

An aerial photograph of a coal mine, showing dark, layered rock formations and winding paths. The image is overlaid with large, diagonal geometric shapes: a white triangle on the left and two orange triangles on the right, creating a modern, abstract design.

**2014**  
**PEOPLE AND**  
**PROJECTS**  
**ACARP**

## Program Management

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## 2015 Proposal Timetable

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<b>11 April</b>	Call for Proposals <ul style="list-style-type: none"><li>Announcement in "The Australian"</li><li>Distribution of 2015 Research Priorities Newsletter</li></ul>
<b>13 May</b>	Closing Date for Short Proposals
<b>July</b>	Short Proposal Selection Meetings
<b>31 July</b>	Call for Full Proposals
<b>2 September</b>	Closing Date for Full Proposals
<b>October</b>	Full Proposal Selection Meetings
<b>11 December</b>	Confirmation of Successful Proposals

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## INTRODUCTION

ACARP – the Australian coal industry’s research program – was established in 1992 through a Memorandum of Understanding between the Australian Coal Association Executive and the Federal Government. When the Australian Coal Association was disbanded in 2012 the MOU was transferred to the Minerals Council of Australia. ACARP 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 2014 to assist the Australian coal industry develop and adopt world leading sustainable mining practices through collaboration.



## 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.
- 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 2014 together with the new series of projects that is about to start. The overview summarises the challenges being addressed and the approach being taken.

## Funding Approved 2014

Category	No of Projects	ACARP Funding	Total Funding
Underground	23	6,346,269	11,485,909
Open Cut	18	4,269,996	15,968,495
Coal Preparation	15	2,017,563	2,752,522
Technical Market Support	12	3,701,459	4,564,325
Mine Site Greenhouse Mitigation	3	608,880	1,027,720
Scholarships	1	330,000	330,000
	<b>72</b>	<b>17,274,167</b>	<b>36,128,971</b>

The resultant leverage = Total funding ÷ ACARP Funding = 2.09 times

## Projects Under Management 2014

Category	No of Projects	ACARP Funding
Underground	61	23,452,959
Open Cut	56	23,298,032
Coal Preparation	32	7,502,865
Technical Market Support	24	5,134,997
Mine Site Greenhouse Mitigation	10	3,278,026
Scholarships	6	1,865,000
	<b>189</b>	<b>64,531,879</b>

## UNDERGROUND PROJECTS

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 drive 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.

### Committee Members

<b>Brad Elvy</b>	<b>Manager of Projects and Studies Co Chair, Underground Committee</b>	<b>BHP Billiton Illawarra Coal</b>
<b>Jim Sandford</b>	<b>Project Manager, Coal Assets Australia Co Chair, Underground Committee</b>	<b>Glencore</b>
Bharath Belle	Group Ventilation Manager	AngloAmerican
Gary Brassington	Manager Approvals	BHP Billiton Illawarra Coal
Greg Briggs	Group Machine Engineering & Procurement Manager	Centennial Coal
Peter Brisbane	General Manager Technical Services	Bandanna Energy (Administrators Appointed)
Steve Burgess	General Manager - Engineering & Operations Support	Centennial Coal
John Grieves	Project Manager – Minyango	Caledon
Dieter Haage	Head of Mining Excellence - Underground	AngloAmerican
Scott Jones	Head of Production Underground Mining	BMA
Mick Kelly	Manager – Underground Directional Studies & Technology	BMA
Bernie Kirsch	Regional Environmental Manager West	Centennial Coal
Andrew Lovell	General Manager Strategic Mine Planning, Coal Australia	Rio Tinto
Brad Lucke	Senior Electrical Engineer	Glencore
Adrian Moodie	Technical Services Manager	Austar Coal
Paul O'Grady	Group Manager - Technical Services (North)	Glencore
Dan Payne	Manager Geotechnical Services	BMA
Richard Porteous	Manager Projects	Glencore
Andrea Rutley	Head of Geosciences	AngloAmerican

Stephen Schaller	Specialist Emerging Markets, Productivity Division Coal Australia	Rio Tinto
Peter Smith	General Manager HSEC	Centennial Coal
Trevor Stay	General Manager Gas	AngloAmerican
Andrew Swiericzuk	Project Manager-Studies, Coal Australia	Rio Tinto
Russell Uhr	Manager – Operational Readiness, Coal Australia	Rio Tinto
Geoff Watson	Study Manager - Underground	Peabody Energy Australia

## Funding Approved 2014

Year	No of Projects	ACARP Funding	Total Funding
<b>2014</b>	<b>23</b>	<b>6,346,269</b>	<b>11,485,909</b>
2013	20	4,780,342	10,524,373
2012	23	5,682,364	9,276,683

## Projects Under Management 2014

Category	No of Projects	ACARP Funding
Detection and Prevention of Fires and Explosions	7	2,939,356
Environment - Subsidence and Mine Water	5	1,271,371
Exploration	6	1,519,087
Maintenance	5	1,629,235
Mining Technology and Production	9	2,589,993
Occupational Health and Safety	6	1,434,585
Roadway Development	5	6,875,745
Strata Control and Windblasts	10	2,934,245
Ventilation, Gas Drainage and Monitoring	8	2,259,342

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECT APPROVALS 2014</b>			
<b>Environment - Subsidence and Mine Water</b>			
<b>Standardised Subsidence Information Management System C20038</b> NSW Department of Trade and Investment, Gang Li	175,000 new  480,000 existing	Phil Enright, Centennial Mandalong Dan Payne, BMA	Subsidence data from NSW underground coal mines spanning three decades is being preserved and transferred from various original formats into a standardised information management system. The extension project will enable industry stakeholders to interrogate the system for subsidence knowledge, prediction and assessment in order to make more informed decisions about resource recovery and subsidence risk management.
<b>Managing and Conserving Native Plant Species in the Mining Environment C24013</b> Royal Botanic Gardens and Domains Trust, Sydney Cathy Offord	168,800	Bernie Kirsch, Centennial Coal Gary Brassington, BHP Billiton Illawarra Coal	The woody shrub genus <i>Persoonia</i> , which is found on mine sites, has nine species listed as 'at risk' or 'of concern' in NSW. Researchers will explore how to effectively propagate these species for mine rehabilitation work; and what the most appropriate ex situ conservation options are. This work will lead to better conservation of rare species on mine leases and increase the likelihood of successful use of common and rare species in mine rehabilitation work.
<b>Exploration</b>			
<b>Automatic Determination of Lithology Boundaries From Downhole Geophysical Logs C24016</b> GeoCheck Brett Larkin	76,000	Patrick Tyrrell, New Hope Group Malcolm Ives, Centennial Coal	Coal geologists spend excessive time adjusting lithology boundary depths in their logs to corresponding depths derived from downhole geophysical logs. This project will improve the efficiency and effectiveness of this process by providing a computer assisted method to make 80% to 90% of the adjustments. Researchers will develop methods to automatically compare computer generated lithology boundary depths with those recorded in geologists' logs and ascertain whether the depths of each hole have been adjusted to geophysics.
<b>Use of Core Scanning and Hand Held Xray Fluorescence Analysis in Coal Quality Assessment C24025</b> University of New South Wales Colin Ward	157,400	Malcolm Ives, Centennial Coal Patrick Tyrrell, New Hope Group	Low cost methodologies for rapidly measuring the nature and concentration of the principal inorganic element in coal are needed. This project will develop and validate new technologies for detailed non destructive chemical analysis of cored and in situ coal seams using laboratory based core scanning and hand held portable X ray fluorescence techniques. This will enable variations in ash percentage, ash composition, sulphur and phosphorus in coal seams to be mapped at much higher spatial resolution than is currently possible.
<b>In Seam Wireless Drill String Communication System: Phase 2 C24065</b> University of Queensland Eddie Prochon	330,000	Brad Elvy, BHP Billiton Illawarra Coal Peter Brisbane, Bandanna Energy (Administrators Appointed) Jim Sandford, Glencore	CRCMining is developing a system called in seam wireless drill string (ISWDS) that provides high data rate, bidirectional wireless communication between the BHA and the drill rig in the hazardous conditions of underground in seam (UIS) drilling. In phase one of the project the performance of the wireless EM signal was successfully assessed using a research prototype tool. This project will develop a commercially operable tool for UIS drilling in cross panel application; conduct "Ex ia" assessments in order to conduct tests in exploration holes; assess and optimise performance towards 1200m distance; and provide a business case and commercialisation strategy. The prototype will be certified for hazardous area and will be integrated into CRCMining's other equipment designs.



PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECT APPROVALS 2014</b>			
<b>Maintenance</b>			
<b>Use of Plastic Metal in Underground Coal Mines for Minor Repair on Flameproof Equipment C23005</b> Simtars, Bipin Parmar, David Turner	100,583 new  81,715 existing	Mark Spinks, AngloAmerican Mark Lydon, Glencore	Repairing flameproof equipment in-situ underground presents a safety hazard. This extension project will investigate the performance of a number of plastic metal products at various compositions and prepared under various environmental conditions. Researchers will recommend properties that need to be considered when selecting plastic metal products for use on certified flameproof and other explosion protected equipment in underground coal mines.
<b>Distributed Acoustic Conveyor Monitoring C24014</b> University of Queensland Saiied Aminossadati	270,000	Peter Brisbane, Bandanna Energy (Administrators Appointed) Jim Sandford, Glencore Brad Elvy, BHP Billiton Illawarra Coal	This team of researchers is developing a novel conveyor condition monitoring (CCM) system that can improve safety and provide substantial financial benefits to the mining industry by detecting the faulty idlers long before they fail. The proposed CCM system incorporates a single fibre optic cable installed on the frame of a conveyor belt and is capable of detecting the acoustic and vibration signals generated by faulty conveyor components. The aim of this project is to develop the concept for underground coal conveyor systems.
<b>Longwall Hydraulic System Over Pressurisation Hazards Prevention C24007</b> Asset Performance Improvements Henry Bartosiewicz	292,250	Shayne Gillett, Centennial Jarrod Sampson, Glencore	Over pressurisation issues have been identified with longwall system hydraulic monitoring programs. Researchers will work with OEMs to understand and determine the nature, extent and causes of these pressure surge problems in different longwall systems design, age and operating conditions.
<b>Mining Technology and Production</b>			
<b>Dynamic Longwall Equipment Location Model C24021</b> CSIRO, Jonathon Ralston	73,860	Mick Kelly, BMA Luke Dyer, Glencore	Collisions between the shearer and roof supports due to equipment failure or operator error can occur during longwall operations, significantly impacting safety and productivity. This project will develop a mathematical model that accurately computes the location of longwall equipment in real time.
<b>Occupational Health and Safety</b>			
<b>Collision Awareness - Capability of Underground Mine Vehicle Proximity Detection Systems C24010</b> Simtars Andre De Kock	482,300	Greg Briggs, Centennial Coal Jim Sandford, Glencore Brad Lucke, Glencore	While the increase in the size and speed of mobile mining and support equipment underground has created many operational benefits, poor visibility has emerged as a significant safety hazard. This project will investigate the most prominent collision scenarios in underground coal mines and test the available proximity detection systems against a set of standard scenarios. Human factors and simple management tools that need to be considered when designing and implementing effective collision awareness and avoidance strategies will also be investigated.
<b>Establish 'At Risk' Distance from Hydraulics C24009</b> University of New South Wales Bill Walsh Gary Nauer	26,908	Shane Hansford, QRC	High pressure injection from hydraulic equipment is an occupational risk in the mining industry. This project will determine a measurable 'at risk' distance for workers from hydraulic systems of the three primary fluids used in coal mining at different pressures. Knowing the 'at risk' distance will lead to the use of more effective controls, such as screens and barriers, thereby reducing the exposure I to high pressure hydraulics.
<b>Holistic Evaluation of Diesel Exhaust Filters and Related Measuring Instrumentation C24022</b> QUT, Zoran Ristovski	247,250	Peter Brisbane, Bandanna Energy (Administrators Appointed) Bharath Belle, AngloAmerican	Ultra fine (<100 nanometres) particles are not frequently measured in mining related diesel particulate matter (DPM) studies. However, the New South Wales Inspectorate is reviewing all aspects of DPM monitoring and measurement. This project will determine how well current and new types of diesel exhaust filters deal with ultra fine particles. It will also assess the applicability of potential measurement instruments to test filters and equipment in mining conditions.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECT APPROVALS 2014</b>			
<b>Occupational Health and Safety cont.</b>			
<b>Real Time Wet and Dry Bulb Temperature Monitoring Systems For Use In Underground Mines - Implementation Challenges C24026</b> CSIRO Manoj Khanal	97,545	Peter Brisbane, Bandanna Energy (Administrators Appointed) Bharath Belle, AngloAmerican	Accurately measuring dry and wet bulb temperatures at different critical locations in underground coal mines remains a challenge. Without this information it is difficult to manage mine safety issues, such as weakening roadways, change in strata properties, spontaneous combustion, fires and ventilation problems. This project will review the current state of the art real time temperature monitoring systems applicable to underground mines, identify the challenges of using dry and wet bulb temperature monitoring systems, and identify suitable technology to deliver real time wet and dry bulb temperature data. If a suitable system is not commercially available, researchers will report on preliminary investigations into the design of a suitable intrinsically safe certified instrument.
<b>Alternative Electronic Spark Test Apparatus: Phase 3 C24066</b> University of Queensland Enver Bajram	460,680	Peter Brisbane, Bandanna Energy (Administrators Appointed) Greg Briggs, Centennial Coal	A more consistent and more easily calibrated spark testing device is needed for underground coal mines as a reliable alternative to the spark testing apparatus (STA). This project will develop an electronic spark tester (EST) prototype that extends the functionality of the current STA. Devices being tested for intrinsically safe approval would be connected to the EST in a similar manner to the current STA, however compliance would be tested by measuring the output performance of the device under a controlled set of electronic stimuli. This provides a test result containing a well defined measure of performance relative to the required standard.
<b>Roadway Development</b>			
<b>CM2010 Roadway Development Improvement - Project Support C17010</b> Patchwork Mining Gary Gibson	148,875 new 935,975 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>Gateroad Development Continuous Haulage System C24023</b> Premron E-BS Mick Whelan	1,445,000	Roadway Development Task Group	The need for shuttle cars at the coal face will be eliminated if the Premron CHS continuous haulage system is introduced to underground mines, resulting in safety, productivity and performance improvements. In this final stage of the project, Premron will manufacture a full scale, full length (150m), mine compliant system and install it above ground on a monorail test rig. Once it has been certified by the Mines Inspector, the next step will be an underground trial on a non productive panel.
<b>Stata Control and Windblasts</b>			
<b>Shear Testing of the Major Australian Cable Types under Different Pretension Loads C24012</b> University of Wollongong Najdat Aziz	250,000	Stephen Schaller, Rio Tinto Brian McCowan, Glencore Roger Byrnes, BHP Billiton Illawarra Coal	Failure of cable bolts due to shear stress is a significant issue in underground coal mining, particularly in longwall gateroads where lateral deformation of the immediate stratification is the most severe. In this project the major cable bolt types will undergo benchmark shear testing. The shear behaviour and failure mechanism of cable bolts of different designs and constructions will be tested under various pretension loads and host materials. A database of comparative performances and design issues will be developed.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECT APPROVALS 2014</b>			
<b>Convergence Based Roof Support Design C24015</b> PDR Engineers Terry Medhurst	196,000	Garth Chester, Rio Tinto Anna Mills, AngloAmerican Gavin Lowing, Peabody Energy Australia Jeremy Byrnes, Glencore	Mining at increasing depths of cover in weaker and more variable strata conditions and greater emphasis on optimisation of mining practice is driving the need for improvements in roof support design. The ability to identify specific factors affecting roof support performance can be limited. Several investigations at Bowen Basin mines have demonstrated the capabilities of a newly developed analytical model to quantify the relationship between support practice and roof convergence. This project aims to extend the approach to a more general framework and design methodology applicable to all underground mines.
<b>Cable Bolt Performance Under Axial Loading and Subject to Varying Geotechnical Conditions C24018</b> University of New South Wales Paul Hagan	117,823	Peter Corbett, Centennial Angus Place Paul O'Grady, Glencore Brian McCowan, Glencore	The wide variety of performance levels across the cable bolt design spectrum makes it difficult to select the most appropriate design for specific underground environments. This project will provide definitive performance characteristics of the five major types of cable bolt design under different ground conditions – including stiffness, peak load and post peak load capacity – so the design of underground support systems can be optimised.
<b>Assessment of Longwall Mining Induced Connective Fracturing of Overburden Strata C24020</b> CSIRO Deepak Adhikary	297,343	Dan Payne, BMA Peter Corbett, Centennial Angus Place Richard Porteous, Glencore	The height of connective fracturing and complete water drainage above mined longwall panels are not well understood and are strongly contested topics among industry professionals. This project will quantify the extent of connective fracturing above these panels – one of the most important parameters required to assess mining impact on groundwater. It will also expand scientific understanding of the strata caving mechanics during longwall mining and quantify the height of complete groundwater drainage above longwall panels.
<b>Ventilation, Gas Drainage and Monitoring</b>			
<b>High Speed In-Seam Drilling System for Effective Gas Drainage C24008</b> University of Queensland Scott Adam	216,000	Peter Brisbane, Bandanna Energy (Administrators Appointed) Jim Sandford, Glencore Brad Elvy, BHP Billiton Illawarra Coal Peter Corbett, Centennial Angus Place	CRCMining's waterjet high speed drilling technology could revolutionise underground in seam drilling. The waterjet's rapid and continuous drilling eliminates the manual handling hazards associated with conventional drilling and increases drilling productivity by 100%. This two phase project will address the technical risks through a program of targeted laboratory based work followed by a field validation trial at Wambo underground mine.
<b>Field Trials of Nitrogen Injection into UIS Directional Boreholes to Enhance Gas Drainage in Low Permeable Seams C24019</b> University of Wollongong Frank Hungerford Ting Ren	336,152	Brad Elvy, BHP Billiton Illawarra Coal Bharath Belle, AngloAmerican	Pre gas drainage using in-seam boreholes has played a critical role in reducing high insitu gas content below threshold limits thereby allowing normal mining activities to be undertaken safely. However reducing gas content below these levels within a given drainage lead time has been challenging. This project will field prove the concept of using enhanced gas drainage by nitrogen injection into underground in-seam boreholes in coal mines extracting gassy and low permeable seams. Researchers will identify the most suitable environment for this technology and associated design parameters, and will develop the operating procedures.
<b>Drilling for Outburst Risk Determination C24024</b> Sigra Ian Gray	380,500	Russell Thomas, BHP Billiton Illawarra Coal Bharath Belle, AngloAmerican Andrew Lewis, Glencore	Although gas drainage and other management techniques have reduced the incidence of gas outbursts in Australian underground coal mines, the physical impacts of particle injection and the noxious gases produced, make them extremely hazardous. This project will use underground drilling trials to retrieve coal cuttings at high speeds. The cuttings will be desorbed and a subsample crushed to yield the residual gas content. This process will provide information on the gas content, diffusion coefficient and particle size characteristics of coal samples and the volume of coal produced compared with the volume of the hole nominally cut. These measurements will then be used in conjunction with the sorption isotherm to determine outburst risk.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Detection and Prevention of Fires and Explosions</b>			
<b>Investigation of the Aging Effect of Electronic Components in Power Supplies C16006</b> Simtars Andre De Kock	175,000	Greg Briggs, Centennial Coal	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.
<b>Airo-Dust - Parameter Testing C20002</b> Mining Attachments (Qld) Matt Ryan	1,339,085	Bharath Belle, AngloAmerican Steven Winter, Glencore Peter Brisbane, Bandanna Energy (Administrators Appointed) Jim Sandford, Glencore	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 has been undertaken through this project to achieve acceptance of the process for use in underground coal mines in Australia.
<b>Cheaper and More Effective Inertant Than Stone Dust C21016</b> SkillPro Services David Humphreys	470,000	Peter Brisbane, Bandanna Energy (Administrators Appointed)	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.
<b>Potential Lightning Impacts on Underground Coal Mines C22003</b> University of Queensland David Cliff	460,000	Brad Elvy, BHP Billiton Illawarra Coal Greg Briggs, Centennial Coal Peter Henderson, Glencore Jim Sandford, Glencore	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.
<b>Frictional Ignition Testing High Tensile Steel Combined with Copper C22006</b> Innovative Engineering Products Myles Wylie	88,568	Bharath Belle, AngloAmerican	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 were 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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Active Explosion Barrier: Refinement of CFD Model and Application of Real Development Panels C22007</b> BMT WBM David Humphreys David Proud	215,400	Jim Sandford, Glencore Peter Brisbane, Bandanna Energy (Administrators Appointed)	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 refined 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 also provided design parameters for explosion suppression systems and clarified the impact of complex mine roadway layouts on the development of pressure and flame passages.
<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 Wayne Hartley	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 studied 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 were 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>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 produced 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, AngloAmerican	The coal industry sought to develop a work program that will generate a more consistently reliable and relevant airborne dust sampling technique.
<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 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 made 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 developed an integrated ground and remotely sensed metrics capable of detecting vegetation condition. This work addressed 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?

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Environment - Subsidence and Mine Water cont.</b>			
<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, AngloAmerican 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 Eddie Prochon	440,322	Mike Armstrong, BHP Billiton Illawarra Coal Paul Murtagh, AngloAmerican	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 Tim Buddle, AngloAmerican	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 developed 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	262,400	Brad Elvy, BHP Billiton Illawarra Coal Peter Brisbane, Bandanna Energy (Administrators Appointed) 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	Steve Walker, AngloAmerican	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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<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 Tim Buddle, AngloAmerican	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>Coal Quality From Geophysical Logs for Enhanced Resource Estimation C23015</b> CSIRO Binzhong Zhou Graham O'Brien	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>Reducing the Risk of Hydraulic Hose Assembly Failures on Longwall Systems: Ext - Longwall Hydraulic System Over Pressurisation Hazards Prevention C17020</b> Monash University	715,420	Jarrod Sampson, Glencore Scott Wyborn, Centennial Coal Trevor Hartley, Centennial Coal Brian Owers, Centennial Coal Peter Crossland, AngloAmerican	The longwall pressurised fluid power systems are a potential major hazard that may result in fatal injuries if they are not properly controlled and maintained. The objective of this project was to assist the mine personnel in formulating management systems for the mitigation and control of the risks associated with longwall hose assemblies.
<b>Big Tyre: Non Pneumatic Non Solid Wheel C18020</b> Big Tyre Bruce Loudon	555,000	John Corben, Glencore Barry Moore, Centennial Coal Keith Cardew, Peabody Energy Australia	In a number of applications the coal industry utilises 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.
<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 cutter heads 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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Maintenance cont.</b>			
<b>Fatigue Life Determination of DN20 D-section 420 Stainless Steel Staples C23011</b> BMT WBM Daniel Carpenter	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>Development of a Safer Underground Explosive C20033</b> University of New South Wales Andres Castro Duncan Chalmers	323,500	Brad Elvy, BHP Billiton Illawarra Coal	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 incensive 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.
<b>Fibre Optic Conveyor Monitoring System C21012</b> CRCMining Saiied Aminossadati	147,000	Peter Brisbane, Bandanna Energy (Administrators Appointed) Jim Sandford, Glencore	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 developed a real time hazard monitoring system that continuously monitors temperature variation on conveyor idlers.
<b>Water Jet Cable Bolt Drill Investigation C21018</b> CRCMining Dihon Tadic	89,527	Brad Elvy, BHP Billiton Illawarra Coal Peter Brisbane, Bandanna Energy (Administrators Appointed) Jim Sandford, Glencore	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 investigated 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.
<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.



PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<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 wifi 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>Automated Mining Horizon Control Using Real Time Coal Seam Sensing C22014</b> CSIRO Jonathon Ralston	268,800	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>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> University of Queensland Scott Adam	350,171	Brad Elvy, BHP Billiton Illawarra Coal Peter Brisbane, Bandanna Energy (Administrators Appointed) 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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<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 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 addressed through this project were: 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	333,740	Peter Brisbane, Bandanna Energy (Administrators Appointed) Bharath Belle, AngloAmerican 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	Mark Smith, Austar Grant Sullivan, 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 built on the developed advanced MISHC risk management methodologies and developed an 'innovative new integrated safety case methodology' that will define the leading practice in electrical isolation.
<b>IS and Non Invasive Detection of Pressure in Hydraulic Hoses Underground C21009</b> Custom Fluidpower Graeme Vennell Neil Martin	394,320	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 preceding 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>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 introduced 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>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 is investigating 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
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Roadway Development</b>			
<b>Automated Bolt and Mesh Handling C17018</b> University of Wollongong Ian Porter Stephen Van Duin	3,236,526	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 enabled 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 Mine Strata Reinforcement and Confinement (ToughSkin) C20041</b> University of Wollongong Ernest Baafi	1,502,189	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/SEBS Continuous Haulage System C23018</b> Scott Technology Australia Michael Pietsch 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.
<b>Strata Control and Windblasts</b>			
<b>Update of Stress Concentration Effects about Longwall Panels for Improved Mine Planning C20031</b> SCT Operations Winton Gale	165,000	Roger Byrnes, BHP Billiton Illawarra Coal John Grieves, Caledon	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 undertook field mapping in association with mine geotechnical staff as a means of transferring the techniques and understanding of stress concentration effects about mine excavations.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Strata Control and Windblasts cont.</b>			
<b>Dynamic Response of Longwall Systems and their Relationship to Caving Behaviour C20032</b> PDR Engineers David Hoyer Peter Hatherly Terry Medhurst	250,000	Roger Byrnes, BHP Billiton Illawarra Coal Ismet Canbulat, UNSW	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 (LVA) 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 analysed various longwall operations using the Geophysical Strata Rating (GSR) to characterise the strata, assess the likelihood of weighting and then correlated this with the various outputs that can be provided by LVA. The project utilised GSR estimates to provide a practical means to identify features that affect caving behaviour, such as massive strata, weak roof, etc.
<b>New Testing Procedure for the Assessment of Resin Performance for Improved Encapsulated Roof Bolt Installation C21011</b> University of Wollongong Najdat Aziz	190,000	Dan Payne, BMA Anna Mills, AngloAmerican Rae O'Brien, Glencore Brian Vorster, Glencore Roger Byrnes, BHP Billiton Illawarra Coal	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.
<b>Improving Cavity Prediction on Longwall Faces through a Combination of Reliable Convergence, Canopy Attitude and Leg Pressure Monitoring C21013</b> Golder Associates Bob Trueman	696,625	Adrian Moodie, Austar Coal Peter Corbett, Centennial Angus Place Dion Pastars, BMA	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.
<b>Real Time Seismic Roof Condition Mapping Ahead of Longwall Mining C21020</b> CSIRO Xun Luo	331,620	Roger Byrnes, BHP Billiton Illawarra Coal Peter Corbett, Centennial Angus Place Anna Mills, AngloAmerican	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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Practitioners Handbook on Managing Geotechnical Risk in Underground Coal Mining C22004</b> Galvin and Associates Jim Galvin	369,000	Anna Mills, AngloAmerican 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	Anna Mills, AngloAmerican Gavin Lowing, Peabody Energy Australia Roger Byrnes, BHP Billiton Illawarra 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 Brian McCowan, 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.
<b>Definition of Coal Mine Roof Failure Mechanisms C23008</b> SCT Operations Winton Gale	430,000	Brian McCowan, Glencore Roger Byrnes, BHP Billiton Illawarra Coal	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.
<b>Ventilation, Gas Drainage and Monitoring</b>			
<b>Application of Numerical Outburst Model for Outburst Management C16016</b> CSIRO Xavier Choi	210,000	Bruce Robertson, Carabella Resources Mike Armstrong, BHP Billiton Illawarra Coal	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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Ventilation, Gas Drainage and Monitoring cont.</b>			
<b>Information Dissemination for the Management of Spontaneous Combustion C18013</b> University of Queensland Darren Brady David Cliff	109,000	John Grieves, Caledon	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.
<b>Development of an Alternative Electronic Spark Test Apparatus C20006</b> CRCMining Bart Pienaar Paul Lever Scott Adam	997,557	Greg Briggs, Centennial Coal Peter Henderson, Glencore	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.
<b>Controlling Heatings and Gas Leakage Using Innovative Polymer Gel - Pilot Plant Scale Testing C20039</b> CSIRO Sheng Xue	226,100	Ken Lewthwaite, AngloAmerican Peter Brisbane, Bandanna Energy (Administrators Appointed)	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 know 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 provided support for the running of information sharing seminars that continue to bring together operators and those with expertise in the area.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>UNDERGROUND PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Development of Guidelines for the Measurement and Reporting of Fugitive Emissions from Underground Coal Mines C21002</b> PacificMGM Dennis Black	60,500	Jim Sandford, Glencore	Accurately measuring fugitive emissions from operating Australian underground coal mines has been problematic. A documented set of guidelines has been developed for mine personnel to use when establishing systems to measure and record fugitive emissions. The guidelines provide a methodology for establishing fugitive emission measurement standards that satisfy the requirements of the National Greenhouse Energy Reporting System. In particular, the guidelines address the measurement of gas emissions from ventilation shafts, gas drainage systems and fugitive emission reduction processes such as flaring and power generation.
<b>Improved Efficiency of Gas Capture From Boreholes Under Active Longwall Panels C23009</b> SCT Operations Winton Gale	380,000	David Webb, Glencore Brad Elvy, BHP Billiton Illawarra Coal	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.
<b>Outburst Risk Determination - Data Review and Analysis Component C23014</b> Sigra Ian Gray Jeff Wood	261,185	Russell Thomas, BHP Billiton Illawarra Coal Bharath Belle, AngloAmerican Andrew Lewis, Glencore	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.

## OPEN CUT PROJECTS

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>	<b>Manager, Project Governance, Coal Assets Australia Co Chair, Open Cut Committee</b>	<b>Glencore</b>
<b>Hans Hayes</b>	<b>Head of Mining Excellence Open Cuts (Aus, Can &amp; RSA) Co Chair, Open Cut Committee</b>	<b>AngloAmerican</b>
Chris Agosto	EME Procurement Superintendent	Mt Arthur Coal
Steve Amor	Principal Technology Open Forum - Sustainability	AngloAmerican
Heather Bone	Group Manager Sustainability	Downer EDI Mining
Shaun Booth	Resource Development, Coal Assets Australia	Glencore
Keith Cardew	Principal Maintenance Engineer	Peabody Energy Australia
Shaun Cleary	Projects Manager	Cobbora Holding Company
Wayne Clement	Group Manager, Global Equipment	Glencore
Brett Domrow	Chief Mining Engineer	New Hope Group
David Drew	Senior Mining Engineer	Wesfarmers Curragh
Lindsay Ford	Project Manager	Glencore
David Goodale	Open Cut Asset Management Manager – Australia & Canada	AngloAmerican
Ross Gooley	Environmental Superintendent	Sojitz Minerva Mining
Martti Kankkunen	General Manager Mine Planning & Technical	GVK Hancock Coal
Angela Kent	Principal Advisor – Safety – Health, Safety & Environment, Coal Australia	Rio Tinto
Win Klass	Senior Mining Engineer ~ OC Development & Business Improvement	Glencore
Andrew Lau	Regional Technical Services Manager Qld & WA	Yancoal Australia
Don McNeil	Principal Advisor - Mine Operations Improvement, Coal Australia	Rio Tinto



Brian Neilsen	Director - Strategic Mine Planning	Peabody Energy Australia
Troy O'Reilly	Risk & Compliance Advisor, Mining Operations	Stanwell Corporation
Simon Orton	Manager Analysis & Improvement Integrated Operations	BMA
Stuart Ritchie	Manager - Environment, Coal Australia	Rio Tinto
Richard Ruddock	Resource Geology Manager, Coal Australia	Rio Tinto
Greg Sheppard	Project Manager	Wesfarmers Resources
Ngaire Tranter	Environment and Approvals Manager	U&D Mining
Kane Usher	Innovation Lead, Productivity Division, Coal Australia	Rio Tinto
David Vink	Chief Operating Officer	Cockatoo Coal

## Funding Approved 2014

Year	No of Projects	ACARP Funding	Total Funding
<b>2014</b>	<b>18</b>	<b>4,269,996</b>	<b>15,968,495</b>
2013	18	4,320,731	7,634,739
2012	15	4,021,797	5,293,328

## Projects Under Management 2014

Category	No of Projects	ACARP Funding
Major Projects	2	8,889,640
Drilling and Blasting	4	1,319,914
Environment	27	6,802,446
Geology	8	2,382,365
Maintenance and Equipment	4	1,572,000
Mining and the Community	3	279,443
Occupational Health and Equipment Safety	6	1,287,865
Overburden Removal	2	764,360

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECT APPROVALS 2014</b>			
<b>Major Projects</b>			
<b>RISKGATE C20003</b> University of Queensland Philipp Kirsch	150,000 new  4,079,733 existing	Occupational Health and Safety Task Group Tony Egan, Glencore	An interactive online risk management system developed by MISHC using industry expertise is being used by coal industry personnel to understand and control selected major incidents. RISKGATE has 18 modules (tasks) including Fitness for Work which was completed in 2014. In this extension project, the RISKGATE team will comprehensively review all modules (cross-reference between modules, ensure consistent language and approach to issues), revise modules in response to user feedback, and convert the collision module into a vehicle interaction module.
<b>Environment</b>			
<b>Toolbox for Fish Health Assessment in Aquatic Ecosystems C24029</b> Central Queensland University Nicole Flint Sue Vink	97,740	Claire Cote, AngloAmerican	The Fitzroy Basin communities consider water and the associated riverine ecosystems to be key environmental assets, and they require an assurance that mining companies can manage and mitigate their environmental impacts. This project will develop practical indicators of fish health that are applicable to monitoring in coal mining regions, thereby helping to improve overall aquatic ecosystem health assessments and informing regional water management.
<b>Verification of the Vertical Distribution of Dust from Mining Activities C24030</b> Advanced Environmental Dynamics Darlene Heuff	321,433	John Watson, Glencore	Results from dust dispersion models are heavily relied upon during the approvals phase of mining projects to assess potential for adverse dust impacts on human health. This project aims to give the mining industry and regulators increased confidence in the results produced by dust dispersion models by validating and improving the methodology applied to open cut mines. Researchers will collect continuous field data over 12 months, providing a far wider range of atmospheric conditions than would be achieved through short term, campaign based field programs.
<b>Cost Efficient, Empirically Based Framework using Integrated Datasets to Demonstrate Rehabilitation Quality C24031</b> University of Queensland Peter Erskine	297,484	Pieter Swart, Glencore Paul Veivers, Stanwell Corporation Bernie Kirsch, Centennial Coal	Current methods of monitoring and assessing open cut coal mine rehabilitation are costly and time consuming. Detailed airborne imagery can cover large areas in one snapshot and, if processed automatically, may be a cost effective tool for mine rehabilitation assessment. This project seeks to develop a common, cost effective framework, informed by empirical data, to assess rehabilitation quality that is focused on assessing relinquishment risk. As part of this work researchers will develop an automated system to detect changes in mine rehabilitation conditions that flags areas for ground investigation.
<b>Applying Risk Based Principles of Dispersive Mine Spoil Behaviour to Facilitate Development of Cost Effective Best Management Practices C24033</b> Tree Crop Technologies Glenn Dale Steven Raine	476,104	Stuart Ritchie, Rio Tinto Ross Gooley, Sojitz Minerva Mining Craig Lockhart, Peabody Energy Australia Jason Fittler, AngloAmerican	A significant number of Bowen Basin coal mines have dispersive spoil which makes rehabilitation difficult and costly. The liability for rehabilitating these dispersive spoil dumps is around 3 billion. However, there is no definitive guideline or best management practices for the application of consistent, reliable, proven and cost effective approaches to managing dispersive spoil. To address the issue, researchers will develop a set of best management practices, risk based decision tools and a framework, and a process for understanding the trade offs between risks and costs.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECT APPROVALS 2014</b>			
<b>Incorporating Salinity into the Source Catchments Model for the Fitzroy Basin C24036</b> BMT WBM Nathan Johnston Tony Weber	304,000	Steve Downes, Glencore Mahdi Mason, Caledon Resources Scott Diggles, Rio Tinto John Merritt, Burton	High salinity in freshwater catchments impacts upon freshwater organisms and ecosystem health, as well as other environmental values such as suitability for drinking water, livestock watering and crop rotation. How saline mine water releases relate to broader catchment salinity issues within the Fitzroy Basin is not well understood. This project will use the Fitzroy Basin Source Model and previous modelling and research to produce a model for salinity processes in the Fitzroy. This information will then be incorporated within the source model to provide a platform for assessing future scenarios and the effectiveness of management actions.
<b>Quantifying Coal Dust in Urban Samples C24038</b> CSIRO David Wainright Graham O'Brien	176,765	Tim Manton, BHP Billiton Illawarra Coal Stuart Ritchie, Rio Tinto Bernie Kirsch, Centennial Coal	Coal dust can be generated during mining, transportation and coal usage. Although coal is often only one of the constituents present in dust near towns, along rail corridors and at ports, there is a general perception that all black dust is coal and that a high proportion of the dust is respirable. This project will use CSIRO's coal grain analysis system to analyse samples provided by residents in urban areas who are concerned with coal dust accumulation at their properties. In addition, researchers will develop a procedure for analysing and reporting results for community supplied dust samples which are not only scientifically rigorous, but are also accepted by the general community. Free image viewing software will be developed and provided community members with the analysis results.
<b>'MRC Wiki' Mine Rehabilitation and Closure Knowledge Management Platform - Implementation for Central Queensland Coal Mines C24067</b> University of Queensland Corinne Unger	176,900	Simon Orton, BMA Craig Lockhart, Peabody Energy Australia Stuart Ritchie, Rio Tinto	The original project identified Wiki as the most suitable tool to address the mine rehabilitation knowledge management needs in the Central Queensland mining region. In this extension project, CMLR will develop a mine rehabilitation and closure wiki (MRC Wiki) to provide access to a live repository of CQ coal mine specific rehabilitation practice information. Providing a platform for uploading information and holding discussion forums which can be managed by a regional practitioner network enables the new system to be kept alive, driven by users and information needs as they evolve over time.
<b>Geology</b>			
<b>Supermodel 2015 - Fault Characterisation in Permian to Jurassic Coal Measures C24032</b> University of Queensland Joan Esterle, Renate Sliwa	316,730	Richard Punt, Cockatoo Coal	The series of Supermodel projects have developed a regional stratigraphic framework for the Rangal and the Moranbah coal measures and their equivalents in the Bowen and Galilee basins. This project will build on that work by providing detailed characterisation of fault structures in the context of basin evolution, overprinting events, and past and present day stress regimes.
<b>Energy Absorption Capacity of Muck Piles and their Status as Engineered Hard Barriers C21032</b> University of Newcastle Anna Giacomini	124,780 new 257,935 existing	Brett Domrow, New Hope Group Shaun Booth, Glencore	Existing approaches to designing energy absorption safety barriers (safety berms) are not adequate for the new generation of large (ultra-class) haul trucks. Because full scale on site testing is not possible due to safety issues, researchers will use numerical modelling to simulate trucks impacting safety berms at various velocities and approach angles. The outcome will be more rigorous guidelines for the design of safety berms on haul roads that cater to ultra class trucks travelling at high velocity.
<b>Rotary Air Blast Drill Rig Top of Coal Detection While Drilling: Phase 3 Production Prototype C24064</b> University of Queensland Kevin Brighton	245,000	Kirk Henderson, Peabody Energy Australia Steve Simmons, AngloAmerican	It is widely accepted in the coal industry that accurate control of overburden blast hole depth can significantly improve mine profitability through reduced coal loss and dilution. Ideally, blast holes would be drilled to a predetermined stand off from the top of coal interface; however, the current techniques for seam mapping do not provide an accurate surface profile at the local scale required for effective stand off control. The aim of this project is to complete pre commercial development of a measurement while drilling system that can accurately detect the top of coal interface while routinely drilling blast holes, prior to the interface being reached by the drill.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECT APPROVALS 2014</b>			
<b>Maintenance and Equipment</b>			
<b>AC Motor Duty Meter for Excavating Machines (Part 2) C24035</b> University of Newcastle Galina Mirzaeva	156,467	Simon Orton, BMA Mark Spinks, AngloAmerican Tony Egan, Glencore	Off the shelf condition monitoring tools for AC motors typically diagnose motor condition by analysing vibrations, electric current or magnetic leakage flux in frequency domain. However, the process is disruptive to normal equipment operation. By using internal sensor instrumentation with miniature Hall Effect flux sensors inside the motor air gap, researchers expect to overcome this issue. As part of this project an AC duty meter prototype will be developed for diagnosing and predicting three major groups of faults. The AC duty meter prototype tool will be tested and validated on a laboratory scale induction motor, then tested and validated on a full scale induction motor with assistance from OEMs at their premises.
<b>Occupational Health and Equipment Safety</b>			
<b>Optimising the Implementation Critical Control Management Planning using a Management of Change Approach C24006</b> University of Queensland Jim Joy, Maureen Hassall	125,000	Tony Egan, Glencore	Critical control management planning (CCMP) is a major step change being undertaken across the Australian coal industry. However it is not yet clear what tactical and strategic impacts CCMP may have on stakeholders and organisation processes. This project will produce a plan for an effective and efficient step change in operational risk management to the CCMP approach across the industry; a set of recommended improvements to existing industry initiatives; and a list of new projects to facilitate this change.
<b>Safety Integrity Level Validation for Satellite Navigation Technologies C24027</b> GPSat Systems Australia Joe Austin-Crowe	142,750	Kane Usher, Rio Tinto	Safety integrity level (SIL) AS61508 assessments for projects reliant on the global navigation satellite system (GNSS), such as mining machine automation projects, are not currently possible. In this project a methodology will be developed to validate GNSS equipment. As a result of this work, manufacturer hardware (specific vendor, model and firmware revision) could be pre qualified, enabling them to be included in SIL related systems.
<b>Interface Design for Haul Truck Proximity Detection Systems C24028</b> University of Queensland Robin Burgess-Limerick	235,620	Gavin White, Rio Tinto Aaron Power, Rio Tinto Kane Usher, Rio Tinto Tony Egan, Glencore	Visibility restrictions inherent in the design of haul trucks can sometimes prevent drivers from seeing other vehicles. After market proximity detection systems have been developed to overcome this issue; however, there are no standards or guidelines available to help equipment designers. Using a haul truck simulator and other methods, researchers will evaluate existing proximity detection systems designed to convey advisory information to truck drivers and develop specifications for proximity detection system interfaces.
<b>Proximity Detection Device Open Specification C24034</b> CSIRO Mark Dunn	90,700	Gavin White, Rio Tinto Aaron Power, Rio Tinto Kane Usher, Rio Tinto Tony Egan, Glencore	There are many proximity detection systems for mobile mining equipment on the market, each with its own proprietary hardware, communication, logging and warning systems and methods. The absence of interoperability between systems is slowing down the uptake of this technology across the industry. As part of this project researchers will work with OEMs to develop industry wide supported platforms for open cut mines. In particular, an open specification set for above ground proximity detection systems will be developed based on the LASC open system interconnection model initially developed by CSIRO for longwall automation.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECT APPROVALS 2014</b>			
<b>Overburden Removal</b>			
<b>Automated Bulk Dozer Push: Reducing the Cost of Overburden Removal C24037</b> University of Queensland Ross McAree	341,400	Tim Baitch, AngloAmerican Kane Usher, Rio Tinto Simon Orton, BMA Greg Sheppard, Wesfarmers Resources Tony Egan, Glencore Don McNeil, Rio Tinto Bridget Perkins, AngloAmerican Martti Kankkunen, GVK Hancock Coal	The Caterpillar SATS semi autonomous tractor system for D11T dozers is capable of executing push to an edge bulk dozing and has been successfully used for dragline bench preparation. However, it cannot currently execute a pivot push with back stacking strategy which is favoured to minimise rehandle. This project will extend the capability of SATS so it can perform pivot push with back stacking, and test the system at an Australian coal mine.
<b>Quantifying Development Risks for a High Capacity Surface Mining Continuous Cutting System in Waste C24011</b> University of Queensland Steve Powell	491,123	Shaun Booth, Glencore Greg Doyle, Rio Tinto Greg Sheppard, Wesfarmers Resources Steve Amor, AngloAmerican Simon Orton, BMA Tim Baitch, AngloAmerican Tony Egan, Glencore Hans Hayes, AngloAmerican	The main impediment to developing a high capacity, continuous surface mining system for overburden in Australian open cut coal mines is the ability to efficiently cut the massive formations (typically sandstone). The objectives of this project are to develop an alternate method to drill/blast/shovel/truck to extract waste rock material in open cut mines by 2020; generate concept designs for a high capacity, continuous cutting system; and assess the feasibility and risks of the technologies that show potential to deliver significantly lower costs per tonne excavated.
<b>OPEN CUT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Major Projects</b>			
<b>Automated Swing Loading System for Electric Mining Shovels C16031</b> University of Queensland CRCMining Ross McAree	4,809,907	Tim Baitch, AngloAmerican Kane Usher, Rio Tinto Simon Orton, BMA Steve Amor, AngloAmerican Wayne Clement, Glencore Hans Hayes, AngloAmerican Greg Sheppard, Wesfarmers Resources Tony Egan, Glencore	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.
<b>Drilling and Blasting</b>			
<b>RAB Drill Rig Top of Coal Detection While Drilling C21005</b> CRCMining Kevin Brighton	459,340	Andrew Denman, BMA Kirk Henderson, Peabody Energy Australia	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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Drilling and Blasting cont.</b>			
<b>Real Time Detection of Moisture Content and Rockmass Structures for Fume Mitigation and Improved Cast Blasting Operations C22024</b> CSIRO Shiva Karekal	253,040	Steve Simmons, AngloAmerican	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.
<b>Improved Blast Outcomes by Integrating Structural and Blast Modelling C23028</b> University of Queensland Alan Cocker George Poropat Sarma Kanchibotla	255,007	Vishwa Bhushan, Rio Tinto Steve Simmons, AngloAmerican David Drew, Wesfarmers Curragh	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.
<b>Alternative and Sustainable Explosive Formulations to Eliminate Nitrogen Oxide Emissions C23029</b> University of Queensland Italo Onederra	352,527	Vishwa Bhushan, Rio Tinto Steve Simmons, AngloAmerican David Drew, Wesfarmers Curragh	Government directives to stop blasting activities due to nitrogen oxide (NOx) fume incidents have led to costly delays in production. This project is developing and evaluating 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.
<b>Environment</b>			
<b>Guidelines for Establishing Ecologically Sustainable Discharge Criteria in Seasonally Flowing Streams C19024</b> University of Queensland Sue Vink	238,000	Claire Cote, AngloAmerican Nardia Keipert, Peabody Energy Australia Stuart Ritchie, Rio Tinto	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.
<b>Soil Organic Matter and Green Carbon in Rehabilitation: Their Role in the Carbon Balance C19029</b> University of Queensland Thomas Baumgartl	253,200	Craig Lockhart, Peabody Energy Australia Nardia Keipert, Peabody Energy Australia Bernie Kirsch, Centennial Coal	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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Sustainable Management of Plantations for Rehabilitation, Carbon and Wood Products C20015</b> Industry & Investment NSW Georgina Kelly	187,068	John Hindmarsh, Rix's Creek Bill Baxter, Rio Tinto	<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>
<b>Criteria for Functioning River Landscape Units in Mining and Post Mining Landscapes C20017</b> Alluvium Consulting Australia Rohan Lucas	255,280	Craig Lockhart, Peabody Energy Australia Stuart Ritchie, Rio Tinto	<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 refined and updated the previous work by reviewing the success or otherwise of diversions constructed using the ACARP design criteria. It updated the criteria based on the outcomes of this work and recent research within the river rehabilitation industry. The project identified the issues associated with diversions through spoil and set a pathway for their resolution.</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	377,810	John Watson, Glencore Andrew Speechly, Rio Tinto	<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>
<b>Improvement of Haul Road Dust Emission Estimation and Controls at Coal Mines C20023</b> Pacific Environment Operations Judith Cox	473,160	John Watson, Glencore	<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 determined the control effectiveness of various dust suppressants under varying site conditions and provided the industry with a methodology to assess their efficiency.</p>
<b>Assessing Environmental Safety of In-pit Disposal of Tailings C20027</b> University of Queensland Thomas Baumgartl	268,600	Craig Lockhart, Peabody Energy Australia	<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 investigated 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>
<b>Tool to Assess Mining Impacts on River Condition C21031</b> Central Queensland University Claire Sellens	325,945	Craig Lockhart, Peabody Energy Australia Stuart Ritchie, Rio Tinto	<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>

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Environment cont.</b>			
<b>Modelling the Water, Energy and Economic Nexus C21033</b> University of Queensland Alan Woodley	194,750	Stuart Ritchie, Rio Tinto Scott Diggles, Rio Tinto Claire Cote, AngloAmerican	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 covered 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.
<b>Multiple Pollutant Analysis of Blast Plumes from Open Cut Mining Activities Using Differential Optical Absorption Spectroscopy (DOAS) C21035</b> Simtars Mark Curtis	130,570	Steve Simmons, AngloAmerican Vishwa Bhushan, Rio Tinto Andrew Speechly, Rio Tinto	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 utilised differential optical absorption spectroscopy technologies to safely measure airborne emissions. This technique is regularly used for the remote measurement of stack emissions.
<b>Physical and Detonation Characteristics of Bulk Explosives to Minimise Post Blast Fume Generation in Deep Hole, Soft Ground and Wet Conditions C21036</b> JKTech Sarma Kanchibotla	400,000	Steve Simmons, AngloAmerican Vishwa Bhushan, Rio Tinto Lindsay Ford, Glencore	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.
<b>Managing Mine Water Under Extreme Climate Variability C21037</b> CSIRO Damian Barrett	293,000	Bernie Kirsch, Centennial Coal Craig Lockhart, Peabody Energy Australia Nardia Keipert, Peabody Energy Australia Stuart Ritchie, Rio Tinto Claire Cote, AngloAmerican	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.
<b>Enhancing Ecological Values of Coal Pit Lakes with Simple Nutrient Additions and Bankside Vegetation C21038</b> Edith Cowan University Mark Lund	187,575	Bernie Kirsch, Centennial Coal Digby Short, Premier Coal	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 examined 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.



PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Microclimate Revegetation Monitoring C21042</b> CSIRO Christian Richter Darren Moore	266,555	Paul Veivers, Stanwell Corporation Troy O'Reilly, Stanwell Corporation	The <i>Environmental Protection Act 1994</i> 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 assessed the opportunity of coupling environmental data obtained through the state of the art wireless sensor network technology, biodiversity habitat attributes recorded through the Bio Condition 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.
<b>Integrated Forward and Reverse Osmosis System for Mine Water Reuse C21043</b> CSIRO Ramesh Thiruvengkatachari	168,560	Nardia Keipert, Peabody Energy Australia Carl Grant, AngloAmerican	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 integrated the non pressure driven forward osmosis system into a widely applied reverse osmosis technology so that mine impacted water can be reused.
<b>Real Time Monitoring and Prediction of Open Cut Blast Fumes C22025</b> CSIRO Darren Moore	356,880	Steve Simmons, AngloAmerican Paul Veivers, Stanwell Corporation	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.
<b>Managing Dig: Ensuring Currency in an Invaluable Resource C22026</b> University of Queensland Melina Gillespie	137,520	Mahdi Mason, Caledon Resources Ann Perkins, Rio Tinto	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.
<b>Australian Specific Dust Emission Factors for Coal Mines C22027</b> Pacific Environment Operations Damon Roddis Judith Cox	413,292	John Watson, Glencore Bruce Foster, Rio Tinto Technology & Innovation	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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Environment cont.</b>			
<b>Salinity Tolerance of Freshwater Organisms from the Southern and Western Coalfields C23010</b> University of Queensland Sue Vink	177,000	Bernie Kirsch, Centennial Coal Gary Brassington, BHP Billiton Illawarra Coal	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 is being 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.
<b>Quantification of PM2.5 Particulate Emission Rates from Mining Operations C23021</b> Air Noise Environment Claire Richardson	277,359	John Watson, Glencore Jason Fittler, AngloAmerican Bruce Foster, Rio Tinto Technology & Innovation	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. This project is determining 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.
<b>Industry based Rehabilitation and Closure Knowledge Management System: Scoping Study C23023</b> University of Queensland Corinne Unger	75,000	Paul Veivers, Stanwell Corporation Bernie Kirsch, Centennial Coal Stuart Ritchie, Rio Tinto	The original project identified Wiki as the most suitable tool to address the mine rehabilitation knowledge management needs in the Central Queensland mining region. In this extension project, CMLR will develop a mine rehabilitation and closure wiki (MRC-Wiki) to provide access to a live repository of CQ coal mine-specific rehabilitation practice information. Providing a platform for uploading information and holding discussion forums which can be managed by a regional practitioner network enables the new system to be kept alive, driven by users and information needs as they evolve over time.
<b>Coal Pit Lake Closure by River Flow Through: Risks and Opportunities C23025</b> Edith Cowan University Mark Lund	362,714	Scott Diggles, Rio Tinto Digby Short, Premier Coal	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 is developing 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.
<b>Reducing Analytical and Water Quality Monitoring Costs Using Diffusive Gradients in Thin Film Technique C23027</b> University of Queensland Sue Vink	163,000	Claire Cote, AngloAmerican John Merritt, Burton	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 is evaluating 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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Collaborative Performance Trajectories for Diversion Licence Relinquishment C23030</b> Alluvium Consulting Australia Rohan Lucas	196,210	Claire Cote, AngloAmerican John Merritt, Burton Scott Diggles, Rio Tinto	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 are working 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.
<b>Pilot Scale Integrated Forward and Reverse Osmosis System for Mine Water Reuse C23031</b> CSIRO Ramesh Thiruvengkatachari	258,237	John Watson, Glencore Nardia Keipert, Peabody Energy Australia Claire Cote, AngloAmerican	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 is developing a pilot scale, integrated treatment system that can process 1m3 of water per day and will complete a preliminary technical and economic assessment of the technology.
<b>Real Time Mine Specific Upper Air Data For Use In The Management of Mine Noise, Dust, Blast Fume and Overpressure C23032</b> Todoroski Air Sciences Aleks Todoroski	165,160	John Watson, Glencore Bruce Foster, Rio Tinto Technology & Innovation	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 verifying 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.
<b>Study of Sustainability and Profitability of Grazing on Mine Rehabilitated Land in the Upper Hunter C23053</b> NSW DPI Lester McCormick Neil Griffiths	200,000	Nigel Charnock, Glencore Bill Baxter, Rio Tinto	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 is addressing the community concerns through a grazing study on two mine sites in the Upper Hunter Valley. The mines are providing 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.
<b>Geology</b>			
<b>Characterisation of Overburden Rock Mass and Top Coal Delineation Using the Triaxial Drill Bit Vertical Seismic Profiling (VSP) Method C19020</b> CSIRO Shiva Karekal	283,290	Kirk Henderson, Peabody Energy Australia Steve Walker, AngloAmerican	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 was undertaken in collaboration with scientists from the National Institute of Advanced Industrial Science and Technology in Japan. A new multi-component sensor was 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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Geology cont.</b>			
<b>Implications of Self Weight, Wetting Up and Weathering Induced Settlements of High Coal Mine Spoil on Stored Volume and Stability C19022</b> University of Queensland David Williams	427,000	Richard Ruddock, Rio Tinto Nicole Tucker, BMA Shaun Booth, Glencore Chris Agosto, Mt Arthur Coal	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.
<b>Reliable Geotechnical Stability Assessment for Very High Spoil Dumps C20019</b> University of Newcastle John Simmons Stephen Fityus	486,500	Jack Krajewski, Rio Tinto Richard Ruddock, Rio Tinto Nicole Tucker, BMA Sarah Bligh, Thiess Shaun Booth, Glencore	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.
<b>Tertiary Volcanic Fields of Eastern Australia: Implications for Mining and Coal Quality C22023</b> University of Queensland Charles Verdel	179,250	Richard Ruddock, Rio Tinto Greg Jones, JB Mining Kirk Henderson, Peabody Energy Australia John Simmons, SGRS	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.
<b>Regional Stratigraphic Framework for the Rangal-Baralaba-Bandanna Coal Measures in the Bowen and Galilee Basins C22028</b> University of Queensland Joan Esterle Renate Silwa	288,800	Richard Ruddock, Rio Tinto Tim Buddle, AngloAmerican Barry Lay, BMA Donna Frater, BMA Patrick Tyrrell, New Hope Group	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.
<b>Non Destructive Characterisation of Borehole Coal Samples using X CT Technology C23024</b> University of Queensland Anh Nguyen	200,000	Barry Lay, BMA Richard Ruddock, Rio Tinto Patrick Tyrrell, New Hope Group Shaun Booth, Glencore	Exploration and development of new coal mines and mine plan strategies depend exclusively on the characterisation of borehole coal samples. This project is developing a novel nondestructive technique to characterise borehole coal samples using x-ray computed tomography, which is safe, environmentally friendly, fast and cost effective.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Rockfall Hazard Matrix For Risk Reduction In Mine Sites C23026</b> University of Newcastle Anna Giacomini Federica Ferrari	259,590	Marjella Meles, BMA Ashley Creighton, Rio Tinto Shaun Booth, Glencore	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 is incorporating 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.
<b>Maintenance and Equipment</b>			
<b>DC Motor Duty Meter C16030</b> CRCMining Galina Mirzaeva Terry Summers	551,066	Kane Usher, Rio Tinto Mark Spinks, AngloAmerican Tony Egan, Glencore	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.
<b>Powerlinkoz High Voltage Electrical Connection System (PLO) C20030</b> Connec John Keir	450,000	Tony Egan, Glencore Barrie Alley, Centennial Coal David Lincoln, Centennial Coal	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.
<b>Robotic Manipulator for Dragline Jewellery Repair C21027</b> University of Southern Queensland Erik Schmidt Peter Milani	275,934	Steve Amor, AngloAmerican John Thomsen, Rio Tinto Troy O'Reilly, Stanwell Corporation Keith Cardew, Peabody Energy Australia	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 was developed to reduce risks associated with the maintenance of heavy machinery. The research also focussed on developing an intuitive interface that may be applicable to other machines. The outcome from the research is an in depth study of innovative machine interfaces as well as pilot prototypes of both the interface and the manipulator.
<b>Synthetic Rope Prototype Development Program for Dragline Application C22022</b> AMOG Olaf Rutgrink	295,000	Shaun Booth, Glencore Tony Egan, Glencore	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.
<b>Mining and the Community</b>			
<b>Cumulative Impact of Growth on Regional Transport Infrastructure C22021</b> Central Queensland University Susan Kinneer	91,443	Madeleine Verdich, Rio Tinto Mahdi Mason, Caledon Resources	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 identified the key issues for regional transport systems arising from the cumulative impacts of resource sector growth in the northern Bowen Basin.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Mining and the Community cont.</b>			
<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	153,000	Craig Lockhart, Peabody Energy Australia Carl Grant, AngloAmerican	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 is investigating methods for operators, various levels of government and co-existing industries to more effectively manage cumulative impacts.
<b>Approval and Planning Assessment of Black Coal Mines in NSW and Qld: A Review of Economic Assessment Techniques C23016</b> Hunter Valley Research Foundation, Jenny Williams	35,000	Bernie Kirsch, Centennial Coal Bret Jenkins, Glencore Julie-Anne Braithwaite, Rio Tinto	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.
<b>Occupational Health and Equipment Safety</b>			
<b>Study of Industry Health and Safety 'Voluntary Initiatives' C22042</b> JKTech Jim Joy	60,000	Shane Hansford, QRC Kylie ah Wong, Glencore Andrew McMahon, NSWMC	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 suggested 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.
<b>Beyond Prescription: Strategies for Transitioning the Major Coal Industry Stakeholders (Regulators, Producers and Unions) to Risk Based Regulation C22043</b> Gunningham and Associates Neil Gunningham	232,038	Shane Hansford, QRC Kylie ah Wong, Glencore Andrew McMahon, NSWMC	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 examined 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.
<b>Improving Onsite Health and Safety Communication C22044</b> Cat.Dog Research and Creative Geoff Denman Jem Wallis	243,500	Shane Hansford, QRC Kylie ah Wong, Glencore Andrew McMahon, NSWMC Phillip Enderby, Glencore	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 aimed to improve the style and optimise the effectiveness of OHS communication. A communication audit and qualitative and quantitative research was conducted at several open cut and underground mines across Queensland and New South Wales. This provided insights and hard numerical data to establish the current levels of awareness and retention of OHS communication and to develop new communication strategies.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>OPEN CUT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Working Well: Mental Health and Coal Mining C22045</b> University of Newcastle Brian Kelly Robyn Considine	353,227	Shane Apps, Peabody Energy Australia Liam Wilson, Rio Tinto Shane Hansford, QRC Andrew McMahon, NSWMC	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.
<b>Methods for Selecting and Optimising Critical Controls C23007</b> University of Queensland Chris Doran, Jim Joy Marcus Punch Maureen Hassall	250,000	Tony Egan, Glencore	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 is developing 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.
<b>Managing Whole Body Vibration at Surface Coal Mines C23022</b> University of Queensland Robin Burgess-Limerick	149,100	Dave Olive, Collinsville Coal Ross Di Corleto, Rio Tinto Global HSEC Troy O'Reilly, Stanwell Corporation	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.
<b>Overburden Removal</b>			
<b>Automated Design of Multi Pass Dragline Strips Using 3D-Dig C21028</b> Earth Technology Murray Phillips	115,000	Bridget Perkins, AngloAmerican Lindsay Ford, Glencore Greg Sheppard, Wesfarmers Resources	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>Dragline Automation System: Optimal Excavation Sequencing C23033</b> University of Queensland Kevin Austin Ross McAree	649,360	Win Klass, Glencore Kane Usher, Rio Tinto Steve Amor, AngloAmerican Simon Orton, BMA Greg Sheppard, Wesfarmers Resources	Improving dragline performance through automation is the overall objective of this project. It is focussing 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.

## COAL PREPARATION PROJECTS

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.

### Committee Members

<b>Dion Lucke</b>	<b>Engagement Lead – Energy, Coal Australia Co Chair, Coal Preparation Committee</b>	<b>Rio Tinto Technology &amp; Innovation</b>
<b>Kevin Rowe</b>	<b>Group Manager of CHPPs Co Chair, Coal Preparation Committee</b>	<b>Glencore</b>
<b>Phillip Enderby</b>	<b>Manager, Ravensworth CHPP and Coal Terminal Past Co Chair, Coal Preparation Committee</b>	<b>Glencore</b>
Alvaro Diaz Lema	Group Process Engineer	Glencore
Ryan Flanagan	Group Process Engineer	Glencore
Rebecca Fleming	Coal Processing Specialist, Coal Australia	Rio Tinto
Rod Fox	General Manager – Coal Processing & Operational Projects	Whitehaven Coal
Alistair Harriman	Director – Process Engineering	Peabody Energy Australia
Phil Howes	CPP Engineer	BHP Billiton Illawarra Coal
Frank Mercuri	Coal Processing Specialist	AngloAmerican
Rod Nicholson	Senior Process Engineer	Bloomfield
Paul Revell	Lead - Process Optimisation	AngloAmerican
Dave Osborne	Coal Technology Consultant	Manford
Colin Surawski	Group Metallurgical Engineer - Technical Services	Vale Australia
Andrew Sutherland	Manager – Coal Processing Improvement, Coal Australia	Rio Tinto
Clinton Vanderkruk	Coal Processing Manager Australia & Canada	AngloAmerican
Tom Wilson	Process Engineer	AngloAmerican
Michael Young	Principal Metallurgist – Minerals Processing	Glencore



## Funding Approved 2014

Year	No of Projects	ACARP Funding	Total Funding
2014	15	2,017,563	2,752,522
2013	14	1,973,450	4,247,096
2012	9	1,579,489	2,270,696

## Projects Under Management 2014

Category	No of Projects	ACARP Funding
Major Projects	1	1,318,748
Dewatering	3	655,864
Environmental Improvement	1	228,000
Fine Coal	15	2,570,928
Gravity Separation	6	1,858,186
Occupational Health and Safety	2	289,000
Process Control	1	236,685
General	3	345,454



PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECT APPROVALS 2014</b>			
<b>Dewatering</b>			
<b>Improving the Dewatering Efficiency of Fine Flotation Concentrates by De-Aerating Froth Products C24040</b> University of Queensland Yongjun Peng	213,600	Alvaro Diaz Lema, Glencore Frank Mercuri, AngloAmerican	Increased salinity in mine water is causing froth handling problems in downstream processes. In this project a model will be developed to predict froth stability and the moisture of dewatered flotation concentrates in saline mine water. Dewatering efficiency of fine flotation concentrates will be improved using de aerating froth products. A laboratory scale de aeration froth column with foam destroyers will be designed, fabricated, tested and optimised. Physical and chemical pre treatments will be combined to minimise energy consumption and reagent cost while maximising the dewatering efficiency.
<b>Steam Pressure Filtration Targeting Step Change Reductions in Filtercake Product Moistures C24047</b> QCC Resources Andrew Swanson	297,049	Ryan Flanagan, Glencore Frank Mercuri, AngloAmerican	The principle of using laser diffraction as a means of measuring a volume size distribution in slurry is well established. The coal industry has not yet adopted routine online particle size analysis for any process unit operations. This project will introduce online particle size monitoring as a tool in optimising fine coal recovery. It will assess whether the SPI500i device can produce accurate and reliable data on the size distribution of solids in fine coal slurries within coal preparation circuits.
<b>Thickener Underflow Monitor C24048</b> Clean Process Technologies John Lucas Noel Lambert	195,000	Rod Nicholson, Bloomfield Justin O'Neil, Peabody Energy Australia Phillip Enderby, Glencore	Dewatering fine tailings material is becoming an important component of the coal mining process, particularly given the challenges around constructing, managing and rehabilitating tailings dams. This project will develop an instrument that is capable of accurately and reliably measuring the quality of the thickener underflow in an operating coal preparation plant environment. The instrument will measure the solids and water loadings and the dynamic and kinematic viscosity of tailings slurry which are not currently reliably measured online. This information will enable the thickener and downstream processes to be optimised.
<b>Fine Coal</b>			
<b>Impact of Sub Optimal Operation C24039</b> BA Firth Bruce Firth	32,000	Andrew Sutherland, Rio Tinto	Although some research has been undertaken on the sub optimal operation of coal preparation plants and unplanned downtime, variation in the approaches used makes it difficult to compare the outcomes. There has also been little recognition of the importance of run of mine washability in this work. Following a comprehensive literature review, the project will develop a methodology for codifying poor operation situations and unplanned downtime events. Case studies will be used to quantify the impact of the poor operation and run of mine washability.
<b>Improving Coal Flotation With Oscillatory Air Supply C24041</b> University of Queensland Liguang Wang	108,000	Frank Mercuri, AngloAmerican Diego Dal'Molin, Rio Tinto Kevin Rowe, Glencore	Ultrafine and fine coal flotation can be considerably improved by microbubbles. A recent research breakthrough shows that microbubbles smaller than 100µm can be cheaply generated from oscillatory air flow. This project will improve coal flotation performance and reduce operating costs by installing a cheap and compact device to supply oscillatory air flow to existing flotation cells. The outcome of this work will be improved flotation performance, reduced frother dosage and decreased energy consumption.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECT APPROVALS 2014</b>			
<b>Pilot Scale Study of Fast Flotation C24042</b> University of Newcastle Kevin Galvin	95,180	Kevin Rowe, Glencore Ryan Flanagan, Glencore Dion Lucke, Rio Tinto Technology & Innovation	Until recently, processing high value coal from tailings dams has been considered uneconomic. This project will establish a low capital cost solution for reducing the volume of fine waste sent to tailings and generating a high value product. The aim of the project is to develop a small, compact two stage flotation system capable of generating a clean coal product from the cyclone overflow.
<b>Simultaneous Gravity Separation and Desliming of Fine Coal - A Novel Concept C24043</b> University of Newcastle Kevin Galvin	141,380	Tom Wilson, AngloAmerican	Flotation currently provides only a single stage option for achieving simultaneous gravity separation and desliming of fine coal in the one vessel. In this project a Reflux Classifier will be inverted. The gangue and slimes will be rejected together via a more dilute underflow, leaving behind a clean coal product that emerges as a concentrated overflow. This innovation will allow the plant to recover much finer coal without the need for flotation. This laboratory scale work will provide the basis for a commercialisation pathway via additional programs at pilot and full scale.
<b>Adaptation of Coal Grain Analysis to Improve Yield Estimation C24045</b> QCC Resources Bruce Atkinson	120,456	Rod Nicholson, Bloomfield Dion Lucke, Rio Tinto Technology & Innovation	Predicting flotation yield and concentrate quality based on resource samples in coal preparation plants has been challenging. This project aims to find an accurate measure of the true flotability of fines in the resource. To achieve this, the CSIRO coal grain analysis interpretation software will be further developed so that it can be separated into distinct size fractions. Thirty six coal samples will be analysed and practical flotation model parameters for each grain type generated. The work should provide sufficient information to differentiate grain response to dose rate.
<b>Online Particle Size Monitoring in Coal Preparation C24046</b> QCC Resources Brad Garraway	168,570	Phillip Enderby, Glencore Rebecca Fleming, Rio Tinto	Pressure filtration is an effective technique for improving dewatering of fine coals; however it has high capital costs, complicated structure and significant operating costs. A pilot scale testing program will be undertaken to confirm that high pressure air filtration supplemented with steam can achieve the dewatering potential indicated by earlier work. Guidelines will be developed for predicting the filter cake moisture and filtration rate based on the filter feed coal quality using the established operating ranges for the various operating process variables. A key outcome of this work will be the prediction of potential increases in recovery and sales revenue in New South Wales thermal coal operations for the successful implementation of this technology.
<b>Performance Enhanced Diesel Collector for Coal Flotation C24049</b> CSIRO Shenggen Hu	148,013	Clinton Vanderkruk, AngloAmerican Andrew Sutherland, Rio Tinto	The natural hydrophobicity of coal in flotation is usually enhanced by adding oily collectors, such as diesel, which is an expensive process. Technologies are needed to reduce the consumption of the diesel oil collector while maintaining good flotation performance and reducing treatment costs. This project will validate the performance enhanced diesel collector at preparation plant scale, which is expected to increase recovery of coarser and fine coal particles and improve flotation yield of low to middle rank coals by up to 20%.
<b>Gravity Separation</b>			
<b>RFID Residence Time Modelling C24044</b> CSIRO Mike O'Brien Nerrida Scott	29,155	Rebecca Fleming, Rio Tinto	Dynamic modelling of dense medium circuits (DMCs) requires collection of information to determine residence times in various parts of the circuits. This project will further develop the hypothesis that density of coarse particles influences the residence times in the DMC and that different sized tracer particles produce discrepancies in partitioning efficiency. Residence time measurements of plant extremities will also be undertaken. The outcome will be better dynamic model verification tools to determine DMC and coal circuit behaviour.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECT APPROVALS 2014</b>			
<b>Gravity Separation cont.</b>			
<b>Options for the Addition and Control of Non Magnetic Material in Correct Medium C24050</b> CSIRO Mike O'Brien	205,490	Clinton Vanderkruk, AngloAmerican Justin O'Neill, Peabody Energy Australia	When operating at correct medium densities, the amount of non magnetic material in the dense medium cyclone (DMC) significantly affects its operational efficiency. Because the quantity of non magnetic material is not monitored, plant operators may be unaware of the negative impacts for several hours. This project will investigate various options for controlling the level of this material, including new pipework to enable material from the thickener underflow to be added and a distributor from the magnetic separator to divert the water containing clays to the correct medium sump. A standard operating procedure will also be developed. This project will reduce the amount of coal lost from inefficient operation due to changes in medium quality.
<b>Effect of Particle Crowding at the Vortex Finder and Spigot on Cyclone Operation C24051</b> CSIRO Mike O'Brien	145,255	Alvaro Diaz Lema, Glencore	The medium to coal ratio, the density of the medium in the underflow and the volumetric amount of particle exiting the dense medium cyclone (DMC) via the vortex finder contribute to particle crowding in the cyclone and this affects medium stability. This project will quantify the changes in DMC operational conditions with respect to particle crowding of the vortex finder and spigot. The outcomes have the potential to improve DMC management and increase saleable coal.
<b>General</b>			
<b>Coal Preparation Field Promotion 2014 C24004</b> Petan Enterprises Peter Newling	75,000	Coal Preparation Committee	This project incorporates an international biennial tour of coal preparation plants and meetings with plant process managers and engineers to disseminate the results of coal preparation research funded by ACARP. The tour is also used to identify key achievements in coal preparation around the world and promote the role ACARP plays as the biggest supporter of coal research in Australia.
<b>Application of ACARP DMC R&amp;D between CSIRO and JKMRC C24052</b> CSIRO Mike O'Brien	43,415	Dion Lucke, Rio Tinto Technology & Innovation Kevin Rowe, Glencore	A significant body of research has been undertaken on DMC instrumentation, DMC online yield determination, medium quality, effect of non magnetics, drain and rinse screens, online washability prediction and medium stability issues. The project will synthesise this knowledge and develop a seminar for plant operators, engineers and other stakeholders and produce a printed set of proceedings, which includes case studies.
<b>COAL PREPARATION PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Major Projects</b>			
<b>Reflux Classifier to 4mm Top Size - Full Scale Trial (Construction of Test Rig) C22046</b> University of Newcastle Kevin Galvin	1,318,748	Dion Lucke, Rio Tinto Technology & Innovation 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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Dewatering</b>			
<b>Enhanced Dewatering of CHPP Tailings through Modification of the Structure of Presedimented Floccs C21054</b> CSIRO Philip Ofori	199,000	Andrew Sutherland, Rio Tinto Dave Osborne, Manford	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 established optimal approaches to alter presedimented floc network structure on a continuous pilot scale system for enhanced sediment consolidation without compromising settling rate.
<b>Belt Press Filter Optimisation Handbook C23040</b> Quality Process Solutions Darren Mathewson	153,550	Kevin Rowe, Glencore Phil Howes, BHP Billiton Illawarra Coal Penny Walker, Bengalla	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> Bilcrest Stuart Whitton	303,314	Alistair Harriman, Peabody Energy Australia	The applicability and utility of a screw press to the dewatering of coal beneficiation plant tailings are being investigated during a field pilot plant trial. Dilution strata and tailings are being 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>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	Rahul Patel, Peabody Energy Australia Dave Osborne, Manford	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	Tom Wilson, AngloAmerican Paul Revell, AngloAmerican Dion Lucke, Rio Tinto Technology & Innovation	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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Fine Coal cont.</b>			
<b>Enhanced Flotation and Desliming Using a Reflux Flotation Cell C20043</b> University of Newcastle Kevin Galvin	229,100	Tom Wilson, AngloAmerican Rod Nicholson, Bloomfield Phillip Enderby, Glencore Paul Revell, AngloAmerican Dion Lucke, Rio Tinto Technology & Innovation	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.
<b>Full Scale Gravity-Desliming Using Cascading Reflux Classifiers C20052</b> University of Newcastle Kevin Galvin	215,480	Paul Revell, AngloAmerican Dion Lucke, Rio Tinto Technology & Innovation	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, AngloAmerican Dion Lucke, Rio Tinto Technology & Innovation	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 was developed at laboratory scale using an alternative binding agent to conventional oil agglomeration. The aim was 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	Frank Mercuri, AngloAmerican 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 investigated 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, AngloAmerican Dion Lucke, Rio Tinto Technology & Innovation	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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Plant Based Investigations of Hydrodynamic Behaviours in Large Coal Flotation Cells C21051</b> CSIRO Shenggen Hu	197,170	Frank Mercuri, AngloAmerican 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 characterised the hydrodynamic behaviours of large Microcel columns and Jameson cells, through undertaking plant based experiments to determine the resident time distribution of liquid and solids phases at multiple points in each of the selected cells, and described these with suitable models. The work also measured gas holdup at different depths and radial positions in the pulp phase.
<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, AngloAmerican Dion Lucke, Rio Tinto Technology & Innovation	The Reflux Classifier offers lower composite $E_p$ 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, AngloAmerican Dion Lucke, Rio Tinto Technology & Innovation	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>Comparison of Column and Mechanical Flotation Technologies C23034</b> BA Firth Bruce Firth	27,250	Frank Mercuri, AngloAmerican Justin O'Neill, Peabody Energy Australia Dave Osborne, Manford	A comparison of the effectiveness of column and mechanical flotation technologies is being 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 Dave Osborne, Manford	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 is demonstrating 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 is being developed and a real time diagnostic tool for maximising the separation efficiency of coal flotation will be evaluated.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Fine Coal cont.</b>			
<b>New Approach to Coarse Coal Flotation C23036</b> University of Newcastle Kevin Galvin	141,457	Tom Wilson, AngloAmerican Rod Nicholson, Bloomfield Phillip Enderby, Glencore Paul Revell, AngloAmerican Dion Lucke, Rio Tinto Technology & Innovation	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 is providing 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	Tom Wilson, AngloAmerican	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 trials will also provide mine personnel who will commission future full scale plants with operating experience and training.
<b>Characterisation and Flotation of Oxidised Coal C23039</b> University of Queensland Yongjun Peng	168,600	Dave Osborne, Manford Frank Mercuri, AngloAmerican	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 is being 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, AngloAmerican Paul Revell, AngloAmerican	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>Gravity Separation</b>			
<b>CPP Feed Washability Prediction from Small Topsize Samples C18041</b> QCC Resources Andrew Swanson	737,688	Ryan Flanagan, Glencore Dion Lucke, Rio Tinto Technology & Innovation	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.



PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Linkage of Dynamic Changes in DMC Circuits to Plant Conditions C20050</b> CSIRO Mike O'Brien Peter Holtham	492,502	Ryan Flanagan, Glencore Frank Mercuri, AngloAmerican Roy Brown, Rio Tinto	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. Project 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>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, AngloAmerican Dion Lucke, Rio Tinto Technology & Innovation	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>Affect of G Force on Banana Screen Efficiency C23037</b> CSIRO Mike O'Brien	36,200	Phillip Enderby, Glencore Yasantha Eleperuma, AngloAmerican	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 is determining 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, Bengalla Frank Mercuri, AngloAmerican	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 is providing 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.
<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	119,000	Alistair Harriman, Peabody Energy Australia	The elimination of organic chemicals, used in float/sink testing 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 initially investigated the application of magnetorheological (MR) fluids to float sink testing. MR fluids contain ferromagnetic particles which are too heavy for Brownian motion to keep in suspension. Modelling indicated that a Ferro fluid layer of homogeneous density could be achieved by application of an alternating magnetic field at a certain frequency. Experiments were conducted; however, the apparatus was unable to generate the required frequency and field strength. Hence the theory could not be validated and the project was terminated at this point.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>COAL PREPARATION PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Occupational Health and Safety cont.</b>			
<b>Washability Analysis of Fine Coal using a Water Based Method C21046</b> University of Newcastle Kevin Galvin	170,000	Paul Revell, AngloAmerican Dion Lucke, Rio Tinto Technology & Innovation	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 delivered an inexpensive and rapid method for obtaining fine coal washability data, and analysis of beneficiation performance using a laboratory scale Reflux Classifier.
<b>Process Control</b>			
<b>Advanced Control and Optimisation of DMC Operation C22033</b> CSIRO Shenggen Hu	236,685	Tom Wilson, AngloAmerican Rahul Patel, Peabody Energy Australia Roy Brown, Rio Tinto	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.
<b>General</b>			
<b>Database Management C15060</b> QCC Resources 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 is accessible to all Australian coal industry personnel, associated consultants and researchers.
<b>Impact of Sample Preparation Procedure on CGA Result C23042</b> QCC Resources Bruce Atkinson	35,202	Dion Lucke, Rio Tinto Technology & Innovation	Different laboratories use different forms of grinding mills and the concept of generating minimum fines is operator dependent. This project is evaluating whether the variability of sample preparation will have an impact on coal grain analysis data. Researchers are assessing 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.
<b>Product Coal Loss Due to Inappropriate Focus on Ep C23043</b> QCC Resources Bruce Atkinson	29,836	Colin Surawski, Vale Australia Dion Lucke, Rio Tinto Technology & Innovation	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 is providing a more practical definition for the curve tails, such that t0 and t1 are left solely as curve fit parameters. That is providing a means for all data assessors to calculate the information uniformly and by a means that has physical significance.



## TECHNICAL MARKET SUPPORT PROJECTS

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.

### Funding Approved 2014

Year	No of Projects	ACARP Funding	Total Funding
<b>2014</b>	<b>12</b>	<b>3,701,459</b>	<b>4,564,325</b>
2013	12	1,409,979	1,969,933
2012	11	1,069,147	1,862,174

### Projects Under Management 2014

Category	No of Projects	ACARP Funding
Major Projects	1	703,625
Metallurgical Coal	15	3,116,965
Thermal Coal	1	118,814
General	7	1,195,593

### Committee Members

<b>Kim Hockings</b>	<b>Coordinator Technical Specialist Chair, Technical Market Support Committee</b>	<b>BHP Billiton</b>
Nick Andriopoulos	Technical Marketing Specialist	AngloAmerican
Morgan Blake	General Marketing Manager	Peabody Coalsales Australia
Stephen Brant	Technical Specialist	BHP Billiton
Jeremy Byrnes	Logistics Superintendent	Glencore
Ashley Conroy	Group Advisor – Coal Technology	Rio Tinto Energy
Phil David	General Manager Coal Generation & Mining Operations	Stanwell
Chris Dempsey	Area Manager, Mining	BMA
Andrew Fikkers		Glencore
Sean Flanagan	Manager, Coal Technology	Wesfarmers Curragh
Graeme Harris	Principal Coal Technologist	Rio Tinto Energy
Tim Manton	Manager Coal Quality & Utilisation	BHP Billiton Illawarra Coal
Dave Osborne	Coal Technology Consultant	Manford
Luke Solomon	Strategic Planning Specialist	AngloAmerican
Chris Stanford	Manager Downstream Coal Quality	Peabody Energy

## TECHNICAL MARKET SUPPORT PROJECT APPROVALS 2014

## Major Projects

<p><b>Transportable Moisture Limits for Coal: Stage 2 C24001</b> University of Newcastle Ken Williams Tobias Krull</p> <p><b>Transportable Moisture Limit Project - International Maritime Organisation Implementation Phase C24062</b> Goodwin Port Solutions Ash Goodwin</p>	<p>2,184,450</p>	<p>Transportable Moisture Limit Steering Committee</p>	<p>In 2014, project C24001 delivered a modified test method for measuring the transportable moisture limit for coal products. This work was undertaken in response to amendments to the International Maritime Organisations International Maritime Solid Bulk Cargoes (IMSBC) code. In December 2014, the test was approved for use by the Australian Maritime Safety Authority (AMSA), and the test will be published on the AMSA Cargoes web site imminently. (<a href="http://www.amsa.gov.au/vessels/ship-safety/cargoes-and-dangerous-goods/">http://www.amsa.gov.au/vessels/ship-safety/cargoes-and-dangerous-goods/</a>). The approval of this test method provides a scientifically proven method to ensure that global coal shipments continue to occur in a safe manner. The project will continue in 2015 as project C24062 with the results of the research and the test procedure to be presented to the International Maritime Organisations CCC2 meeting in London in September 2015, with the test likely to be adopted for use by all international coal shippers in 2017-2018.</p>
<b>Metallurgical Coal</b>			
<p><b>Coke Analogue to Examine the Effect of Mineralogy on Coke Reactivity C23049</b> University of Wollongong Brian Monaghan</p>	<p>158,998 new</p> <p>154,010 existing</p>	<p>Oliver Scholes, Vale 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 characteristic is, in part, limited by unknown or non-quantified effects of minerals in coke. This project will quantify the effects of key minerals and mineral combinations on the coke analogue reactivity; quantify and assess the effects of coke porosity on coke reactivity; and assess the effects of mineral proximity and size on coke reactivity.</p>
<p><b>Effect of Coke Reactivity Upon Coke Strength With Focus on Microstructure C24053</b> CSIRO David Jenkins</p>	<p>161,032</p>	<p>Stephen Brant, BHP Billiton Nick Andriopoulos, AngloAmerican</p>	<p>The NSC developed coke strength after reaction (CSR) index is used as a key indicator of the suitability of a coke for use in blast furnace and is a key consideration in determining coal price. Producers need to understand how cokes made from their coals perform in the CSR test. This project will compare micro CT analysis of cokes before, during and after reaction in order to determine the key differences between them. As a result, researchers will be able to identify the components of microstructure which are most affected by the reactions.</p>
<p><b>An In-situ Study of the Plastic Layer Formation in Coking Coals using a Lab Scale Test Furnace C24054</b> University of Newcastle Jianglong Yu</p>	<p>147,630</p>	<p>Chris Stanford, Peabody Energy Sean Flanagan, Wesfarmers Curragh</p>	<p>The link between coal chemistry and the coking behaviour and carrying capacity of Australian coking coals and competing international coals is not well understood. An in situ investigation will be undertaken on the formation, migration and characteristics of the plastic layers of these coals during coking. The migration speed, temperature history and internal gas pressure of the plastic layer will be measured during coking.</p>
<p><b>Physical and Chemical Interactions Occurring During Cokemaking and their Influence on Coke Strength C24055</b> University of Newcastle Karen Steel, Wei Xie</p>	<p>118,510</p>	<p>Graeme Harris, Rio Tinto Energy Nick Andriopoulos, AngloAmerican</p>	<p>Interactions between components during coking – including components within an individual coal and components within a blend of coals – play a key role in coke strength development. The precise nature of these interactions is not known. This project will isolate the physical and chemical interactions, quantify them and determine which have an over riding influence on strength development. This work will provide new insights into poorly understood coke blend behaviour and identify new methods of exploiting the interactions to help optimise the use of Australian coals in cokemaking.</p>

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>TECHNICAL MARKET SUPPORT PROJECT APPROVALS 2014</b>			
<b>Metallurgical Coal cont.</b>			
<b>Relationship Between Internal Pressure and Coke Strength and Implications For Semi Soft Coking Coals in Blends C24056</b> ALS Coal Karen Steel, Philip Bennett	174,147	Stephen Brant, BHP Billiton Luke Solomon, AngloAmerican Morgan Blake, Peabody Coalsales Australia Ashley Conroy, Rio Tinto Energy	Coke is not necessarily a linear combination of the quality of the component coals. When the proportion of semi soft coking coal in the blend exceeds a certain level, there is a sudden drop off in tumble drum strength. The precise location of this sudden drop in coke quality and whether it occurs across all semi soft coking coals is not known. This project will develop a standardised approach to evaluating the contribution of coking coals in blends, which will result in better than linear coke strength behaviour and help reduce oven wall pressure.
<b>Estimating the Fusible Content of Individual Coal Grains and its Application in Cokemaking C24057</b> CSIRO Karen Warren, Merrick Mahoney	230,026	Kim Hockings, BHP Billiton	The link between coal grain composition of the coke oven feed and the final coke microstructure and coke strength is not well understood. This project will use enhanced coal grain analysis, the analysis of 3D microstructure of coke from computed tomography scanning and the analysis of fracture surfaces using fractographic techniques to explore these relationships. The outcomes of this work will be a better understanding of the sensitivities to inert grind for different coals, and how to use coal grain analysis to optimise the preparation of coal for coking and in the prediction of coke strength.
<b>Microscopic Properties of Coal and Coke: Comparing Coal Grains with the Optical Properties of Coke and Determining their Relationship C24058</b> ALS Coal Philip Bennett	42,600	Kim Hockings, BHP Billiton	Variation in the fusibility of inertinite macerals and the heterogeneous nature of coal grains make it difficult to predict the relationship between coal petrographic analysis and coke microstructure. However, coal grain analysis (CGA) can quantify the heterogeneous nature of coal grains. This project will determine the relationship between CGA and coke microstructure to provide a reliable prediction method and determine whether this method could be used in a commercial laboratory. This information could be used by coal producers to recommend milling strategies to optimise coking performance.
<b>Volatile Release During Pulverised Coal Injection as a Factor in Determining Combustability C24059</b> University of Newcastle Liza Elliot	149,000	Nick Andriopoulos, AngloAmerican Chris Stanford, Peabody Energy	It is not clear why some low volatile coals have good combustion performance in the PCI process compared with other coals. This project will use coals previously studied in BHP Billiton's PCI rig to determine the volatile released during pyrolysis at PCI heating rates in addition to whole coals and temperatures on maceral concentrates.
<b>Structural Differences Between Coking Coals of the Sydney Basin and Other Sources C24060</b> CSIRO Richard Sakurovs	182,000	Morgan Blake, Peabody Coalsales Australia Kim Hockings, BHP Billiton	Cokes made from Australian coals of relatively low fluidity can have better strength and reactivity values than their equivalent European or American coals with the same low fluidity. However, low fluidity remains an issue in contract negotiations for Australian coals, which are often penalised. This project aims to better predict the behaviour of cokes from their coal properties. Small angle scattering, gas sorption and release behaviour will be used to examine a range of coals and cokes to identify differences in their microstructure and gas transport characteristics.
<b>General</b>			
<b>Australian Participation in Development of ISO Methods for Sampling, Analysis and Coal Preparation and National Technical Committee Support C15003</b> Standards Australia Ahshanur Rashid	153,066 new  472,460 existing	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 2015 and 2016.

## TECHNICAL MARKET SUPPORT PROJECTS UNDER MANAGEMENT 2014

## Major Projects

<b>Transportable Moisture Limits for Coal: Stage 1 C22040</b> CSIRO David McCallum Ken Williams Ralph Holmes	703,625	Transportable Moisture Limit Steering Committee	<p>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 liquify 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.</p>
<b>Metallurgical Coal</b>			
<b>Advanced Characterisation of Metallurgical Coals - Coke Properties and Reactivity C17050</b> University of New South Wales Merrick Mahoney Richard Roest Sushil Gupta Veena Sahajwalla	704,113	Stephen Brant, BHP Billiton Luke Solomon, AngloAmerican Dave Osborne, Manford	<p>This final extension to the project aimed to take techniques used to understand the direct causal sources of mechanical failure in other model systems and apply them to both the feed metallurgical coke and the coke collected in the tuyere probe.</p>
<b>Application of Optical and SEM Imaging to Characterise Cokes for Strength and Reactivity C18043</b> ALS COAL Lauren Johnson Philip Bennett	348,800	Tim Manton, BHP Billiton Illawarra Coal Dave Osborne, Manford Chris Dempsey, BMA	<p>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.</p>
<b>Development of a Synthetic Sulphur Calibrant and Associated Test Method C19050</b> HRL Technology Nicolas Miller	79,750	Chris Stanford, Peabody Energy	<p>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 identified 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.</p>

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>TECHNICAL MARKET SUPPORT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Metallurgical Coal cont.</b>			
<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 investigated 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>Relationship Between Internal Pressure and Coke Strength and Implications for Semi Soft Coking Coals in Blends C21058</b> ALS COAL Karen Steel Philip Bennett	190,540	Stephen Brant, BHP Billiton Luke Solomon, AngloAmerican Morgan Blake, Peabody Coalsales Australia	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.
<b>Estimating the Fusible Content of Individual Coal Grains and its Application in Cokemaking C21059</b> CSIRO George Poropat Graham O'Brien Merrick Mahoney	128,382	James Graham, A & B Mylec	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 extended 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.
<b>Quality of Stamp Charged Cokes and Stampability of Coals at Small Scale C22035</b> ALS COAL Lauren Johnson	114,530	Chris Stanford, Peabody Energy Sean Flanagan, Wesfarmers Curragh	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.
<b>Fractographic Approach to Understanding the Mechanisms of Coke Breakage C22036</b> University of Newcastle Richard Roest	123,986	Nick Andriopoulos, AngloAmerican Stephen Brant, BHP Billiton	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 assessed 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 allowed 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.



PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>TECHNICAL MARKET SUPPORT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Fundamental Reasons for Different Coking Behaviour of Coals from Different Basins - Behaviour of Semi Inerts C22037</b> University of Newcastle Rohan Stanger	149,187	Sean Flanagan, Wesfarmers Curragh	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.
<b>Implications of Coke Oven Testing Conditions C22039</b> ALS COAL Philip Bennett	217,766	Chris Stanford, Peabody Energy Graeme Harris, Rio Tinto Energy	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.
<b>Mechanistic Model for the Understanding of the Sole Heated Oven C23047</b> University of Newcastle David Jenkins, Merrick Mahoney	169,000	Kim Hockings, BHP Billiton Chris Stanford, Peabody Energy	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.
<b>Links Between Microstructure Development In Softening Coal and the Characteristics Controlling Coke Quality C23048</b> University of Queensland David Jenkins, Karen Steel	241,885	Chris Dempsey, BMA Oliver Scholes, Vale Luke Solomon, AngloAmerican	The fundamental mechanisms by which a particular coal or blend produces a strong coke is still largely unknown. This project is obtaining 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.
<b>Optical Image Analysis of Coke Structure and the Effects of Structural Parameters on Coke Strength C23051</b> CSIRO Eugene Donskoi Merrick Mahoney	147,416	Ashley Conroy, Rio Tinto Energy Oliver Scholes, Vale	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 is applying 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.
<b>Extension of a Theoretically Based Coke Strength Index to Small Scale Coke Oven Samples and Adhesion Controlled Cokes C23056</b> ALS COAL Frank Shi Philip Bennett	126,100	Chris Stanford, Peabody Energy Oliver Scholes, Vale Graeme Harris, Rio Tinto Energy	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 JKMRRC 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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>TECHNICAL MARKET SUPPORT PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Thermal Coal</b>			
<b>The Mercury Treaty - Implications and Responses C19009</b> Macquarie University Peter Nelson	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. As part of this project, regular briefing documents were produced on the development of the global treaty and Australian expert involvement in the Global Mercury Partnership for mercury from coal combustion was facilitated through a central point.
<b>General</b>			
<b>Investigation of Factors Which May Cause Coal Flow Problems During Discharge from Rail Wagons C22034</b> Introspec Marketing Services John Planner	136,160	Chris Stanford, Peabody Energy Sean Flanagan, Wesfarmers Curragh Dave Osborne, Manford	'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.
<b>Prediction of Electrostatic Precipitation Performance C22038</b> ALS COAL Don Holcombe	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 improved 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.
<b>Review of the TMS Research Program and Needs C23003</b> A&SJ Lowe Consulting Services Allen Lowe	26,000	Technical Market Support Committee	Inhouse review of technical market support committee program direction.
<b>Development of CGA Maceral Chemistry and Optical Mineral Marker Database C23050</b> CSIRO Priyanthi Hapugoda	167,040	Dave Osborne, Manford 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 is adding information on another six coals to this database. In addition, methods are being 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.
<b>Revised Dustiness and Dust Extinction Moisture Testing Method (Update of AS 4156.6) C23054</b> University of Newcastle Alan Roberts Dusan Ilic John Planner	130,000	Chris Stanford, Peabody Energy Tim Manton, BHP Billiton Illawarra Coal	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.

PROJECT / RESEARCHER

ACARP FUNDING INDUSTRY MONITORS

OVERVIEW

TECHNICAL MARKET SUPPORT PROJECTS UNDER MANAGEMENT 2014

General cont.

**Phosphorus in Coal: Status of Test Methods in Use and Applicability to Industry Needs C23055**

QCC Resources

Ian Anderberg

55,762

Morgan Blake, Peabody Coalsales 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.

## MINE SITE GREENHOUSE MITIGATION PROJECTS

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.

### Committee Members

<b>Alex Zapantis</b>	<b>Principal Adviser, Product Stewardship Chair, Mine Site Greenhouse Mitigation Committee</b>	<b>Rio Tinto Energy</b>
Heather Bone	Group Manager Sustainability	Downer EDI Mining
Sam Bretherton	Energy and Emissions Advisor	Peabody Energy Australia
Brett Garland	Managing Director	Caledon Coal
Jan Green	Group Manager Environment and Sustainability	Idemitsu Australia Resources
Ben Klaassen	Manager Environment Climate Change	BMA
Jim Sandford	Project Manager, Coal Assets Australia	Glencore
Trevor Stay	General Manager Gas	AngloAmerican

### Funding Approved 2014

Year	No of Projects	ACARP Funding	Total Funding
<b>2014</b>	<b>3</b>	<b>608,880</b>	<b>1,027,720</b>
2013	4	687,516	1,207,512
2012	3	539,409	785,529

### Projects Under Management 2014

Category	No of Projects	ACARP Funding
Mine Site Greenhouse Mitigation	10	3,278,026

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>MINE SITE GREENHOUSE MITIGATION PROJECT APPROVALS 2014</b>			
<b>Novel Stone Dust Looping Process for Mitigation of Ventilation Air Methane C23052</b> University of Newcastle Kalpit Shah	235,650 new  173,747 existing	Trevor Stay, AngloAmerican Jim Sandford, Glencore	In phase one of this project, the stone dust looping (SDL) process abated a wide range of ventilation air methane (VAM) flows with methane concentrations between 0.005% and 2% in the temperature range of 400-600oC. This second phase of the project will demonstrate the SDL process at 0.5%-1Nm3/hr at bench scale; identify the optimum process conditions (temperature, pressure, gas velocities, particle size, stone dust inventory); and establish the technical knowledge needed to achieve the optimum design and operation of the SDL process.
<b>Improving Methods for Quantifying Fugitive Emissions from Open Cut Coal Mining C24017</b> CSIRO Stuart Day	224,110	Ben Klaassen, BMA Jim Sandford, Glencore	Fugitive emissions from coal mining are the largest source of greenhouse gas emissions from the Australian coal industry and, under carbon pricing legislation, potentially represent a major cost to mine operators. To address this issue, the feasibility of using inverse methods and plume traversing techniques to improve the accuracy and precision of greenhouse gas emissions measurements will be rigorously assessed. Once the preferred method for determining fugitive emissions has been confirmed, researchers will design a full scale trial of the method.
<b>Proof of Concept Photocatalytic Destruction of Methane for Coal Mining Fugitive Emissions Abatement C24061</b> CSIRO Yonggang Jin	149,120	Jim Sandford, Glencore Alex Zapantis, Rio Tinto Energy	Open cut coal mines are the second largest source of fugitive emissions, accounting for more than 30% of fugitive coal mine emissions. This project will use photocatalytic oxidation of methane into carbon dioxide as a means of abating fugitive emissions from coal mining. The multiple stage project will start with proof of concept, followed by exploration of effective photocatalysts and large scale prototype photoreactor development and site trials.
<b>MINE SITE GREENHOUSE MITIGATION PROJECTS UNDER MANAGEMENT 2014</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 reviewed and investigated 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>VAM Enrichment with a Two Stage Adsorption Process C19054</b> CSIRO Jun-Seok Bae Shi Su	468,506	Trevor Stay, AngloAmerican 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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>MINE SITE GREENHOUSE MITIGATION PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Ceramic Block Vent Air Methane Mitigator C19055</b> CSIRO Shi Su	342,696	Alex Neels, Peabody Energy Australia	At present there is no economically viable demonstrated technology for mitigating coal mine ventilation air methane. Depending on mine site specifications, a range of technologies are needed for cost effectively mitigating and utilising diluted mine methane. This project developed 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.
<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 examined a range of mine scenarios to determine the relative uncertainty of periodic versus continuous measurement. The project also looked at the accuracy of existing measurement techniques and devices.
<b>Particulate Matter Characteristics of Mine Ventilation Air For Designing Methane Mitigation Technologies C21063</b> CSIRO Stuart Day	329,500	Trevor Stay, AngloAmerican 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>Catalytic Combustion of VAM - Effect of Changing Composition and Concentration of Gases C21064</b> University of Newcastle Bogdan Diugogorski Eric Kennedy Michael Stockenhuber	756,977	Trevor Stay, AngloAmerican 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>Flame Arresting Mechanisms and Flameproof Device for VAM Mitigation C21065</b> CSIRO Shi Su	359,970	Trevor Stay, AngloAmerican 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.

PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>MINE SITE GREENHOUSE MITIGATION PROJECTS UNDER MANAGEMENT 2014</b>			
<b>Development Of New Generation Carbon Composites For VAM Capture C22041</b> CSIRO Jun-Seok Bae	239,800	Jim Sandford, Glencore	<p>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.</p>
<b>Development of VAM Abatement Technology Assessment Tool C23004</b> University of Newcastle Behdad Moghtaderi	55,689	Jim Sandford, Glencore	<p>This project is developing 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 is assisting to assess the basic performance characteristics of different abatement processes.</p>

## SCHOLARSHIPS

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 2014

Year	No of Projects	ACARP Funding	Total Funding
2014	1	330,000	330,000
2013	-	-	-
2012	1	330,000	330,000

### Projects Under Management 2014

Category	No of Projects	ACARP Funding
Scholarships	6	1,865,000



PROJECT / RESEARCHER	ACARP FUNDING	INDUSTRY MONITORS	OVERVIEW
<b>SCHOLARSHIP APPROVALS 2014</b>			
<b>Bowen Basin Coal Mine Spoil Classification for Improved Mine Rehabilitation Outcomes C24063</b> University of Queensland Bevan Emmerton	330,000	Bernie Kirsch, Centennial Coal Ross Gooley, Sojitz Minerva Mining Pieter Swart, Glencore	Mine spoils and mined landscapes represent a large and ongoing liability to operating coal mines. Achieving liability minimisation concurrent with cost minimisation requires that contiguous areas are identified and that appropriate data is collected at a scale that demonstrates confidence in the quality of the rehabilitated outcomes. This work will further define the characteristics of some challenging Bowen Basin spoil types so that rehabilitation methodologies can be tuned specifically towards identified spoil types which have predictable behavioural characteristics.
<b>SCHOLARSHIP UNDER MANAGEMENT 2014</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 sought to determine the suitability of enhanced gas drainage techniques, utilising nitrogen or nitrogen/CO2 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	Research Committee	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	Open Cut Committee	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>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
<b>SCHOLARSHIP UNDER MANAGEMENT 2014</b>			
<b>Dynamic Analysis of Dense Medium Circuits C22002</b> University of Queensland Nerrida Scott	330,000	Jeremy Byrnes, Glencore	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.
<b>Improved Situation Awareness for Autonomous Equipment using Computer Vision C22047</b> QUT Alex Bewley	330,000	Hans Hayes, AngloAmerican	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.



