many cases the Ep value is completely irrelevant or even misleading. The Ep value has little to no impact on the misplaced material as is highlighted by the partition curves. The amount of misplaced material is dominated by the 'tails' of the partition curve, which provide details of bypassed material. The low density tail is the 'ultimate' quantity of misplaced low RD material, and the high density tail is the 'ultimate' quantity of contamination by sinks material in the product. This project aims to provide a more practical definition for the curve tails, such that t0 and t1 are left solely as curve fit parameters. That will provide a means for all data assessors to calculate the information uniformly and by a means that has physical significance.

## COAL PREPARATION PROJECTS UNDER MANAGEMENT 2013

### Major Project

<p><b>Reflux Classifier to 4mm Top Size - Full Scale Trial (Construction of Test Rig) C22046</b></p> <p>University of Newcastle Kevin Galvin</p>	728,000	Rod Nicholson, Bloomfield Phillip Enderby, Glencore	This project will move an innovative process improvement from the laboratory to a trial in an operating plant. A larger size feed, up to 4mm, will be directed to the Reflux Classifier, thereby reducing the load to dense medium cyclones. The work has the potential to increase plant throughput for a given capital expenditure. The project has a committed host site, and strong engineering and scientific support.
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### Dewatering

<p><b>Dewatering of Ultrafine Coals and Tailings by Centribaric Technology C21004</b></p> <p>University of Queensland Liguang Wang</p>	86,000	Justin O'Neill, Peabody Energy Australia Jennifer Woodgate, BMA Rebecca Fleming, Rio Tinto Coal Australia Jeremy Byrnes, Glencore	The existing processes used to dewater ultrafine Australian coals are inefficient in terms of moisture reduction and solids recovery. Some producers deslime their fine coal streams and discard the ultrafine fraction into tailings. A new hyperbaric centrifuge technology – Centribaric™ – was developed in the US which could help to resolve these issues in Australia. This project examined the response of Australian coals and tailings to the Centribaric technology and provided detailed information on the impact of particle size, type and surface properties on its dewatering performance.
<p><b>Enhanced Dewatering of CHPP Tailings through Modification of the Structure of Presedimented Floccs C21054</b></p> <p>CSIRO Philip Ofori</p>	199,000	Andrew Sutherland, Rio Tinto Coal Australia Dave Osborne, Xstrata Technology	The current practice of storing waste slurry in tailings dams to settle over long periods is not environmentally sustainable. In addition, there is legislative pressure to move away from traditional tailings dams. Mechanical dewatering systems such as belt press filters are available, but have relatively high capital and operating costs. Thickened tailings technology has been identified as a cost effective approach to tailings handling and management. The project is establishing optimal approaches to alter presedimented floc network structure on a continuous pilot scale system for enhanced sediment consolidation without compromising settling rate. This may then be deployed on large scale.

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECTS UNDER MANAGEMENT 2013</b>			
<b>Advanced Dynamic Control of Paste Thickeners C21055</b> University of New South Wales Gotz Bickert Jie Bao	131,285	Wayne Bower, Glencore Roy Brown, Rio Tinto Coal Australia	Mechanical dewatering of tailings is of growing interest to Australian coal preparation plants. Two sites have already installed paste thickeners to evaluate their potential. However, due to the challenges in thickener control, these thickeners are either controlled manually or with conventional strategies which do not provide adequate performance. This project is developing an online dynamic feedback control approach to improve the operation of paste thickeners by adopting modern control strategies which are already successfully applied in the petrochemical industry.
<b>Environmental Improvement</b>			
<b>Improved Dewatering, Management and Rehabilitation of Problematic, Clay Rich Coal Mine Tailings C20047</b> University of Queensland David Williams Stuart Whitton	228,000	Jennifer Woodgate, BMA Trent Moorman, Glencore Dave Osborne, Xstrata Technology	Clay rich coal mine tailings are difficult to process, manage and rehabilitate. As a result large tailings storage areas are commonly required for surface disposal. This project is undertaking a systematic review and assessment of current and emerging technologies and options for the dewatering, management and rehabilitation of problematic, clay rich coal mine tailings and the associated water, with the aim of optimising tailings dewatering, management and achieving lease surrender. It is focusing on alternatives and enhancements to existing mechanical dewatering methods for treating clay rich tailings and also methods for improving tailings disposal management and stabilising the deposited tailings material.
<b>Fine Coal</b>			
<b>Full Scale Trial of the Reflux Classifier to at Least 4mm Top-Size C19001</b> University of Newcastle Kevin Galvin	185,200	Steve Lempereur, Anglo American Metallurgical Coal Paul Revell, Anglo American Metallurgical Coal Dion Lucke, Rio Tinto Coal Australia	In this project a full scale reflux classifier is undergoing a plant trial at the Bloomfield coal preparation plant near Newcastle to investigate the separation efficiency for 0.25 to 4mm particle size feed and to determine the limits on the solids throughput. It is investigating the extent to which previous work conducted during the pilot can be scaled up.
<b>Improving the Treatment of Clay Minerals in Coal Flotation using Saline Water C20042</b> University of Queensland Dee Bradshaw Yongjun Peng	196,000	Jennifer Woodgate, BMA Joan Cowburn, Anglo American Metallurgical Coal	The treatment of clay minerals in coal flotation in saline water is a challenge. Clay minerals cause high viscosity and therefore reduce bubble-particle collision and attachment efficiency in pulp phase and froth recovery in froth phase. This may result in low coal recovery with a contaminated final product. This project investigated the unique behaviour of clay minerals in coal flotation in saline water and developed new technologies to reduce the adverse effect on coal recovery in both pulp and froth phases.
<b>Enhanced Flotation and Desliming Using a Reflux Flotation Cell C20043</b> University of Newcastle Kevin Galvin	179,100	Rod Nicholson, Bloomfield Steve Lempereur, Anglo American Metallurgical Coal Phillip Enderby, Glencore Paul Revell, Anglo American Metallurgical Coal Dion Lucke, Rio Tinto Coal Australia	The project addresses the major problem that exists in many NSW coal operations in recovering fine coal by providing a powerful method for rejecting slimes from a flotation froth product. With the improved desliming performance there would also be significant benefits for producing higher yield of metallurgical coal, at a given ash, and the benefits could also be extended to include beneficiation of ultra low ash coal. This project is investigating the potential to achieve improved fine coal flotation performance and significant desliming using a device that resembles an inverted reflux classifier.

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECTS UNDER MANAGEMENT 2013</b>			
<b>Full Scale Gravity-Desliming Using Cascading Reflux Classifiers C20052</b> University of Newcastle Kevin Galvin	215,480	Paul Revell, Anglo American Metallurgical Coal Dion Lucke, Rio Tinto Coal Australia	This project addresses a major problem found in many NSW coal operations when recovering and desliming fine coal, and also in producing metallurgical coal, at a given ash. The objective is to investigate the performance of cascading reflux classifiers in the gravity separation and desliming of fine coal at full-scale, and in turn assess the scale-up achieved. This work will provide the information needed to assess whether this new approach for producing a clean fine coal product can be achieved at the same level of performance as observed in the laboratory or at pilot scale. The potential for recovering a further 3% yield could lead to significant additional mine revenue.
<b>Fine Coal Agglomeration using a Novel Economic Binding Agent C21045</b> University of Newcastle Kevin Galvin	219,100	Jeremy Byrnes, Glencore Paul Revell, Anglo American Metallurgical Coal Dion Lucke, Rio Tinto Coal Australia	Oil agglomeration is a remarkably powerful process for selectively growing particles of ultrafine coal into small balls of several millimetres in diameter, leaving behind ultrafine particles of clay and mineral matter. The fine coal is then easily dewatered using a screen to produce a clean coal product. The technology was investigated extensively in the 1970s and shown to be effective on fine coal tailings. However, due to the significant cost of oil following the oil crisis, this approach was abandoned. In this project, a fine coal agglomeration process is being developed at laboratory scale using an alternative binding agent to conventional oil agglomeration. The aim is to achieve beneficiation by aggregating the ultrafine coal to a size sufficient for direct separation and dewatering over a sieve bend. The approach could be retrofitted to treat existing flotation tailings, or to process tailings streams thereby recovering ultrafine coal that would have been lost.
<b>Improving the Performance of Froth in Coal Flotation Using Saline Water C21048</b> University of Queensland Yongjun Peng	195,000	Jeremy Byrnes, Glencore	There is strong evidence that attributes the over frothing in coal flotation to saline water or the combination of saline water and the frother or collector. When the salinity in the process water is high, over frothing occurs and the concentration of the frother has to be reduced. This project is investigating the role of frothers, the action of saline water and the moisture of flotation products including the factors controlling their behaviour.
<b>Maximising Flotation Kinetics C21049</b> University of Newcastle Kevin Galvin	179,100	Paul Revell, Anglo American Metallurgical Coal Dion Lucke, Rio Tinto Coal Australia	This project is investigating the potential to maximise flotation kinetics by a factor of between 10 and 100-fold. With the increased kinetics it should be possible to use a relatively small device to process dilute feeds (such as cyclone overflows) and concentrate the product by a factor of 5 to 10-fold. This concentrated feed would then be sent at a greatly reduced flow rate to conventional flotation cells to achieve the required level of product upgrade, reducing the very significant capital investment by more than five-fold. This work is being undertaken using an inverted reflux classifier that incorporates a novel feed downcomer consisting of parallel, closely spaced channels and a lower system of parallel inclined plates to prevent bubble loss to tailings.
<b>Plant Based Investigations of Hydrodynamic Behaviours in Large Coal Flotation Cells C21051</b> CSIRO Shenggen Hu	197,170	Jeremy Byrnes, Glencore	Since the 1980s, fine coal cleaning in Australia has been dominated by Microcel column and Jameson cell technologies. The increase in the size of these flotation cells has, in some cases, led to undesirable changes in mixing and internal flow patterns as the hydrodynamic behaviours of these cells have not been experimentally characterised in the context of fine coal flotation and the scale-up of these flotation cells is still not fully understood. This project is characterising the hydrodynamic behaviours of large Microcel columns and Jameson cells, through undertaking plant based experiments to determine the residence time distribution of liquid and solids phases at multiple points in each of the selected cells, and describe these with suitable models. The work will also measure gas holdup at different depths and radial positions in the pulp phase.

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
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### COAL PREPARATION PROJECTS UNDER MANAGEMENT 2013

<b>Generalised Model of the Reflux Classifier using Computer Simulations Based on the Discrete Element Method (DEM) C22030</b> University of Newcastle Kevin Galvin	103,700	Paul Revell, Anglo American Metallurgical Coal Dion Lucke, Rio Tinto Coal Australia	The Reflux Classifier offers lower composite Ep values than other technologies, providing potential to control the cut point down to the low levels required for metallurgical coal product. A new computational model of the Reflux Classifier will be developed to quantify partition curves and associated EP and D50 values across the relevant size range. As a result of this work, plant personnel will be able to determine the best place to insert pressure transducers for measuring and controlling the system.
<b>Measurement and Control of the Reflux Classifier C22032</b> University of Newcastle Kevin Galvin	132,730	Paul Revell, Anglo American Metallurgical Coal Dion Lucke, Rio Tinto Coal Australia	A pilot scale study of the Reflux Classifier will be carried out to establish the best way to operate and control the separator. Ludowici Australia will provide a new RC300 fitted with six pressure transducers, with the potential to record the full bed profile in real time, together with the response of the PID controller. A basis for properly measuring and interpreting the suspension density measurements of the lower bed and, in turn, a generalised approach to ensuring optimal underflow control will be established.
<b>General</b>			
<b>Database Management C15060</b> QCC Resources Pty Limited Andrew Swanson Bruce Atkinson	280,416	Phillip Enderby, Glencore	This database provides a singular reference for coal preparation equipment performance data, which encompasses all unit operations including sizing and dewatering. It's accessible to all Australian coal industry personnel, associated consultants and researchers.
<b>Improved Automation Reclaim For Uneven Stockpiles C19044</b> BMT WBM Russ Morrison Stuart McCarthy	284,690	Jennifer Woodgate, BMA Shaun Booth, Glencore Rod Fox, Whitehaven Coal	This project was extended to allow for the inclusion of additional trials with a new type of lidar (laser scanner) that has recently become commercially available and could prove to be a suitable choice of stockpile sensor. The original project included the testing of a 3D microwave scanner which has been mounted on a bucket wheel reclaimer at Hay Point. This scanner is designed to generate an image of the stockpile ahead of the bucket wheel, enabling pre-emptive action to improve the automatic control and efficiency of the reclaimer .
<b>Seal, Spray and Wash Water Filtration in CHPPs C21047</b> GBL Process Gotz Bickert	33,800	Jennifer Woodgate, BMA	Extensive process water is used in coal preparation plants for pump seals, flotation wash water, TBS upward current water, spray nozzles and vacuum seals on vacuum filters and vacuum pumps. Some Australian preparation plants have installed strainers and filters to eliminate solids blocking the nozzles, providing wear on seal strips on belt filters and to protect the vacuum pumps. This project is reviewing seal and spray water filtration technologies and document current practices in Australia and overseas. The study covered strainers, back wash and other self cleaning filters, media filters, centrifugal separators and other devices used or with potential to be used for large flow rates of process water with very variable solids loading from snails to slimes.
<b>Gravity Separation</b>			
<b>Large Diameter DMC Performance in Low Density/High Near Gravity Environment C20045</b> A & B Mylec Andrew Meyers	479,747	Jeremy Byrnes, Glencore Rod Fox, Whitehaven Coal	DMCs treat the overwhelming majority of coal in the Australian coal industry. With DMCs being nominally fed between 60% and 80% of any plant feed stream, the efficiency of this area of the plant has a substantial impact on the plant yield and hence revenue. In addition, the specific mechanisms of inefficiency are usually associated with the finer fractions. It is now common place for new and upgraded plants to install DMCs of larger than 1000mm diameter, however, debate continues over the resultant impact on unit performance for the full size range being processed, particularly for smaller particles as the cyclone diameter increases. This project measured very large DMC performance under a series of much more challenging conditions to generate data which starts to deviate from acceptable performance. Without this additional data accurate modelling of optimum performance cannot be assessed, limiting the resolution of current industry speculation regarding optimum feed pressure and M:C ratio settings for design and routine operation.

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECTS UNDER MANAGEMENT 2013</b>			
<b>Linkage of Dynamic Changes in DMC Circuits to Plant Conditions C20050</b> CSIRO Bruce Firth Mike O'Brien Peter Holtham	492,502	Roy Brown, Rio Tinto Coal Australia Jeremy Byrnes, Glencore	DMC circuits are responsible for producing more than \$25 billion of product coal in Australia. The link between the process dynamics of a DMC circuit and prevailing plant operation has been the subject of previous research. C17037 led to a number of new online monitoring devices incorporated into the host mine's DMC circuit. In this extension project, a better management approach will be defined to mitigate the dynamic impacts of the mining and preparation processes on plant efficiency. The significant research findings will be detailed in a handbook, including potential remedial actions. 'The Intelligent Plant' diagnostic system will also be updated.
<b>Effect of Dynamic Changes in Medium Quality on Coal Processing C20051</b> CSIRO Mike O'Brien	128,075	Roy Brown, Rio Tinto Coal Australia Jeremy Byrnes, Glencore	Magnetite medium slurries used in the processing of coals in DMCs require an amount of non-magnetic material, to maintain a stable medium. Loss of coal due to unstable mediums and offset effects resulting from different cut points in the loops of a coal preparation plant's dense medium cyclone circuit can result in considerable financial losses. This project quantified the variation in the concentration of non-magnetics in the DMC medium which may lead to practices that ensure the concentration of non-magnetics in the medium is optimised for efficient and stable DMC operation to prevent coal loss due to unstable mediums at start up, following a shutdown or feed mass rate change.
<b>Monitoring and Prediction of Catastrophic Multi Sloped Screen Failures C21053</b> CSIRO Mike O'Brien	260,024	Colin Surawski, Vale Australia Phillip Enderby, Glencore	Multi sloped (banana) screens are commonly used in Australian coal preparation plants for desliming and drain and rinse applications. While these screens have gained widespread acceptance, they are susceptible to mechanical failure. With the current trend for increasing the capacity and size of these screens, the potential for damage should one fail is high. This project is determining the mechanism of failure. It will trial numerous non-destructive testing techniques such as vibration monitoring, pressure monitoring, acoustic monitoring, strain gauges and a novel technique based on research at Monash University to measure the cyclic deformation. It is the cyclic nature of the force that can cause irreversible dislocations at the surface of the material, leading to deformation structures that can initiate the catastrophic failure.
<b>Investigation of the Graviton Separator at Pilot Scale C22031</b> University of Newcastle Kevin Galvin	271,120	Paul Revell, Anglo American Metallurgical Coal Dion Lucke, Rio Tinto Coal Australia	This project will develop a continuous steady state separator consisting of Reflux Classifiers located within a centrifuge. This device, known as the Graviton, will be developed and investigated. This technology could replace flotation and provide new options for desliming, eliminating the need for flotation reagents.
<b>Occupational Health and Safety</b>			
<b>Application of Nano Particles to Fine Coal Float Sink Test C20044</b> University of Queensland Gary Cavanough Michael Campbell	168,500	Alistair Harriman, Peabody Energy Australia	The elimination of organic chemicals from laboratories is a priority for the coal industry. A variety of replacements are under investigation including ferro-fluids, zirconium dioxide and caesium formate. This project is investigating the use of ferromagnetic nano particles in a laboratory fine coal separation. The project outcome will be an evaluation of a prototype float sink separation procedure/device.
<b>Washability Analysis of Fine Coal using a Water Based Method C21046</b> University of Newcastle Kevin Galvin	170,000	Paul Revell, Anglo American Metallurgical Coal Dion Lucke, Rio Tinto Coal Australia	The risk to health and growing cost of conventional coal analysis using organic liquids is well recognised and of great concern in the coal industry. This project is delivering an inexpensive and rapid method for obtaining fine coal washability data, and analysis of beneficiation performance using a laboratory scale Reflux Classifier. The industry has been proactive on delivering a solution to this ongoing problem.



PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
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**COAL PREPARATION PROJECTS UNDER MANAGEMENT 2013**

<b>Application of X Ray Computed Tomography (CT) for Coal Washability Analysis C21050</b> University of Queensland Anh Nguyen	174,803	Jeremy Byrnes, Glencore Joan Cowburn, Anglo American Metallurgical Coal	The washability curve for coal is the basic indicator of coal quality and its amenability to cleaning. The curve is characteristic of a given coal and determines whether the coal can be cleaned to meet the necessary product specifications or whether it needs further processing. The washability curves are currently obtained by sink float analysis using mixtures of organic liquids which are toxic and environmentally hazardous. This project investigated the use of X-ray computed tomography (CT) in obtaining the washability characteristics of coal. The CT based coal washability analysis will be non-destructive, non-toxic, fast and will allow for the development of an online coal washability analysis system.
<b>Process Control</b>			
<b>Gravity Concentrator Expert Control System C20048</b> QCC Resources Bob Drummond	162,900	Jennifer Woodgate, BMA Alistair Harriman, Peabody Energy Australia Joan Cowburn, Anglo American Metallurgical Coal	There are over 25 gravity concentrators operating in Australia treating raw coal plant fines. The gravity concentrator requires judicious selection of the gravity concentrator operating variables to control the gravity concentrator operating cutpoint and hence the fine coal circuit yield and ash outcomes. Unfortunately the adjustment of the concentrators operating settings is rarely implemented to optimise the gravity concentrator circuit yield and ash. In this project range point density readings at different elevations within the bed were measured. The resulting density profile should provide a correlation with respect to the processing cutpoint and processing efficiency. Once derived the density profile signature was trialed as a feedback control mechanism, to optimise the bed density set point and the fluidising water flowrate and in doing so optimised the yield and ash outcomes of the fine coal circuit.
<b>On-line Estimation of Plant Feed Washability C20049</b> CSIRO Shenggen Hu	178,975	Steve Lempereur, Anglo American Metallurgical Coal	In order to optimise the cut-point of individual DMC operation and determine the maximum possible feed rate to the DMC it is necessary to monitor the washability on-line. Unfortunately, there are currently no practical on-line techniques for obtaining this most fundamental of all coal cleaning information and the industry relies on radioactive source based ash gauges to monitor the product rather than the feed. The associated delays in responding to changing ash contents results in significant loss of yield. This project used a formulae developed in previous ACARP projects to develop a system for on-line estimation of plant feed washability with input from a screen motion analyser and a screen spring weight sensing device.
<b>Centrifugal Dewatering Properties of Australian Coals C21052</b> CSIRO Mike O'Brien	131,180	Rod Fox, Whitehaven Coal	Mines with a low moisture content may have difficulty meeting their contractual obligations when changing from a low internal moisture seam to a high internal moisture seam. Advance knowledge of the total product moisture could save companies from penalties imposed due to product moistures being outside the specified range. This project provided a database showing centrifugal dewatering properties versus rank and proximate analysis from a broad range of Australian coals with a particular emphasis on lower rank coal. The data was plotted against the rank of the coal expressed as carbon content. The project examined the effects of air drying the coal and the effect that float sink chemicals may have on dewatering characteristics.
<b>Advanced Control and Optimisation of DMC Operation C22033</b> CSIRO Shenggen Hu	236,685	Rahul Patel, Peabody Energy Australia Jennifer Woodgate, BMA Roy Brown, Rio Tinto Coal Australia Joan Cowburn, Anglo American Metallurgical Coal	The goal of an effective dense medium cyclone (DMC) is to select operating conditions that will maximise the plant to a quality constraint imposed by customer's specifications or overall plant performance. Theoretical analysis shows that the total yield from a coal preparation plant may be maximised by operating all parallel unit operations at a constant incremental ash. The objective of this project is to develop, implement and demonstrate an advanced control system that optimises DMC operating conditions under which a target product ash and/or a given incremental ash can be achieved.

### COMMITTEE MEMBERS

Understanding the properties of Australian coals which impact on market acceptance and value in use, particularly where they represent an advantage over coals from international competitors, is a major goal for research in this area. A specific priority is understanding the environmental performance of Australian coals and whether they will conform to emerging legislative regimes, both domestically and internationally.

<b>Chris Dempsey</b>	Superintendent Mine Planning Caval Ridge (Co Chair, Technical Market Support Committee)	BMA
<b>Dave Osborne</b>	Coal Technology Manager (Co Chair, Technical Market Support Committee)	Xstrata Technology
<b>Morgan Blake</b>	Marketing Manager	Peabody Energy Australia
<b>Stephen Brant</b>	Technical Manager	BHP Billiton
<b>Ashley Conroy</b>	Group Advisor – Coal Technology	Rio Tinto Energy
<b>Sean Flanagan</b>	Manager, Coal Technology	Wesfarmers Curragh
<b>Graeme Harris</b>	Principal Coal Technologist	Rio Tinto Energy
<b>Kim Hockings</b>	Technical Specialist	BHP Billiton
<b>Sauli Kallio</b>	Technical Marketing Manager	Anglo American Metallurgical Coal
<b>Tim Manton</b>	Manager Coal Quality & Utilisation	BHP Billiton Illawarra Coal
<b>Oliver Scholes</b>	Technical Marketing Specialist - Coal	Vale Australia
<b>Luke Solomon</b>	Strategic Planning Superintendent	Anglo American Metallurgical Coal
<b>Chris Stanford</b>	Manager Downstream Coal Quality	Peabody Energy
<b>Ken Sullivan</b>	Technical Advisor	Cornwall Coal

### FUNDING APPROVED 2013

Year	No of Projects	ACARP Funding	Total Funding
<b>2013</b>	<b>12</b>	<b>\$1,409,979</b>	<b>\$1,969,933</b>
2012	11	\$1,069,147	\$1,862,174
2011	8	\$905,691	\$1,578,313

### PROJECTS UNDER MANAGEMENT 2013

Category	No of Projects	ACARP Funding
Metallurgical Coal	17	\$3,306,126
Thermal Coal	2	\$204,589
General	4	\$1,308,300

**TECHNICAL MARKET SUPPORT PROJECT APPROVALS 2013**

**Metallurgical Coal**

<p><b>Implications of Coke Oven Testing Conditions C22039</b></p> <p>ALS Coal Philip Bennett</p>	<p>167,766 New</p> <p>50,000 Existing</p>	<p>Chris Stanford, Peabody Energy Oliver Scholes, Vale Australia Graeme Harris, Rio Tinto Energy</p>	<p>Although small scale coke tests are being used increasingly as cheaper alternatives to pilot scale coke making, they are less able to make coke that has properties and quality similar to pilot or commercial cokes made from the same coal. If the coke making technique is not correctly optimised there is a risk that these tests may understate the coke strength after reaction (CSR) for Australian cokes compared with CSR from a pilot or battery coke. This project will identify the critical factors that distinguish coke reactivity index (CRI)/ CSR measurements of cokes made in small scale coke tests and develop a methodology that will allow Australian producers to better interpret CSR results on cokes produced under different coking conditions.</p>
<p><b>Mechanistic Model For The Understanding of Sole Heated Ovens C23047</b></p> <p>University of Newcastle David Jenkins Merrick Mahoney</p>	<p>169,000</p>	<p>Sauli Kallio, Anglo American Metallurgical Coal</p>	<p>Sole heated ovens are an important tool for understanding the coking behaviour of coals. Despite their widespread use, fundamental understanding of the processes driving the results of sole heated ovens is poor. This project aims to improve the understanding of the processes occurring in sole heated ovens and to use this information to improve knowledge of the behaviour of coal in the plastic state.</p>
<p><b>Links Between Microstructure Development In Softening Coal and the Characteristics Controlling Coke Quality C23048</b></p> <p>University of Queensland David Jenkins Karen Steel</p>	<p>211,885</p>	<p>Chris Dempsey, BMA Oliver Scholes, Vale Australia Luke Solomon, Anglo American Metallurgical Coal</p>	<p>The fundamental mechanisms by which a particular coal or blend produces a strong coke is still largely unknown. This project sets out to obtain key insights into the microstructural features dictating coke strength and how those structures form. To achieve this goal the project combines micro computed tomography analysis and rheometry. The insights obtained are expected to help improve prediction models and to improve the strength of particular coals.</p>
<p><b>Coke Analogue to Examine the Effect of Mineralogy on Coke Reactivity C23049</b></p> <p>University of Wollongong Brian Monaghan</p>	<p>154,010</p>	<p>Oliver Scholes, Vale Australia Tim Manton, BHP Billiton Illawarra Coal</p>	<p>Coke reactivity test data are considered key metrics of a coke's quality as they correlate with blast furnace performance. An ability to predict the reactivity of coke from its key characteristics is, in part, limited by unknown or non quantified effects of minerals in coke. This project will validate a test methodology for quantifying the effects of minerals on coke reactivity and quantify the specific effects of selected combinations of quartz, iron bearing minerals and feldspars on the coke analogue reactivity.</p>
<p><b>Optical Image Analysis of Coke Structure and the Effects of Structural Parameters on Coke Strength C23051</b></p> <p>CSIRO Eugene Donskoi Merrick Mahoney</p>	<p>147,416</p>	<p>Ashley Conroy, Rio Tinto Energy Oliver Scholes, Vale Australia</p>	<p>Understanding of the dependence of coke strength on its structure and the relationship of these structures to coal properties will help optimise coal blend formulation. This project will apply novel structural and characterisation techniques to high resolution optical photomicrographs of coke to understand the dependence between coke strength, its structural characteristics and the parent coal blend. Combined with other research showing how coke structures develop during pyrolysis, this work could help develop projects leading to coke strength improvements, predictive models for use in blending studies and evaluation of coal resources.</p>
<p><b>Determination of a Theoretically Based Coke Strength Index or Indices Based on Drum Tests C23056</b></p> <p>ALS Coal Philip Bennett</p>	<p>126,100</p>	<p>Chris Stanford, Peabody Energy Oliver Scholes, Vale Australia Graeme Harris, Rio Tinto Energy</p>	<p>Small scale coke testing offers considerable savings in testing costs and is the only option when evaluating bore core samples. At present there is no coking strength test that can be conducted on limited quality of coke that shows reasonable correlation to standard drum tests that are routinely performed on pilot scale cokes. This project aims to address this issue by testing the applicability of the JKMRc breakage model to cokes that exhibit adhesion controlled breakage, extending the modelling of breakage to include coke produced in the small scale coke oven (8kg) where the strength of the coke is determined by the modified micum or the drum test, and recommending a suitable method for the preparation of coke Nippon Steel Corporation (NSC) reactivity test.</p>

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>TECHNICAL MARKET SUPPORT PROJECT APPROVALS 2013</b>			
<b>General</b>			
<b>Australian Participation in Development of ISO Methods for Sampling, Analysis and Coal Preparation and National Technical Committee Support C15003</b>	25,000 New	Technical Market Support Committee	Payments for coal sales contracts are based on a sampling and analysis certificates. These certificates are based on International Standards Organization (ISO) standards in most cases. It is important to retain the ability to influence developments and/or changes to International Standards to ensure Australian coal industry interests are properly accommodated. To this end, an Australian delegation has been attending ISO meetings since 1982. ACARP assumed responsibility for funding attendance in 2005, supporting 4 delegates. ISO meetings are held every 2 years, and funding is approved in 2-year blocks. This project will continue to support the delegation through 2011 and 2012.
Standards Australia Ahshanur Rashid	467,409 existing		
<b>Investigation of Factors Which May Cause Coal Flow Problems During Discharge from Rail Wagons C22034</b>	30,000 New	Chris Stanford, Peabody Energy Sean Flanagan, Wesfarmers Curragh	'Sticky' coal is an ongoing issue in the transportation of product coal as it can increase the unloading time of trains at the port resulting in costly delays. A coal is classified as being 'sticky' when it is hung up in rail wagons, or when mechanical assistance, such as vibration, is required to empty wagons during unloading. In this project, laboratory tests and field trials will be conducted to evaluate three proposed methods of improving the flow of sticky coal times from rail wagons, thereby achieving a reduction in train unloading delays.
Introspec Marketing Services John Planner	106,160 Existing	Dave Osborne, Xstrata Technology	
<b>Review of the TMS Research Program and Needs C23003</b>	26,000	Technical Market Support Committee	Inhouse review of technical market support committee program direction.
A&SJ Lowe Consulting Services Allen Lowe			
<b>Extension of the CGA Maceral Chemistry Database and Development of Optical Mineral Markers to Provide Mineral Abundance Information by CGA C23050</b>	167,040	Dave Osborne, Xstrata Technology Graeme Harris, Rio Tinto Energy Stephen Brant, BHP Billiton	A database containing information on maceral chemistry and maceral reflectance relationships for Australian coals has been developed. This project will add information on another six coals to this database. In addition, methods will be developed for estimating the proximate and ultimate properties and mineral species abundance for each individual particle in coal particles up to four millimetres in size, and for obtaining quantitative size information on the mineral species and mineral/maceral association information for the dominant coal minerals.
CSIRO Priyanthi Hapugoda			
<b>Revised Dustiness and Dust Extinction Moisture Testing Method (Update of AS 4156.6) C23054</b>	130,000	Tim Manton, BHP Billiton Illawarra Coal Dave Osborne, Xstrata Technology	A reliable, science based method for testing coal dustiness and dust extinction moisture will be developed for the purpose of producing a future Australian Standard. The existing standard will be updated to reflect the new test method and will incorporate a relationship between the different airborne particle size ranges and effects on both environment and health. The standard will include advice on optimal moisture level with respect to dust extinction moisture level.
University of Newcastle Alan Roberts John Planner			
<b>Phosphorus in Coal: Status of Test Methods in Use and Applicability to Industry Needs C23055</b>	55,762	Oliver Scholes, Vale Australia Morgan Blake, Peabody Energy Australia	Phosphorus is a key coal quality parameter and will become more significant in the future with higher phosphorus levels expected in various coal types. The precision of methods for high phosphorus levels identified in the existing standards is relatively poor. The objective of this study is to assess whether laboratory testing of phosphorus in coal is meeting current and future industry needs or whether further work is required.
QCC Resources Ian Anderberg			

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
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**TECHNICAL MARKET SUPPORT PROJECTS UNDER MANAGEMENT 2013**
**Metallurgical Coal**

<b>Advanced Characterisation of Metallurgical Coals - Coke Properties and Reactivity C17050</b> University of New South Wales Sushil Gupta, Veena Sahajwalla, Merrick Mahoney, Richard Roest	704,113	Sauli Kallio, Anglo American Metallurgical Coal Stephen Brant, BHP Billiton Luke Solomon, Anglo American Metallurgical Coal Dave Osborne, Xstrata Technology	Previous research has shown that coal mineral matter and blast furnace operating conditions have significant impacts on coke performance that are not necessarily reflected in bench-scale reactivity measurements. This project is the second of a series of stages in a collaborative research program with Ruukki Steel, Finland. In stage 1, coke samples from Ruukki blast furnace, obtained through unique tuyere drilling equipment, were used to characterise the effect of blast furnace conditions on changes in coke carbon structure and mineral matter. This second stage will focus on coke weakening mechanisms and fines generation.
<b>Application of Optical and SEM Imaging to Characterise Cokes for Strength and Reactivity C18043</b> ALS Coal Lauren Johnson Nic Andriopoulos Philip Bennett	348,800	Tim Manton, BHP Billiton Illawarra Coal Dave Osborne, Xstrata Technology Chris Dempsey, BMA	Predicting the influence that coal properties have on coke properties (particularly microstructural and microtextural features) is critical to understanding the true value of coals. Using recent advances in microscopy and mathematical techniques to interpret complex images, an imaging system for coke has been developed which will assist in interpreting coke microstructure and microtexture. In this extension project these image analysis techniques will be applied to a larger range of cokes to ascertain if the parameters determined can relate to coke strength, in particular coke drum indices. The use of a robust coke imaging system will assist coking coal producers to identify the reasons why a certain coal has good cold or hot strength or why it has poor coking characteristics.
<b>PCI Combustion Test C19049</b> University of Newcastle Terry Wall	304,200	Morgan Blake, Peabody Energy Australia Sean Flanagan, Wesfarmers Curragh Tim Manton, BHP Billiton Illawarra Coal	A simple laboratory scale test that is cost effective and relatively quick to complete would help iron makers assess the suitability of various coals for pulverised coal injection (PCI). The validity of drop-tube furnaces for assessing coals for PCI was proven in a previous ACARP project by comparing the combustion performance of coals not commonly used for PCI with coals known to be used in PCI application. Drop-tube furnaces are operated in most universities and some industrial laboratories. This project assessed a further six coals.
<b>Development of a Synthetic Sulphur Calibrant and Associated Test Method C19050</b> HRL Technology Nicolas Miller	79,750	Chris Stanford, Peabody Energy	In the past classical methods for the determination of sulphur levels in coal were based on first principles and did not rely on direct comparison to a reference value. However, with the increased pressure on timeliness of analysis results, classical methods have been replaced with more rapid instrumental techniques that require calibration with certified reference coals. This project is identifying synthetic sulphur compounds, confirming their suitability for calibration of instrumental sulphur analysers and developing a new instrumental method incorporating the selected calibrants in order to expedite the development of a new Australian Standard.
<b>Characterisation of Australian and Indian Coals and their Cokes from Stamp and Top Charged Coke Ovens C19051</b> University of New South Wales Graham O'Brien Sushil Gupta	221,500	Sean Flanagan, Wesfarmers Curragh Tim Manton, BHP Billiton Illawarra Coal	There has been strong interest in finding ways to prepare high quality coke using low premium weak coking coals. With the advances of stamp-charging practice in heat recovery as well as by-product coke ovens, it has been possible to utilise a greater percentage of weaker coking coals in the blend to achieve acceptable coke strength. There is still limited understanding of association or correlation of coal properties and the properties of cokes made using stamp-charging technology. This project is investigating the influence of coal properties, mainly grain size variation, on the composition of organic matter and their influence on rheological and coke properties made from weak coking coals.
<b>Mineral Matter Effects on Coke Degredation in Blast Furnace Samples C19052</b> CSIRO David French	176,800	Chris Stanford, Peabody Energy Stephen Brant, BHP Billiton Ken Sullivan, Cornwall Coal Ashley Conroy, Rio Tinto Energy	A recent study has indicated that the behaviour of coke in the lower part of the blast furnace cannot be adequately predicted by the NSC test. The study has shown that the behaviour of the organic fraction in the NSC test differs from that in the blast furnace and that the furnace cokes have a distinctive mineralogy. This project provided an understanding of the behaviour of coke mineral matter and mineral reactions in the lower part of the blast furnace and determine to what extent the different forms of mineral matter formed as a consequence of these reactions affect coke reactivity and abrasion resistance.

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>TECHNICAL MARKET SUPPORT PROJECTS UNDER MANAGEMENT 2013</b>			
<b>Understanding Coal Grain Effects on Coke Quality C20008</b> University of Newcastle Graham O'Brien Merrick Mahoney	187,093	Stephen Brant, BHP Billiton Dave Osborne, Xstrata Technology	Quantifying the link between coal grain composition and coke quality can assist customers optimise their milling practices when using Australian coking coals. The recently developed microscopic imaging capability, Coal Grain Analysis, has been used to characterise the performance of the differing coal grinds on coking performance. It was demonstrated that grain compositional analysis gave a superior explanation of coke quality variations than simple grind parameters alone. The test program quantified the grain size distribution impact on coke quality for two new coals. Coke information will be obtained using the pilot scale research coke oven now being rebuilt at CSIRO in Brisbane.
<b>Theoretically Based Coke Strength Index or Indices Based on Drum Tests C20009</b> ALS Coal Frank Shi Philip Bennett	158,000	Oliver Scholes, Vale Australia Sean Flanagan, Wesfarmers Curragh Chris Dempsey, BMA	Drum indices are commonly used as the mechanical strength index of cokes. Unfortunately these indices don't represent the basic property that controls the breakage and are only test results derived under restricted conditions. This project determined if the coke size data, normally collected when a set of drum tests are performed, can be used to determine a theoretically based strength index. This strength index will be based on sound breakage theory and, since it is determined from all the data generated, it will be a better representation of the coke strength for the whole sample.
<b>Understanding Exploration Samples by Coal Grain Analysis C20040</b> CSIRO Bruce Firth Graham O'Brien	115,720	Tim Manton, BHP Billiton Illawarra Coal Dave Osborne, Xstrata Technology	Australian coals of similar rank and maceral composition sometimes exhibit differing utilisation behaviour and it is anticipated that the maceral chemistry investigated in this project will provide an explanation for these differences. This project established correlations between maceral reflectances and chemistries to determine if they are independent of coal origin. This hypothesis was tested on Australian coals and coals from India and China. As coal is used as a particulate material in coke making and in power generation, this grain by grain chemistry information will provide new data for utilisation models developed by other researchers. It highlighted similarities and differences between Australian coals and International coals of similar rank and composition.
<b>Microstructure Variability in Coke and its Effect on Coke Properties C21056</b> CSIRO David Jenkins Merrick Mahoney	129,090	Luke Solomon, Anglo American Metallurgical Coal Graeme Harris, Rio Tinto Energy	The performance of coke in the blast furnace depends critically on its strength and reactivity which, in turn, depend on the microstructure of the coke. The microstructure depends on the nature of the coal charge used in coke making, such as the coal blend, particle size and the operational parameters of the coke oven. While there are standard experimental procedures to assess coke strength and reactivity, they are limited to small samples and the tests cannot always be carried out under conditions which are typical of actual operational use. This project investigated a complementary approach by determining specific properties of coke by examining its microstructure. This was achieved using a digital representation of the coke microstructure obtained from a micro computed tomography image of the sample. This provided the input for a finite element modelling tool. The approach allows porosity, effective internal surface area, compressive strength, fracture properties and gas permeability to be estimated.
<b>Predicting Dilation of Coal Blends from Models of Softening, Bubble Growth and Gas Transport C21057</b> CSIRO David Jenkins Merrick Mahoney	124,435	Chris Dempsey, BMA	A key part of the transformation of coal into coke is the plastic phase, when particles soften, volatiles are evolved and bubbles are formed. The specific contributions of each process to the properties of the resulting coke remain difficult to quantify. In this project a modelling framework was developed to examine the role that these processes play in the development of coke during the plastic phase. A key outcome was the development of a model of contraction and expansion of coal in the dilatometer test. This is an important tool for predicting coke quality from coal blends. The results were compared with dilatometer tests for a range of Australian coals and blends in order to validate the model's performance.

PROJECT/RESEARCHER      ACARP FUNDING      INDUSTRY MONITORS      OVERVIEW

**TECHNICAL MARKET SUPPORT PROJECTS UNDER MANAGEMENT 2013**

<p><b>Relationship Between Internal Pressure and Coke Strength and Implications for Semi Soft Coking Coals in Blends C21058</b></p> <p>ALS Coal Karen Steel Nic Andriopoulos Philip Bennett</p>	190,540	<p>Stephen Brant, BHP Billiton Luke Solomon, Anglo American Metallurgical Coal Morgan Blake, Peabody Energy Australia</p>	<p>When blending coals, particularly soft coking coals with hard cokings coals there is often a maximum concentration of weaker coal that can be incorporated before there are significant decreases in coke strength. The amount of weaker coking coal that can be added before this decrease occurs is dependent upon the properties of the coal, the void space into which the coal can expand and the pressure exerted on the plastic layer. These factors control the porous structure of the coke and therefore coke strength. This project extension is characterising the viscoelastic properties of a series of coals tested in the modified SHO and a Sapozhnikov plastometer.</p>
<p><b>Estimating the Fusible Content of Individual Coal Grains and its Application in Cokemaking C21059</b></p> <p>CSIRO George Poropat Graham O'Brien Merrick Mahoney</p>	128,382	James Graham, A & B Mylec	<p>Recent research shows that the composition of individual coal grains and the size of different grain types can affect the coking performance of coal. This work used the image based coal grain analysis method to classify each particle on the basis of the relative amount of vitrinite, liptinite, inertinite and minerals they contained as a single component or as composite grains. As this method was developed to characterise fine coal, it did not provide compositional information for the entire particle, just on a portion of the grain. This project is extending this technique to enable reflectance fingerprint information to be obtained for a statistically relevant number of entire grains in coke oven feed samples, and determining the fusible and infusible inertinite abundances in each particle. The project should lead to a more accurate prediction of coking performance.</p>
<p><b>Quality of Stamp Charged Cokes and Stampability of Coals at Small Scale C22035</b></p> <p>ALS Coal Lauren Johnson</p>	114,530	<p>Chris Stanford, Peabody Energy Sean Flanagan, Wesfarmers Curragh</p>	<p>Stamp charging of coals is widely used to improve the productivity and coke quality in coke making operations where poorer quality coking coals are prevalent as this type of technology affords increased flexibility in the coals that can be used within a blend. An important consideration for operators that make use of stamp charging is the stampability, which is defined as the amount of energy that is required to pack the coal to the target bulk density. The objectives of this project are to implement a standard procedure to determine the stampability of a coal or coal blend and demonstrate the use of stamp charging at small scale to investigate coals being considered for stamp charging operations.</p>
<p><b>Fractographic Approach to Understanding the Mechanisms of Coke Breakage C22036</b></p> <p>University of Newcastle Richard Roest</p>	123,986	<p>Sauli Kallio, Anglo American Metallurgical Coal Stephen Brant, BHP Billiton</p>	<p>Coke is a brittle heterogeneous composite consisting of carbon derived from fusible, semi-fusible and inert coal particles that form a porous matrix. Coke strength is controlled by the properties of the matrix, the resulting porosity and existing and resultant defects formed by the coke making process. This project will assess the mechanical properties of the coke after it has been subjected to cyclic loading and the resultant wear and fracture processes it would likely undergo in a blast furnace environment. This will allow a more accurate picture of the physical degradation mechanisms of metallurgical coke and whether the major degradation mechanism varies between cokes prepared from different coals and blends.</p>
<p><b>Fundamental Reasons for Different Coking Behaviour of Coals from Different Basins - Behaviour of Semi Inerts C22037</b></p> <p>University of Newcastle Rohan Stanger</p>	149,187	Sean Flanagan, Wesfarmers Curragh	<p>While most coke operators use empirical relationships between coking performance and standard indices such as rank, fluidity, reflectance and dilation, such empiricism can only be used with certainty on coals within the testing suite. This project will use two novel thermal analysis techniques to compare thermal behaviour of both Moranbah and Rangal coal measures in order to develop a more fundamental understanding of the reason for differences in their coking behaviour. The behaviour of coals from the Moranbah coal measures are well known. Although significant work has been done on the Rangal coal measures, coal behaviour is still not widely understood.</p>

**TECHNICAL MARKET SUPPORT PROJECTS UNDER MANAGEMENT 2013**

**Thermal Coal**

<b>Submicron Ash Emissions and Trace Elements from Boiler Simulation Furnace C18044</b>	85,775	Ashley Conroy, Rio Tinto Energy	Fine particle emissions, ie less than 2.5 micron, from power stations are coming under increasing scrutiny due to their potential health impact. This very fine dust is the most difficult to collect and it is relevant to know the rate of production of ash fines in order to design adequate dust collection equipment. This project burned coals in a boiler simulation furnace fitted with an electrostatic precipitator that mimics full scale plant. Fly ash was sampled and analysed for total flow rate, size distribution down to submicron sizes and the concentrations of trace elements on each size fraction.
ALS Coal Don Holcombe			

<b>The Mercury Treaty - Implications and Responses C19009</b>	118,814	Ashley Conroy, Rio Tinto Energy	In 2009 the UN Environment Programme's Governing Council agreed to develop an international mercury treaty which, potentially, has major implication for the coal and mineral processing industries. Coal combustion is the major human-induced source of mercury emissions. The treaty is not expected to be completed until 2013. As part of a previous ACARP project, regular briefing documents were produced on the development of the global treaty and Australian expert involvement in the Global Mercury Partnership for mercury form coal combustion was facilitated through a central point. This extension project ensures the existing work program continues until 2013.
Macquarie University Peter Nelson			

**General**

<b>Prediction of Electrostatic Precipitation Performance C22038</b>	55,105	Ashley Conroy, Rio Tinto Energy	Electrostatic precipitator (ESP) performance is frequently identified as the main limitation of Australian coals competing against Indonesian suppliers. The prediction of ESP performance of a coal is presently less reliable than most other aspects of power plant performance. This project will improve the capability to predict the ESP performance of a coal based on either coal quality data or laboratory scale testing of the ash. These prediction methods are cheaper and require less coal sample than the existing approach.
ALS Coal Don Holcombe			

<b>Transportable Moisture Limits for Coal C22040</b>	679,625	Transportable Moisture Limit Steering Committee	There are three methods available for measuring transportable moisture limit as specified in the International Maritime Solid Bulk Cargoes Code. Depending on its classification under the code, cargoes that may liquefy must specify a transportable moisture limit and an assurance provided that the moisture content for the cargo is below its specified transportable moisture limit. This project seeks to better understand the conditions under which liquefaction may occur as well as the suitability and/or relative performance of current methods for measuring transportable moisture limit, including investigation of alternative test methods if none of the current methods prove to be suitable.
CSIRO Ralph Holmes David McCallum Ken Williams			



## COMMITTEE MEMBERS

Australian coal producers need to report greenhouse gas emissions from mining operations and where possible to act to reduce those emissions. Fugitive seam gases have been clearly identified as the largest contributor to greenhouse emissions from coal mines. The Mine Site Greenhouse Mitigation Committee has been funding a range of activities in this area since its formation in 1998, and is increasingly targeting two technical challenges for the industry; estimation of fugitive methane emissions from open cut operations and mitigation of the methane in underground mine ventilation air.



<b>Peter Roe</b>	Manager Environment Regulation (Chair, Mine Site Greenhouse Mitigation Committee)	BMA
<b>Heather Bone</b>	Group Manager Sustainability	Downer EDI Mining
<b>Patrick Booth</b>	Manager Energy Utilisation	BHP Billiton Illawarra Coal
<b>Sam Bretherton</b>	Energy and Emissions Advisor	Peabody Energy Australia
<b>Brett Garland</b>	Chief Executive Officer	Caledon Resources
<b>Jan Green</b>	Manager Corporate Sustainability and Environment	Idemitsu Australia Resources
<b>Ben Klaassen</b>	Manager Environment Climate Change	BMA
<b>Peter Morris</b>	Senior Advisor – Coal	Minerals Council of Australia
<b>Alex Neels</b>	Manager Energy and Emissions	Peabody Energy Australia
<b>Jim Sandford</b>	Project Manager, Coal Assets Australia	Glencore
<b>Trevor Stay</b>	General Manager Gas & Carbon	Anglo American Metallurgical Coal
<b>Alex Zapantis</b>	Principal Adviser, Product Stewardship	Rio Tinto Energy

## FUNDING APPROVED 2013

Year	No of Projects	ACARP Funding	Total Funding
2013	4	\$687,516	\$1,207,512
2012	3	\$539,409	\$785,529
2011	4	\$1,105,408	\$1,417,408

## PROJECTS UNDER MANAGEMENT 2013

Category	No of Projects	ACARP Funding
Mine Site Greenhouse Mitigation	9	\$2,771,536

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>MINE SITE GREENHOUSE MITIGATION PROJECT APPROVALS 2013</b>			
<b>Ventilation Air Methane Capture Study - Carbon Fibre Composite C19054</b> CSIRO Paul Webley, Shi Su	205,840 New	Patrick Booth, BHP Billiton Illawarra Coal Trevor Stay, Anglo American Metallurgical Coal Jim Sandford, Glencore	Treatment of ventilation air methane (VAM) with cost-effective technologies has been an ongoing challenge due to its high volumetric flow rate and low, variable methane concentrations. This project aims to enrich VAM concentrations to more than 25 per cent volume using a two stage VAM adsorption process at the existing large scale test unit at CSIRO's QCAT facility. A methodology will be developed to ensure operational safety in the course of methane enrichment and operational parameters will be identified for a scale up.
<b>Catalytic Combustion of VAM - Effect of Changing Composition and Concentration of Gases C21064</b> University of Newcastle Bogdan Diugogorski Eric Kennedy Michael Stockenhuber	252,240 New 504,737 Existing	Patrick Booth, BHP Billiton Illawarra Coal Trevor Stay, Anglo American Metallurgical Coal Jim Sandford, Glencore	Catalytic combustion technology is being developed to mitigate ventilation air methane (VAM). Previous research has found that high levels of methane conversion could be achieved under mild conditions (lower temperatures), using a low reactor volume, and that excellent overall conversion performance could be achieved, even under conditions of varying methane concentrations. This project will develop test protocols for technical and commercial assessment of catalysts as well as fast deactivation methods/protocols to reduce costs and time. The protocols will be used as a VAM assessment tool and will help mine personnel choose technological options for pilot plant and full scale VAM mitigation systems.
<b>Development of VAM Abatement Technology Assessment Tool C23004</b> University of Newcastle Behdad Moghtaderi	55,689	Patrick Booth, BHP Billiton Illawarra Coal Jim Sandford, Glencore	This project will develop a Ventilation Air Technology Assessment Tool, that will be available to the industry to examine the merit of alternate technical paths to the removal or reduction of underground mine ventilation air. It will assist assess the basic performance characteristics of different abatement processes.
<b>Novel Stone Dust Looping Process for Mitigation of Ventilation Air Methane C23052</b> University of Newcastle Kalpit Shah	173,747	Trevor Stay, Anglo American Metallurgical Coal Jim Sandford, Glencore	This project aims to develop and demonstrate a novel process for abating ventilation air methane (VAM). Known as stone dust looping, the process is based on the chemical looping concept and involves the cyclic calcination and carbonation of a sorbent to convert the methane content of VAM into carbon dioxide. The key outcome of the first phase of this project will be the design and operation of stone dust looping process and the development of a laboratory scale stone dust looping prototype.
<b>MINE SITE GREENHOUSE MITIGATION PROJECTS UNDER MANAGEMENT 2013</b>			
<b>Horizontal Post Drainage Design C18047</b> CSIRO Hua Guo	360,331	Jim Sandford, Glencore Paul O'Grady, Glencore	Gas drainage in longwall mining is increasingly challenging and complex because more mines have gassy conditions, multi-seam environments, beneath extant goafs, and environments where drilling conventional surface gas drainage holes is not practical. Increased longwall retreat and development rates have produced mine gas levels that challenge safe and productive operation and are a serious threat to sustained and efficient coal production. Horizontal post drainage holes using advanced surface to in-seam drilling technologies have received considerable attention as a new and viable approach to address gas drainage issues, offering potential key advantages however careful design is required to manage a number of risks. This program will review and investigate the various techniques leading to a conceptual horizontal post drainage model to highlight the drainage mechanisms, key performance controlling factors, and design methodology and procedures.
<b>Ceramic Block Vent Air Methane Mitigator C19055</b> CSIRO Shi Su	342,696	Alex Neels, Peabody Energy Australia Patrick Booth, BHP Billiton Illawarra Coal	At present there is no economically viable demonstrated technology for mitigating coal mine ventilation air methane (VAM). Depending on mine site specifications, a range of technologies are needed for cost-effectively mitigating and utilising diluted mine methane. This project is developing a novel self-sustaining mine ventilation air methane mitigator in a scalable format and will demonstrate it at an Australia mine as a step towards commercial uptake. The mitigator uses a newly structured thermal oxidation process within individual passages of a honeycomb-shaped refractory cast-cement block. Preliminary design, calculation and analysis indicate that it can be operated with $\geq 0.3\%$ methane in air.

PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
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**MINE SITE GREENHOUSE MITIGATION PROJECTS UNDER MANAGEMENT 2013**

<b>Linear Gas Flow Measurement System for Gas Drainage Boreholes C19057</b> CRCMining Eddie Prochon Paul Lever	181,026	Brad Elvy, BHP Billiton Illawarra Coal Jim Sandford, Glencore	This project further developed a prototype linear gas flow measurement and management system. The enhanced system incorporates flow models for improved visualisation and determination of flow at any point in the borehole. The system uses a fibre optic temperature sensor deployed in the borehole.
<b>Criteria for Selection of Appropriate Instrumentation for Measuring Gas Emissions from Underground Coal Mines C21062</b> CSIRO Brendan Halliburton Stuart Day	190,810	Alex Neels, Peabody Energy Australia Jim Sandford, Glencore	Accurate accounting for greenhouse gas emissions is becoming an increasingly important activity for the coal industry; however estimation of these emissions is subject to significant uncertainty. Continuous monitoring is potentially the most accurate methodology but simpler periodic methods may be more appropriate for low gas underground mines where the ventilation system does not change significantly over time. This project is examining a range of mine scenarios to determine the relative uncertainty of periodic versus continuous measurement. The project is also looking at the accuracy of existing measurement techniques and devices. This will enable guidelines to be developed that help assess whether continuous monitoring is appropriate for the level of fugitives emitted by the mine. This analysis will also identify if a hybrid system of monitoring may be suitable such as continuous analysis of the ventilation air, but use of periodic flow measurements.
<b>Particulate Matter Characteristics of Mine Ventilation Air For Designing Methane Mitigation Technologies C21063</b> CSIRO David French Stuart Day	329,500	Patrick Booth, BHP Billiton Illawarra Coal Trevor Stay, Anglo American Metallurgical Coal Jim Sandford, Glencore	A number of experimental technologies intended to remove methane from ventilation air have been developed. While these systems show considerable promise, some designs are affected by dust in the airstream. Other systems are designed to tolerate a certain amount of dust but this level and the effect of particle characteristics such as size and shape have yet to be determined. This project is quantifying the amount and size distribution of particulate matter entrained in the ventilation air at the outlet. The material will also be comprehensively characterised in terms of its chemical and mineralogical composition. The information obtained through this project will greatly assist in the selection and design of appropriate methane mitigation technology.
<b>Flame Arresting Mechanisms and Flameproof Device for VAM Mitigation C21065</b> CSIRO Shi Su	359,970	Patrick Booth, BHP Billiton Illawarra Coal Trevor Stay, Anglo American Metallurgical Coal Jim Sandford, Glencore	The integration of ventilation air methane (VAM) mitigation technologies which employ high temperature regenerative beds to abate methane have the potential to create a new hazard. An explosive mixture of methane could be directly ducted to a potential ignition source in the mitigation unit. Therefore, a safe ducting method is required to capture ventilation air flow for its treatment in any commercial mitigation unit. This project is providing the Australian coal industry with knowledge of flame arresting mechanisms, and a prototype flameproof device which can be installed in the ventilation air intake of a mitigation unit. It will enable coal mines to safely implement VAM mitigation technologies at their sites.
<b>Development Of New Generation Carbon Composites For VAM Capture C22041</b> CSIRO Jun-Seok Bae	239,800	Alex Neels, Peabody Energy Australia Jim Sandford, Glencore	There is presently no universally viable, proven technology for capturing coal mine ventilation air methane (VAM). A range of cost effective technologies is needed to capture and use dilute VAM depending on specific site and general market conditions. This project aims to enhance the VAM capture by more than 30% by synthesising and characterising new carbon composites derived from macadamia nut shells and carbon nanotubes. The adsorption performance of the new carbon composite adsorbents will be tested using existing laboratory scale equipment. This should determine optimum operational parameters and methane adsorption.

The Australian coal industry is keen to support those who work in the industry to upgrade their skills by undertaking PhD on research of interest to the producers. The support is in the form of a tax free scholarship awarded on the recommendation of the Research Committee. Potentially, scholarships can cover the full range of challenges facing the industry; underground geotechnical, gas drainage and open cut geotechnics, for example.

### FUNDING APPROVED 2013

Year	No of Projects	ACARP Funding	Total Funding
2013	0	-	-
2012	1	\$330,000	\$330,000
2011	3	\$930,000	\$930,000

### PROJECTS UNDER MANAGEMENT 2013

Category	No of Projects	ACARP Funding
Scholarships	7	\$2,165,000



PROJECT/RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>SCHOLARSHIPS UNDER MANAGEMENT 2013</b>			
<b>Application of Enhanced Gas Drainage Techniques to Coal Mine Gas Drainage Systems C18003</b> University of New South Wales Russell Packham	275,000	Paul O'Grady, Glencore	The draining of coal seam gas prior to mining is an important process, and one that is critical to the safe mining of gassy seams. Anything that can be done to improve the drainage is of interest to the industry. This work is seeking to determine the suitability of enhanced gas drainage techniques, utilising nitrogen or nitrogen/CO <sub>2</sub> mixtures, for application within the Australian coal mining industry.
<b>Poverty in the Midst of Plenty: Economic Empowerment, Wealth Creation and Institutional Reform for Sustainable Indigenous Communities C20001</b> University of Melbourne Kerry Mudge	300,000	Roger Wischusen, ACARP	Mining companies are increasingly recognising the importance of creating strong relationships with the traditional owners of the land in which they operate. These relationships are generally formalised through legal agreements that often result in significant resources being made available to both indigenous communities and mining companies alike. The creation and implementation of these agreements tends to be a very complex process with many social, political and economic challenges. This project is evaluating the strategies employed by coal mining companies in implementing these agreements, specifically examining how it can alter the socio-economic situation of indigenous communities and the implications it has on the environment and culture of these people.
<b>Geotechnical Stability of Coal Mine Dumps and Co-disposal of Tailings Waste C21007</b> University of Newcastle Kai Koosmen	300,000	Dan Stolberg, Thiess	The full impacts of combined rejects placement within spoil dumps are not fully understood by the coal industry. Current management practices are based on empirical experience that coarse rejects dumping and small tailings cells have not posed any significant operational stability problems. This PhD research project is examining the strength and moisture properties of mixtures of coal preparation plant bulk press filter fine rejects and coarse plant rejects when encapsulated in overburden spoil within waste dumps. In particular, reliable shear strength and moisture content change models will be developed for the rejects and spoil materials.
<b>Introduction of Full Scale VAM Abatement Technology to the Australian Coal Industry C21008</b> University of Newcastle Neil Alston	300,000	Jim Sandford, Glencore	Ventilation air methane (VAM) abatement technologies are being put forward as one of means of addressing fugitive emissions from underground coal mines. However, even the most developed form of this technology, regenerative thermal oxidation, is not ready for safe deployment at commercial scale. One of the key issues to be resolved is how to prevent an explosive mix of methane from an unplanned underground event (such as outburst) from reaching the core of the thermal oxidiser unit, which operates at 1000oC. This PhD research project is exploring the intrinsic safety and safety controls of a proprietary VAM abatement technology called VAM RAB.
<b>Gas Distribution is Fundamental to Estimation and Management of Fugitive Emissions C21061</b> University of Queensland Agi Burra	330,000	Jim Sandford, Glencore	The ability to determine site based emissions and develop cost effective in situ gas distribution models offers the coal industry significant benefits by reducing financial exposure to likely carbon tax liabilities. This PhD research project will allow the industry to reduce carbon tax exposure and offer an approach for more targeted and cost effective gas exploration and modelling for emissions estimation. The project is presenting a case for considering gas distributions in the context of geological controls to reduce uncertainty in the understanding and interpretations of gas characteristics encountered in various geological environments. It is investigating the relationships between gas and coal parameters; and identifying exploration tools to streamline the available exploration and modelling resources.

PROJECT/RESEARCHER      ACARP FUNDING      INDUSTRY MONITORS      OVERVIEW

## SCHOLARSHIPS UNDER MANAGEMENT 2013

**Dynamic Analysis of Dense Medium Circuits C22002**

330,000

Jeremy Byrnes, Glencore

University of Queensland  
Nerrida Scott

Dense Medium Cyclones are a key component of coal processing. This project will utilise instrumentation and information collected from project C17037, Joint Evaluation of Monitoring Instrumentation for Dense Medium Cyclones, to analyse the dynamic changes in a DMC circuit with the intention of developing a dynamic model that provides producers with a guideline on critical drivers for dynamic DMC performance. Part of the Thesis submission will include guidelines for coal handling and preparation plants on the levers that a plant can utilise to enhance dynamic control of DMC circuit performance.

**Improved Situation Awareness for Autonomous Equipment using Computer Vision C22047**

330,000

Hans Hayes, Anglo American  
Metallurgical Coal

Queensland University of Technology  
Alex Bewley

This project potentially provides a path to an alternate approach to locating moving and stationary objects. In the industries pursuit of a system that provides collision avoidance as a failsafe, the use of radar, lasers, radio and GPS has figured prominently. This program will look to develop a tracking system utilising a higher level of situational awareness from visual data. The capture of visual data and real time analysis of a massive volume of data will be the key to realizing this system and it's subsequent introduction to the mining industry.



## 2014 PROPOSAL TIMETABLE

## ACARP CONTACTS

<b>APRIL 12</b>	Call for Proposals <ul style="list-style-type: none"> <li>• Announcement in “The Australian”</li> <li>• Distribution of 2014 Research Priorities Newsletter</li> </ul>
<b>MAY 14</b>	Closing Date for Short Proposals
<b>JULY</b>	Short Proposal Selection Meetings
<b>JULY 31</b>	Call for Full Proposals
<b>SEPTEMBER 3</b>	Closing Date for Full Proposals
<b>OCTOBER</b>	Full Proposal Selection Meetings
<b>DECEMBER</b>	Confirmation of Successful Proposals

### PROGRAM MANAGEMENT

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