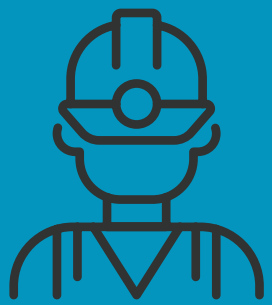
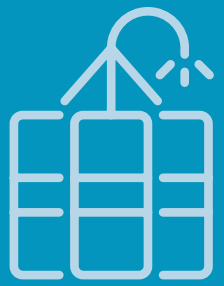
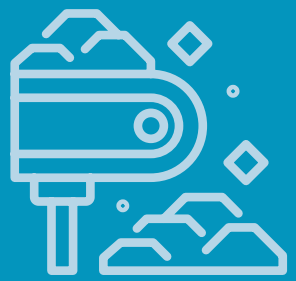
ACARP



2024





Welcome to our 2024 ACARP Report

ACARP remains a highly successful platform for industry collaboration, with reinvigorated engagement from many of the industry bodies and continued engagement from long-term contributors at board, committee, task group, and project monitor levels. This year, we are especially pleased to welcome many new faces to these roles, enhancing our diversity and strengthening our connections with producers and key stakeholders. These additions significantly boost ACARP's capacity and value to the industry.

ACARP continues to deliver critical research for the black coal industry as it marks its 32nd year. Amid a global energy transition, ongoing international conflicts driving a volatile price environment, and persistent skills and labour shortages in Australia, resilient Australian saleable coal production has once again provided the ACARP funding for research meeting industry needs. We continue to lead the development and implementation of best practice sustainable mining.

Our strategy to place greater emphasis on energy transition-related emissions mitigation, measurement and management research continues; while our drive to continue improving workplace safety and efficiency remains, ensuring we stay at the forefront of current and emerging issues.

In 2024, ACARP funded 46 new projects with a total value of $13.95 million, including 13 projects outside the funding cycle, highlighting its responsiveness to industry needs. As of end November, there were 185 projects underway, with a total ACARP funding of $83.1 million. Industry and researcher collaboration, together with in-kind support, multiplies the real value of the research underpinned by ACARP funding, and are important contributors to ACARP's success.

Preparation of the renewal of ACARP for a further five year term accelerated during 2024. We have obtained ongoing support to secure the Memorandum of Understanding (MoU) with the Federal government through to 30 June 2030 and at the time of writing with a great majority of all Australian coal producers. This is a significant achievement for our members, researchers, and the dedicated volunteer base of more than 230 passionate industry professionals, who continue to collaborate and drive success as an industry.

I would like to extend my heartfelt thanks to everyone involved in ACARP for another year of outstanding achievements. ACARP enters 2025 well positioned to continue providing leadership in world-class black coal research across Australia.

Please enjoy the 2024 ACARP Report.

John Grieves
Chairperson, Australian Coal Research Limited Board

ACARP – the Australian black coal industry's research program - is the nation's pre-eminent coal research funding organisation. It was established in 1992 and is fully funded by a levy of 5 cents per tonne of product coal paid by all Australian black coal producers.

ACARP is a collaborative program that utilises the industry's technical competence together with the broader research and science community to develop technologies and solutions to the many challenges facing our industry. This program helps producers to combine their expertise and resources and share the risks and rewards.

The sustainable production of coal remains the primary objective of the program. Major regional issues such as emissions measurement and management ,water resource management, automation and impact of noise and dust on local communities are of major importance, as are safety and productivity.

This publication documents how the ACARP levy contributions have been invested during 2024.

People are the most important aspect of ACARP and are listed in this report falling into 4 categories.

- The Researchers who undertake each project.
- Industry committee and task group members who evaluate and guide each proposal and provide funding recommendations.
- Industry Monitors who provide technical guidance for projects.
- The Board which provides corporate and program governance.

BOARD	• Strategic objectives • Allocation of funds • Corporate governance
RESEARCH COMMITTEE	• Program overview - technical • Definition of strategic projects • Sustainability issues
TECHNICAL COMMITTEES	
Underground Committee	• Definition of priorities • Project selection • Technical oversight • Nomination of Industry Monitors
Open Cut Committee	
Coal Preparation Committee	
Technical Market Support Committee	
Mine Site Greenhouse Gas Mitigation Committee	

Task Groups - Provide technical debate and advice on priorities and proposals to the technical committees

• Environment	• Roadway Development
• Geology	• Rock Mechanics
• Health and Safety	• Strata Control
• Maintenance and Equipment (open cut)	• Ventilation

Industry Monitors - Provide technical guidance and ensure project results are adopted by industry

Vision

To assist the Australian black coal industry develop and adopt world leading sustainable mining practices and, through collaboration, to ensure a sustainable position for the global use of coal.

Mission

Utilise the collective technical competence and resources of the Australian black coal industry to develop and manage a comprehensive research program which, through technological and process innovation, assists coal producers achieve their financial, environmental and social objectives for sustainable development.

To maintain their position as world leaders, Australian coal producers must be profitable, innovative and, at the same time, mindful of their social and environmental obligations. Through ACARP, they combine their expertise and resources to direct and fund world class research that benefits the whole industry.

As a leader in research and development within the coal industry, ACARP has expanded its research capacity, with a primary focus on reducing emissions and minimising the environmental impact of the industry. Today our projects cover a wide range of subjects, from developing and enhancing technology to reduce production costs, to improving safety for mine workers and to measuring our impact on the communities within which we operate.

Key facts:

- Invests approximately $20 million annually in research projects.
- Is fully funded by Australian black coal producers via a levy of five cents per tonne of product coal, currently committed to June 2030.
- Operates under a Memorandum of Understanding between the Commonwealth Government and the Minerals Council of Australia.
- The technical strength and industry focus is provided by the 230 senior technical people who are members of the technical committees, task groups and Industry Monitors.
- ACARP research projects are hosted at many mine sites.
- Has awarded $455.7 million in direct funding to 2,089 projects since ACARP's inception in 1992.

ACRL Board of Directors and Alternates *

DIRECTORS

Glen Corfield	Head of Production	Bravus Mining & Resources
Anthony De Domenico	Vice President Technical Development	Coronado Global Resources
John Desouza	Head of Internal Assurance	Jellinbah Group
Brett Domrow	Mine Planning Manager	New Hope Group
Tony Egan	Manager Project Governance	Glencore Coal Assets Australia
Matthew Fellowes	Executive Director	ACRL
Frank Fulham	Executive General Manager – Technical Support & Projects	Yancoal Australia
John Grieves	Tenements Manager	QCoal Group
Brian Neilsen	Director of Engineering – Open Cut Mining	Peabody Australia
John O'Connell	General Manager - Planning	Batchfire Resources
Andrea Rutley	Head of Technical and Analytics	Anglo American SMC
Robert Simpson	Manager - Integration	Whitehaven Coal
Simon Thomas	General Manager - Dendrobium Mine	GM-3 Illawarra Coal
Sonia Winter	General Manager Planning Technical Environment	BHP Mitsubishi Alliance

ALTERNATE DIRECTORS

Rhiannon Bailey	Manager Technology Delivery	BHP Mitsubishi Alliance
Sharif Burra	Executive General Manager – Health, Safety & Sustainability	Yancoal Australia
Kevin Rowe	Group Manager of CHPP's	Glencore Coal Assets Australia
Scott Weatherall	Manager, Feasibility and Studies	Coronado Global Resources

* Directors and Alternate Directors serving at 31 December 2024.

Research Committee

The Research Committee, together with the Executive Director, is responsible for the overall operation and strategic direction of ACARP research. It takes a whole of industry view, striking a balance between the priorities of the five technical committees, short term operational challenges and longer term strategic issues. The individual technical committees develop detailed research priorities and select projects in their respective areas, addressing critical issues such as safety, licence to operate, cost effective resource utilisation and market support.

Communicating project outcomes is vital. The Research Committee encourages constructive engagement with government and community groups. ACARP also provides high quality technical information to key industry organisations. The technical committees publicise their individual project results through on site demonstrations, focused seminars, conference papers, journal articles, focussed E-Newsletters, and the ACARP website.

Responsibilities

The Australian coal mining industry works to address sustainability issues over the longer term to support mining companies to retain their licence to operate. ACARP has responded by funding the development of new and innovative technologies and practices that will help producers achieve their financial, environmental and social goals.

Research is undertaken that is driving minimised emissions and environmental impact of industry. Each of the technical committees has identified key priority areas of research to support this.

Health and Safety

Health and safety, which reflects the industry's aspiration for a zero harm workplace, remains an important priority for the program.

Community and the Environment

The cumulative effects of coal mining are assuming a greater importance in Australia and a more collaborative approach is needed to assess and understand the complex range of economic, social and environmental impacts of new mine development and the expansion of existing ones. ACARP continues to support research in this important area.

Productivity

ACARP has a strong focus on increasing recoverable coal yield and reducing the cost of production. The coal preparation area continues to invest in research designed to improve plant efficiency and the underground producers are focused on extending automation and roadway development technologies. In open cut operations the productivity focus is on improving equipment performance and reliability.

A portion of the funding is set aside for major projects that the Research Committee and Board deem strategically important for the entire industry.

COMMITTEE MEMBERS

Tony Egan	**Manager, Project Governance (co-chair)**	**Glencore Coal Assets Australia**
John Grieves	**Tenements Manager (co-chair)**	**QCoal Services**
Sam Anderson	Global Head of Corporate Sustainability	Peabody Australia
Sharif Burra	EGM - Health, Safety & Sustainability	Yancoal
Luke Dimech	BMA Principal Process Engineering	BHP
Graeme Harris	Manager Technical Marketing and Logistics	Kestrel Coal Resources
Ben Klaassen	Principal Environment (GHG)	BMA
Andrew Lau	Mine Closure Manager	Yancoal
Lauren North	Principal Sustainability Partnerships	BHP
Paul O'Grady	Group Manager - Technical Services	Glencore Coal Assets Australia
Kevin Rowe	Group Manager	Glencore Coal Assets Australia

Funding for projects is summarised in the following table in categories that demonstrate the diversity of projects supported by the ACARP program.

CURRENT OR COMPLETED DURING YEAR

Category		No of Projects	ACARP Funding
Underground	Coal Burst	6	$2,082,313
	Detection and Prevention of Fires and Explosions	2	$546,200
	Environment - Subsidence and Mine Water	6	$2,480,864
	Health and Safety	13	$5,341,567
	Maintenance and Equipment	7	$4,099,739
	Mining Technology and Production	12	$7,491,306
	Roadway Development	3	$10,393,332
	Strata Control and Windblasts	16	$3,571,805
	Ventilation, Gas Drainage and Monitoring	18	$7,344,835
Open Cut	Drilling and Blasting	4	$1,367,210
	Environment	20	$9,843,269
	Geology	8	$1,356,652
	Health and Safety	2	$396,833
	Maintenance and Equipment	9	$1,993,789
	Mining and the Community	1	$199,472
	Rock Mechanics	7	$2,096,474
Coal Preparation	Dewatering	10	$2,444,984
	Environmental Improvement	4	$2,274,897
	Fine Coal	16	$7,104,686
	General	5	$1,209,629
	Gravity Separation	6	$1,140,494
	Maintenance and Equipment	3	$1,278,397
	Process Control	5	$1,310,483
Technical Market Support	General	4	$1,330,858
	Maritime Regulation	1	$4,169,012
	Metallurgical Coal	31	$4,472,528
	Thermal Coal	2	$804,850
Mine Site Greenhouse Gas Mitigation		9	$4,604,794
Scholarships		6	$1,980,000
Total		**236**	**$94,731,272**

NEW FUNDING

ACARP supports projects with immediate need outside the yearly funding round. These projects are included within this report as new funding.

Category	No of Projects	ACARP Funding	Total Funding
Underground	14	$4,459,887	$6,264,375
Open Cut	11	$2,833,613	$4,209,555
Coal Preparation	6	$1,804,867	$1,999,588
Technical Market Support	10	$1,879,874	$2,451,721
Mine Site Greenhouse Gas Mitigation	3	$2,394,402	$3,007,344
Scholarships	1	$330,000	$330,000
Total	**45**	**$13,702,643**	**$18,262,583**

Total Funding includes in-kind support provided by the researcher and host mine as identified in the research proposal.

The resultant leverage i.e. Total funding ÷ ACARP Funding = 1.33 times meaning that for every $1.00 of ACARP funding research there is $0.33 of in-kind support (note this leverage varies project by project).

ACARP is focused on research aimed at minimising emissions and reducing the environmental impact of the industry. The Underground Committee has identified the following key priority areas to support this goal:

- Minimise scope 1 and 2 emissions.
- Management of seam gas in ventilation and optimising gas drainage systems.
- Extending automation and roadway development technologies.
- Improved understanding of geological conditions to be encountered prior to mining

A significant goal of the underground research program is to achieve zero fatalities while minimising negative effects on the workforce, environment, equipment and the resource. This is reflected in the targeted occupational health and safety program, strengthening ventilation and gas management technology, minimising exposure to coal dust and diesel particulates, minimising risks from fires, explosions and coal bursts, advancing emergency response technologies and addressing workplace health risks.

The program's research assists producers to adopt new and innovative technologies that reduce operating costs, along with improved exploration methods and better management of the risks associated with ground control. The industry is also determined to improve roadway driveage rates.

The environmental impacts of mining are assuming a greater importance and must be managed to the satisfaction of the community. Complementary priorities include development of intrinsically safe electrical vehicles to facilitate the reduction of diesel particulates in the underground work environment. ACARP recognises the importance of continuous improvement in this area to ensure the industry maintains broad community support.

COMMITTEE MEMBERS

Sharif Burra	**EGM - Health, Safety & Sustainability (co-chair)**	**Yancoal**
Paul O'Grady	**Group Manager - Technical Services (co-chair)**	**Glencore Coal Assets Australia**
Michael Barker	Senior Project Manager	Whitehaven Coal
Dennis Black	Manager Technical Services	GM3
Peter Corbett	General Manager Technical	Centennial Coal
Bob Coutts	Superintendent Geology & Geotechnical	BHP Coal
Ryan Davidson	Mining Engineering Manager	Yancoal
Frank Fulham	Executive General Manager - Technical Support & Projects	Yancoal
Ravindu Goonawardene	Geotechnical Manager (Open Cut & Underground)	Anglo American Steelmaking Coal
John Grieves	Tenements Manager	QCoal Services
Raymond Howard	Chief Mining Engineer	Yancoal
Brad Lucke	Operations Manager	Plumpton Group
Jimmy Martin	Superintendent Production Engineering - Broadmeadow	BHP
Graham Morris	Technical Services Principal	Anglo American Steelmaking Coal
Van Oppel	Manager Mine Planning	BHP
Peter Quinn	Mining Engineering Manager	GM3
Patrycja Sheffield	Group Manager Mining Engineering & Business Development	Centennial Coal
Matt Tsang	Geotechnical Manager – OC & Projects	Anglo American Steelmaking Coal
Matt Wang	Mechanical Engineering Manager	Yancoal
Steve Winter	Technical Services Manager	Kestrel Coal Resources
Dave Young	General Manager Engineering & Operational Support Service	Centennial Coal

PROJECTS UNDER MANAGEMENT

Category	No of Projects	ACARP Funding
Coal Burst	6	$2,082,313
Detection and Prevention of Fires and Explosions	2	$546,200
Environment - Subsidence and Mine Water	6	$2,480,864
Health and Safety	13	$5,341,567
Maintenance and Equipment	7	$4,099,739
Mining Technology and Production	12	$7,491,306
Roadway Development	3	$10,393,332
Strata Control and Windblasts	16	$3,571,805
Ventilation, Gas Drainage and Monitoring	18	$7,344,835

NEW FUNDING

ACARP supports projects with immediate need outside the yearly funding round. These projects are included within this report as new funding.

No of Projects	ACARP Funding	Total Funding
14	$4,459,887	$6,264,375

Total Funding includes in-kind support provided by the researcher and host mine identified in the research proposal.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Coal Burst			
Current	**Management of Coal Bursts and Pillar Burst in Deep Mines C27020** Murat Karakus, University of Adelaide $380,240	Coal Burst Task Group	Coal bursts (coal bumps) are sudden, violent ejections of coal or rock into the mine workings. They occur without warning and are a significant hazard for people working in deep underground coal mines. This project is developing coal burst mitigation methods. Using continuum mechanics principles, a new damage model is being developed for coal and pillar bursts in deep mines under high stress. This research will enable mine personnel to model and predict damage from coal bursts.
Current	**Microfracture Analysis as a Trigger for Coal Bursts C28012** Yvette Heritage, SCT Operations $498,000	Coal Burst Task Group	Gas related coal bursts can be generated in coal with an elevated pore space or an increased frequency of micro fractures. The ability to analyse the geometry of micro fracture fabrics is challenging and not feasible using optical methods. This extension project will use high resolution digital imaging to form the basis for micro fracture analysis.
Complete	**Innovative Coal Burst System to Investigate the Influence of Confinement Loss and Pre-Conditioning on Coal Burst Mechanism C29007** Murat Karakus, University of Adelaide $329,000	Coal Burst Task Group	This project investigated coal burst due to loss of confinement by using hollow cylinder loading/unloading systems which will enable replication of the excavation process. This approach provides reliable, cost effective data for direct use in mine design and geotechnical monitoring. The project developed laboratory apparatus for realistic coal burst tests to examine the mechanism; investigated and quantified the influence of confinement loss on coal burst and developed a stress relief method based on induced damage to reduce the risk of coal burst.
Current	**In-situ Stress Measurements using Cored Coal/Rocks for Coal Burst Management C29010** Murat Karakus, University of Adelaide $228,600	Coal Burst Task Group	It is challenging to measure in situ stress in areas at great depth when access is only available via exploration boreholes. It is also challenging to access the areas above longwall face where a high-stress concentration is expected. Knowing in situ stress magnitudes and their orientations are critical in managing coal burst. This project aims to develop a new method based on deformation rate analysis and acoustic energy to calculate the magnitude and principal directions of in situ stresses from cored rocks.
Current	**Coal Burst Research Findings C33014** Yvette Heritage, SCT Operations $388,000	Coal Burst Task Group	Risk assessment and management of dynamic burst events are hampered by the inability to apply threshold characteristics from one seam to another as the threshold values are dictated by local geological characteristics. This project aims to examine the threshold energy requirement for a range of 'generic' mined seams, provide guidance on the factors that should be considered in risk analyses, and estimate the threshold values associated with dynamic bursts. The energy threshold values will be converted into stress, gas pressure and seismic magnitude, which are more readily applied to mining practice.
Current	**Investigation of Pre-Installation of Optic Fibre Cable in Exploration Holes for Longwall Weighting and Coal Burst Monitoring C35014** Joey Duan, CSIRO $258,473	Marc Henderson and Tim Dean, Anglo American Steelmaking Coal	Distributed optic fibre sensing (DOFS) has been proven to be more effective than geophones for microseismic monitoring of ground conditions. This project will develop a novel optic fibre installation approach for assessing longwall weighting progress and coal burst risks using multiple geo-exploration holes for DOFS microseismic monitoring. This new method will enable mine operators to obtain fracturing event locations with high reliability and spatial resolution in a more cost effective manner compared with using geophones.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Detection and Prevention of Fires and Explosions			
Current	**Use of Compressed Air Foams (CAFs) to Alter Goaf Air Circuits and Mitigate Spontaneous Combustion Events C28013** Alaster Wylie, Mines Rescue $392,500	David Webb, Glencore Coal Assets Australia Martin Mackinnon, Whitehaven Coal Owen Salisbury Paul Wild, Anglo American Steelmaking Coal Peter Baker, BHP Sharif Burra, Yancoal	Spontaneous combustion in the goafs of longwall mines is a serious hazard. Compressed air foam has been used in Turkey, the Czech Republic and China to bring spontaneous combustion under control. This technology, which is inexpensive and simple to use, has not be tested nor deployed under Australian conditions. In this project, a full system ready for deployment will be procured, deployed in at least one Australian underground longwall panel, and the cost and effectiveness of this technique evaluated. If the trial is successful, the system will be retained by New South Wales Mines Rescue and maintained similarly to the MineShield.
Current	**Investigation into the Thermal Ignition Caused by IS Power Supplies C29026** Gareth Kennedy, Simtars $153,700	Brad Lucke, Plumpton Group Jarod Chadwick, Glencore Coal Assets Australia	It is difficult to comply with intrinsically safe standards when cabling is installed on mining machines in confined areas and is subjected to a regular build-up of dust and other flammable materials. This project aims to determine the fault conditions arising in an intrinsically safe electrical circuit that could ignite combustible material on a mining machine. Researchers will examine the role and extent that combustible material accumulation can cause or contribute to the risk of equipment fires when ignited by intrinsically safe power supplies, and the parameters to be considered in installing an intrinsically safe circuit in an area where there could be an accumulation of flammable materials.
Environment - Subsidence and Mine Water			
Current	**Monitoring Hydrological Status of Complex Upland Heath Communities Using Canopy Conductance and Thermal Imaging C28004** Andrew Fletcher, Queensland University of Technology $230,964	Gary Brassington, GM-3 Peter Corbett, Centennial Coal	Regulators are concerned about the loss of listed communities in complex shrub swamp systems due to modified hydrology. Existing technology can detect dramatic changes in vegetation health, however new methods are needed to detect subtle, long term spatial and temporal changes to moisture patterns. This project aims to identify remote sensible signals for plant stress in these communities. Researchers will use calibrated thermal imaging on board small unmanned aerial service platforms to assess canopy water use through the day. Foliage is usually cooler than the ambient air temperature when soil water is readily available, so higher temperatures indicate change in moisture patterns.
Complete	**Inclusion of High Interest Native Plants in Mine Site Restoration Programs: Propagation, Translocation and Field Reintroduction C28028** Cathy Offord, Royal Botanic Gardens and Domains Trust Sydney $444,055	Gary Brassington, GM-3 Peter Corbett, Centennial Coal	The Australian Persoonia genus of shrubs and small trees has a high ecological importance. Nine species are listed as 'at significant risk' in New South Wales due to population decline. Seven of these species are recorded within mining leases; however, they have not been included in mine site restoration plans due to a lack of success in germination, propagation and translocation of plants on a horticultural scale. This project sought to improve the conservation capacity of this genus by conducting experimental plantings on a mining lease. The project enables the first field introductions of Persoonia hindii to be undertaken.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Complete	**Southern Coalfields Coal Washery Reject (CWR) Characterisation and Classification, including Management Strategies for Applications in Civil Engineering C29016** Christopher Meikle, SLR Consulting Australia $160,000	Gary Brassington, GM-3	Despite decades of successful use in civil engineering projects, the utilisation of coal washery rejects has not been embraced by legislators, regulators, government agencies and other project stakeholders. A key constraint is the lack of contemporary reference resources that address modern environmental and geotechnical performance criteria. The project delivered a peer reviewed research paper that addresses these issues. The paper can be used as an industry standard document for reference by mine suppliers, developers, contractors and regulators when using coal washery rejects in civil engineering applications.
Current	**Pilot Scale Membrane Distillation Crystalliser (MDC) with Renewable Heat Source for Mine Water Brine Management C33021** Ramesh Thiruvenkatachari, CSIRO $969,195	Paul O'Grady, Glencore Coal Assets Australia Tim Kendrick, Anglo American Steelmaking Coal	Acid mine water and highly saline reverse osmosis brines can be treated by low thermal based membrane distillation process coupled with a crystalliser (MDC) process. This process concentrates challenging mine waters to saturation levels and reduces their volume, with simultaneous recovery of reusable quality water. This project aims to undertake a mine site demonstration of the MDC system at Glencore Collinsville mine. Saline and acid mine drainage and mine impacted water will be treated under mine site conditions.
Complete	**Fire Resilience of Temperate Highland Peat Swamps on Sandstone C33028** Mandana Shaygan, University of Queensland $279,450	Gary Brassington, GM-3 Peter Corbett, Centennial Coal	Temperate highland peat swamps on sandstone are listed as endangered ecological communities and there are concerns regarding their vulnerability to the impacts of underground coal mining. This project assessed the resilience of these to fire and how resilience varies between mine impacted swamps and non-impacted swamps.
Current	**Rehabilitation Options for Ponded Areas Due to Longwall Coal Mining C35016** Louisa Rochford, University of Queensland $397,200	Callum Gawne, Whitehaven Coal Jason Fittler, Anglo American Steelmaking Coal Michael Moore, Yancoal Ned Stephenson, Glencore Coal Assets Australia	Little research has been undertaken into the most appropriate options for rehabilitating land subsided by longwall mining in Australia. This project will investigate the implications of retaining ponded areas from longwall mining, including their contribution to environmental values. Researchers will analyse the impacts on site topography and drainage, surface hydrology, geomorphology, soil hydrology, water quality and geochemistry, fauna and flora.
Health and Safety			
Current	**Proximity Detection Systems Specification for Underground Coal Mining Machines C24010** Gareth Kennedy, Simtars $565,988	Brad Lucke, Plumpton Group	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.
Complete	**Mine Rescue Vehicle Radar Sensing Integration C27049** Lance Munday, CSIRO $254,405	Brad Lucke, Plumpton Group	Reliable situational awareness in low visibility conditions underground remains an important issue for the coal industry. A robust, relatively low cost sensor is needed that is unaffected by high ambient dust, smoke or water vapour conditions. The major finding of the project was that a single forward looking radar sensor was insufficient for navigating the mine when the operator's vision was completely blocked. The combination of a suitable optical sensor, coupled with more extensive radar coverage is required to provide the operator with sufficient spatial information.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Personal Real Time Dust/Particulate Monitor (Direct Mass Based Measurement) C28029** Peter Phaedonos, Lear Siegler Australasia $1,521,730	Ian Marshall, BHP Brad Lucke, Plumpton Group Glenn Owens, Detekd	The effects of exposure to respirable coal dust in large and sustained doses leads to health effects, such as coal workers pneumoconiosis. The personal dust monitor (PDM), a device worn to measure the quantity of hazardous airborne particulates, logs and records exposure levels and provides warnings to the user if dangerous levels are reached. The original device, which uses tapered element oscillating microbalance technology, was the result of a collaboration between NIOSH, MSHA and the US mining industry. The objective of this project is to use the existing technology to develop a PDM that is suitable for use in Australian underground coal mines. The PDM will be portable, ergonomic, rugged and rated for use in explosive environments. This additional support will enable SIMTARS to complete intrinsically safe certification of a personal dust monitor (PDM). The PDM is portable, ergonomic, rugged and rated for use in explosive environments of Australian coal mines.
Current	**Silica Analysis of Dust on PDM filters: Phase 2 Optimisation and Field Demonstration of the Developed Methodology C33001** Yonggang Jin, CSIRO $516,700	Andrew Lau and Sharif Burra, Yancoal Kevin Rowe, Glencore Coal Assets Australia	A novel solvent back flush method was developed in a previous stage of this project to monitor personal exposure levels of respirable coal dust and crystalline silica (RCS). It is a simple and rapid process. In this second phase of the project, researchers will optimise the methodology via laboratory testing then conduct onsite analysis of RCS at the end of shift.
Complete	**Breathing Zone Exposure Quantification and Respirators Performance – Review of Exposure Control Strategies C33006** Rao Balusu, CSIRO $329,450	Andrew Lau and Sharif Burra, Yancoal Kevin Rowe and Tony Egan, Glencore Coal Assets Australia	The main objective of this project was to investigate the spatial variability of dust exposure levels in the breathing zone and to evaluate the effectiveness of respirators, such as various types of powered air purifying respirators, on personal dust exposure levels in underground coal mines.
Current	**Respirable Dust Reference Testing Method and Dust Chamber Facility C33012** Gareth Kennedy, Simtars $215,950	Andrew Lau and Sharif Burra, Yancoal Kevin Rowe and Tony Egan, Glencore Coal Assets Australia	Concerns about the accuracy and ability of respirable dust measurement devices used in Australian coal mines to comply with AS2985 highlight the need for a testing facility in Australia. In collaboration with NIOSH, Simtars is building a respirable dust chamber equivalent to facilities in the USA and UK. The chamber will be an important verification and reference tool for regulators, original equipment manufacturers and other researchers. The aim of this project is to establish the methodology for the respirable dust chamber as a reference tool for cyclones and devices used in the coal mining industry.
Complete	**New PDM filter for Direct-on-Filter Silica Analysis of Coal Mine Dust C33069** Yonggang Jin, CSIRO $298,240	Andrew Lau and Sharif Burra, Yancoal Kevin Rowe and Tony Egan, Glencore Coal Assets Australia	With analysis always undertaken offsite, it can take up to two weeks to receive the monitoring results from mine worker exposure levels of respirable coal dust and crystalline silica. This project developed novel type of filter for use in personal dust monitoring units to enable real time respirable dust monitoring throughout the sampling shift and silica content measurement at the end of the sampling shift using one dust sampling unit.
Current	**Resilience and Mental Health in Mining Pilot Program C34006** Rebecca Mitchell, Macquarie University $476,099	Sharif Burra, Yancoal	Mining has unique factors that contribute to mine employee stress and resilience. A pilot workplace resilience intervention program that supports and strengthens mine employee psychological resilience and mental health will be developed, implemented and evaluated. Based on the pilot evaluation, researchers will provide guidance on the requirements and design features of an effective and scalable resilience intervention program that is specifically tailored to the Australian coal mining industry.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Evaluating Toxicity of Different Types of Respirable Crystalline Silica Particles to Lung Cells and Tissues C34007** Gordon Xu, University of Queensland $207,950	Andrew Lau and Sharif Burra, Yancoal Kevin Rowe and Tony Egan, Glencore Coal Assets Australia	Silica dust is one of the world's most significant causes of occupational diseases, including the lung disease silicosis. Coal mine workers are exposed to different types of respirable crystalline silica (RCS) dusts related to where they work and what tasks they undertake. This project aims to evaluate the toxicity of three typical RCS particles, i.e. freshly generated, hydrated and aged, on lung cells, and understand their levels of acute risk to lung tissues in the mouse model.
Current	**Advanced Breathing Apparatus with Gas Membrane Modules C34023** Victor Chang, Monash University $298,436	Ken Singer, BMA Lee Earnshaw, Peabody Australia Coal Paul Wild, Anglo American Steelmaking Coal	The self contained self rescuer (SCSR) is an essential supporting device for underground employees encountering adverse conditions. In a previous project, researchers developed a lightweight membrane that is able to separate oxygen and carbon dioxide, which enables carbon dioxide to be removed from the closed loop breathing system. This means that no exothermic heat is released and that the device can be smaller and lighter than existing SCSRs. This project will further develop the membrane technology with the aim of integrating it into an existing SCSR design.
Complete	**Is Exposure to Illite Dust Linked to Pneumoconiosis? C35017** Graeme Zosky, University of Tasmania Basil Beamish, B3 Mining Services $302,428	Andrew Lau, Sharif Burra and Frank Fulham, Yancoal Brad Lucke, Plumpton Group Kevin Rowe, Glencore Coal Assets Australia Shane Apps, Peabody Australia Coal	Coal worker's pneumoconiosis is an irreversible lung disease associated with inhalation of coal dust. Recent epidemiological disease patterns suggest that the chemical properties of coal dust can influence disease risk. However, no studies have identified which chemical component(s) of the coal dusts might be driving this geographical variation in disease risk. This project determined whether the illite content of coal is directly correlated with the detrimental lung cell response by conducting a systematic review of the potassium alumino-silicates and pneumoconiosis literature.
Current	**Advanced Lung Function Assessments for Diagnosis of Coal Mine Dust Lung Disease (CMDLD): The Next Step Towards a Better Health Surveillance Program C36006** Katrina Kildey, I-MED Radiology Network $186,832	Andrew Lau, Yancoal Kevin Rowe, Glencore Coal Assets Australia Shane Apps, Peabody Australia Coal Sharif Burra, Yancoal	This study will investigate whether a new advanced lung function test - Lung Ventilation Analysis Software (LVAS) - can improve the diagnosis of Coal Mine Dust Lung Disease (CMDLD), compared to the current mainstay test of spirometry. Previous projects showed most individuals subsequently diagnosed with CMDLD had no lung function impairments on their spirometry and that spirometry incorrectly identified lung function abnormalities in otherwise healthy individuals. LVAS could enable the earlier detection of lung diseases and reduce the need for additional tests. If confirmed by this project, introduction of LVAS testing could lead to a more effective health surveillance program for CMDLD and minimise harm to affected individuals.
Current	**Hydraulic Fluid Safe Distance pH Detection C36009** Rema Oliver, Prince of Wales Hospital $167,359	Andrew Esdaile and Clint Maynard, Glencore Coal Assets Australia Trevor Hartley, Centennial Coal	Hydraulic equipment has long been known to be an occupational risk, as high pressure injections can cause devastating injuries to the human body. While previous research focused on detecting the presence and extent of injury, little is understood about the effective 'at risk' distance of escaping fluids that have the capacity to inject human tissue. Risk mitigation controls implemented in the mining industry have not eliminated exposure to sustained flow from escaping fluids. This follow-on project will provide essential information on the interaction, detection and treatment of hydraulic injections and assist in providing quality care for personnel who interact with hydraulic equipment and reduce injury recovery time by one to five months. The project will also look at potential elimination of these hazards.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
New	**Role of Particle Surface Characteristics in CWP Risk C37009** Graeme Zosky, University of Tasmania $413,709	Brad Lucke, Plumpton Group Frank Fulham, Yancoal Kevin Rowe, Glencore Coal Assets Australia Shane Apps, Peabody Australia Coal	Coal worker's pneumoconiosis (CWP) is an irreversible lung disease associated with inhalation of coal dust. This project builds on previous ACARP-funded work that suggests that mitochondrial dysfunction is likely to be the central mechanism regulating cell injury in response to coal dusts. We will explore this further to investigate the link between coal dust chemistry and the development of CWP. This work will help industry to prioritise risk mitigation and identify biomarkers of exposure and potential treatments for workers.
Maintenance and Equipment			
Complete	**Photocatalytic Destruction of Diesel Particulate Matter C25063** Yonggang Jin, CSIRO $527,192	Dave Young and Trevor Hartley, Centennial Coal	The particulate matter emission generated in diesel engines – diesel particulate matter (DPM) – has been classified as a Group 1 human carcinogen by the World Health Organisation. DPM control in underground coal mines has been an ongoing problem for many years. Controlling tailpipe emissions is a reliable and effective way to reduce the exposure of mine workers to DPM by controlling its input into the mine environment. Compared with the common passive filter approach, deployment of photocatalytic destruction is a more active and direct way to mitigate DPM emissions. This project will explore and develop a novel approach for better control of tailpipe DPM emissions by photocatalytic oxidation of DPM under ultraviolet irradiation into carbon dioxide.
Current	**Towards Better, Safer Mines - Optical Technologies for Software Defined Instrumentation C28010** Francois Ladouceur, University of New South Wales $704,974	Ben McCamley, BHP Brad Lucke, Plumpton Group Dave Young, Centennial Coal Jonathan Harris, Glencore Coal Assets Australia	Connecting field instruments in harsh environments, such as underground coal mines, using intrinsically safe technology is challenging. The aim of this project is to design, build and characterise an industrial optical telemetry system based on an optical network of passive analogue sensors connected to a programmable logic controller (PLC). This will be achieved by exploiting the unique properties of liquid crystal-based optical transducers and a purposely designed PLC module. Benefits include a dramatic increase in data throughput due to multiplexing in the optical domain and elimination of potential cyber-attacks by centralising the digital interface of all sensors.
Complete	**Control of Touch Potential Transients During Switching C29009** Peter Stepien, ResTech $114,000	Barrie Alley, Centennial Coal	To ensure safe operation of electrical equipment, installations must comply with state and national regulations and follow best practice as set out in Australian Standards. However, the standard does not provide guidance on the touch potential transient. The objective of this project was to investigate transient touch potentials during switching and identify methods to reduce them to a safe level under all conditions.
Current	**Ceramic Wall Flow Filter Commercialisation C33009** Bradley Drury, PPK Mining Equipment $888,778	Andrew Esdaile, Glencore Coal Assets Australia Steve Coffee, GM-3 Trevor Hartley, Centennial Coal	The purpose of this project is to develop a commercially available improved diesel particulate filter (DPF) for widespread use in underground coal mines. Project C26070, undertaken by Orbital, demonstrated that a ceramic wall flow filter can effectively filter diesel particulate matter (DPM) emissions. This project will allow filter design refinements for retro fitting, testing against regulatory requirements and finally approval for commercial use.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Specialised Instrumentation and Data Processing for Real Time FEA Condition Monitoring of AFC Chain C33017** Ryan Norris, Vayeron $185,000	Brad Lucke, Plumpton Group Jarrod Sampson, Glencore Coal Assets Australia	Armoured face conveyor (AFC) chain failure causes serious production delays and associated costs for longwall operators, accounting for up to 27% of longwall failures. This project will develop a closed loop quasi real time prototype AFC chain link to model real time stress and strain monitoring.
Current	**Prototype Battery Electric Load Haul Dump C33026** Lewis Grainger, 3ME Technology $1,431,295	Brad Lucke, Plumpton Group Dave Young, Centennial Coal Sharif Burra, Yancoal	The focus of this project is to develop and provide evidence that battery technology will support heavier platforms and can operate in the demanding underground environment without impacting production activities. The project will also prove the LHD retrofit model which aims to convert existing diesel powered platforms to battery power.
Current	**Ex.P Enclosure Designs C35013** Peter Reid, CSIRO $248,500	Brad Lucke, Plumpton Group Colin Hoyle, Glencore Coal Assets Australia Dave Young, Centennial Coal	Flameproof enclosures enable the use of electrical equipment in coal mining operations where there is risk of exposure to explosive atmospheres. However, existing enclosures are not suitable for all contexts. This project will develop a system that employs pressurisation of the enclosure in conjunction with facility to de-energise enclosure equipment if the pressure is compromised. The resulting design/s will represent a new approach to quickly designing and manufacturing enclosures for use in zone 1 environments.
Mining Technology and Production			
Current	**Development of a Safer Underground Explosive C20033** Duncan Chalmers, University of New South Wales $468,000	Brad Elvy, Brad Elvy Mining Services Paul Wild, Anglo American Steelmaking Coal Rob Nowell, Longwall Solutions Russell Thomas, GM-3	Underground mines resort to the use of explosives to break extremely hard materials that intrude into coal seams. Since there is no longer P5 explosive available for delay firing, mines resort to using type 1 explosive. Confusion arises as to how these explosives can be safely used. Currently permitted explosives are being used outside the recommended guidelines as published by the Buxton Testing Authority in the UK. In order that they can be used safely, mines are conducting risk assessments to manage the incendive hazard that possibly could be created by a cut off shot and additionally managing the deflagration hazard with the same risk assessment when using P1 explosives. This project developed an alternate test regime that adequately assesses the deflagration risk of an explosive. The information gained from this testing provides additional data to change the testing regime for permitted explosives.
Current	**Longwall Floor Horizon Sensing C28018** Andrew Strange, CSIRO $269,680	Jarod Chadwick, Glencore Coal Assets Australia	Effective longwall horizon control is essential for safety and productivity in underground coal mines. The key to achieving this outcome is a reliable means of actively sensing the geological strata. A prototype radar sensing system was demonstrated in a previous project but it is not yet ready for installation on a production longwall. Mines still rely on manual monitoring to infer seam geology, which limits the potential to introduce fully automated longwall mining. This project will extend the outcomes of the previous project to deliver a reliable coal floor thickness sensor that is ready for sustained use in an automatic longwall horizon control system. The physically compact system will be encased in an approved dielectric flameproof enclosure.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Alternative Flameproof Enclosure Protection Techniques C29033** Peter Reid, CSIRO $272,000	Brad Lucke, Plumpton Group Colin Hoyle, Glencore Coal Assets Australia	Flameproof enclosures enable the use of electrical equipment in coal mines where an explosive atmosphere may be present, but they are not sufficient in circumstances which exceed the specified ratings. Researchers will develop a module capable of sensing the internal pressure of the enclosure, using redundant sensing techniques, and ensure the intrinsically-safe power supply is disconnected from the payload in the event of pressure loss. Researchers will investigate ways to pressurise the enclosure, re-pressurise it after inspection, and maintain a minimum pressure. The prototypes will represent a new approach to achieving enclosure certification in zones 1 and 2 and will be able to be deployed on an operating longwall face.
Complete	**Intrinsically Safe RFID Sensors for Underground Coal Mining C29037** Lance Munday, CSIRO $136,050	Brad Lucke, Plumpton Group	Higher levels of automation of underground mining require more sensing capability to improve longwall control, machine localisation, roof bolting, personnel tracking and asset management. New sensor systems have had slow uptake due to installation difficulties and regulation requirements for flameproof enclosures. This project aimed to deliver a suite of IS radio frequency identification (RFID) tags to enable sensor measurement on an underground longwall and/or other mining equipment with minimal effort and cost. The project did not achieve its objectives as the current limitations of UHF RFID technology made it unsuitable for the intended application.
Current New	**Self-Drilling Bolt Automation: Finalisation of Development C34003** Mark Levey, OKA Rock Bolt Technologies $2,357,744 Current $210,000 New	Roadway Development Task Group	This project focusses on adapting new technology to current mining equipment to allow semi-automation of roof bolting. Pending the success of the current project of semi-automating a self-drill rock bolt, this stage's objective is to remove remaining barriers for end users of the technology. It aligns with ACARP's goals of improved safety, productivity and efficiency in the development of underground roadways.
Current New	**Assistive Shuttle Car: Development of an Industry Ready Guidance System C34015** Andrew Strange, CSIRO $205,395 Current $245,678 New	Roadway Development Task Group	This stage of this project will draw on the outcomes of previous stages to provide shuttle car operators with machine guidance information to achieve greater consistency and safety. Shuttle cars transfer coal from the working face to the conveyor, which is highly repetitive and entirely manual, affecting development performance and health and safety of operators. A new assistive guidance system will deliver safe and consistent steering recommendations to the operator through an in-cab display. This system will help accelerate further introduction of remote and automated roadway capability.
Complete	**Longwall Bretby Cable Handling Monitoring with Fibre Optics C34019** Karsten Hoehn, CSIRO $210,360	Nick Belton, Yancoal	Longwall shearer cables and hoses are contained within a flexible housing called a 'Bretby'. Rock and coal regularly fall into the cable tray, blocking the passage of the Bretby, which creates a potential hazard for nearby operators. This project aims to develop, test and evaluate a Bretby monitoring system that can automatically detect major failures of the cable handling system. Researchers will determine how early this detection can be made in practice and assess the feasibility of using fibre optic-based acoustic and vibration sensing to detect operational anomalies.
Current	**Effects of Rock Weathering on Life-of-mine Roadway Stability C34024** Zhongwei Chen, University of Queensland $312,534	Brian Vorster, Glencore Coal Assets Australia Matt Tsang, Anglo American Steelmaking Coal	Understanding and predicting the nature and impact of time-dependent weathering on roadway stability is a significant technical challenge in underground coal mines. A more effective and sophisticated method of quantifying rock degradation over time is required. This project aims to develop a rock weathering testing methodology appropriate for the underground coal mining environment. Researchers will identify dominant weathering mechanisms, determine the quantitative correlations of a suite of rock weathering assessment parameters and provide a reference table for users to apply a de-rating to roof support design. They will then develop a detailed procedure for implementing the weathering effect into numerical modelling software and conduct a sensitivity study to illustrate the timeframe required for roof re-support.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current New	**Advancing Remote and Automated Capability for Longwall and Roadway Development C35004** Andrew Strange, CSIRO $2,517,000 Current $1,000,000 New	Roadway Development Task Group	This stage of this project will address challenges in delivering the next generation of advanced remote, automated, and integrated mining systems to achieve safer, cleaner, and more efficient underground mining. The project aims to advance remote underground mining operation capabilities by targeting specific technology developments in areas of high strategic need and opportunity for industry. This will be done by utilising the flexible industry directed project model; focussed research and development to provide solutions to industry challenges and controlled evaluations of technology developments.
Current	**Longwall Remote Operations – Face Mapping Robot – Phase 1 C35009** Luke Dyer, Quantum Engineering and Consulting Group $170,000	Duane Witkowski and Jarod Chadwick, Glencore Coal Assets Australia	Underground mines are transitioning from on-face to off-face longwall operations. While many advancements in technology have been made, there are significant deployment and execution issues. In the first phase of this project, researchers will design, build and perform on-face tests with a manually propelled prototype robot. The aim is to determine whether the data captured is suitable for the various automation systems currently in use. The robot will contain inertial navigation hardware, forward (coal face), rear-facing (goaf), and traverse (walkway) cameras and laser scanners.
Current	**Planar Reflecting Radio Antenna (PRRA) for Underground Coal Mines C36013** Dane Zielinski-Nicolson, Roobuck $360,000	Dave Young, Centennial Coal Jarod Chadwick and Jonathan Harris, Glencore Coal Assets Australia	This project seeks to improve wireless network coverage for underground coal mines without the need for additional networks or power infrastructure by developing a multiband radio reflecting antenna. This highly cost effective and scalable solution for underground coal mines will accelerate the digital transformation of the mining industry and enable improved safety, remote asset tracking/optimisation, diagnostics and maintenance, coal resource management, emission and groundwater level monitoring and better production management. The project will develop this technology and prototypes through new hardware, achieving deployment in a real coal mining environment with high reliability, easy installation, and minimal maintenance.
Current	**Roof Support Location using Wireless Ranging C36014** Matt van de Werken, CSIRO $212,543	Tom Hudson, Moolarben Coal Operations Brad Elvy, Brad Elvy Mining Services	One of the problems associated with automation in longwall mining is when roof supports are left behind. If a roof support doesn't progress, the hydraulic, water and electrical lines between it and its neighbours can be stretched, sometimes to the point of failure, causing significant downtime. The roof support automation system has several mechanisms to detect this issue, however failure of the drive mechanism also often coincides with a failure of the detection system. This project will develop a prototype system for real-time tracking of roof support location in an underground coal mine to detect when a roof support has been left behind. This system could also be used to sense the gate end alignment.
Roadway Development			
Current	**Underground Coal Mine Gateroad Development Continuous Haulage System C27076** Mick Whelan, Premron CHS $9,773,528	Roadway Development Task Group	Premron's Continuous Haulage System (CHS) utilises the Premron "Enclosed Belt System", which has been proven in above ground installations worldwide and now proven in prototype testing over the last 4-5 years at Premron's Gladstone facility. The overall goal is to improve gateroad development in an underground coal mine application, by way of significant improvements in safety, productivity, performance and acceptance of this new technology. This system will be used to remove coal from the face and transport the coal to the panel conveyor, hence removing the requirement for shuttle cars and providing the Australian coal industry with a safe and continuous coal haulage method. The aim of this project is to take the full mine compliant Premron CHS (CHS - 180m system) and trial it in a gateroad development panel within an Australian coal mine for a period of 3 to 6 months. This will prove its performance, mine integration and to demonstrate any potential improvements within a gateroad development process.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Light Weight Composite Conveyor Support Structures C33013** Ganga Prusty, University of New South Wales $499,804	Roadway Development Task Group	Steel underground mining conveyor systems are very heavy and pose manual handling challenges for workers. Fibre reinforced composites have a higher strength-to-weight ratio and fatigue strength than steel and are also corrosion-free. A prototype light weight, composite conveyor support structure that meets underground coal mine requirements will be designed and manufactured to improve underground conveyor installation.
Current	**Floor Horizon Control for Roadway Development C33020** Andrew Strange, CSIRO $120,000	Roadway Development Task Group	Effective horizon control is essential for safety and productivity in roadway development in underground mines. Existing horizon control methods rely on sparse borehole data or seismic surveys used in conjunction with visual tracking of geological features behind the miner. A floor coal/stone thickness sensor that can be deployed on a continuous miner is needed. This project will test the enclosure and associated cables on the miner. It will also include test the closed loop system.
Strata Control and Windblasts			
Complete	**Prevention Techniques for Stress Corrosion Cracking Failures of Rock and Cable Bolts C28011** Serkan Saydam, University of New South Wales $298,380	Lesley Munsamy, Anglo American Steelmaking Coal Patrycja Sheffield and Peter Corbett, Centennial Coal	Over the past two decades, the frequency of cable bolt failure due to stress corrosion cracking (SCC) in Australian underground mines has increased. Similar failures have been reported globally. In this project, interdisciplinary research was conducted into the development of prevention techniques, such as antimicrobial coating, for SCC failure of rock and cable bolts.
Current	**Optimising the Cablebolt Pre-Tensioning Practice to Control Roadway Roof Failure Using Advanced Combined Axial and Shear Testing Facility C28020** Hossein Masoumi, Monash University $165,000	Brian Vorster, Glencore Coal Assets Australia Patrycja Sheffield and Peter Corbett, Centennial Coal	There are conflicting views on the cause of shear failure of cable bolts under high shear displacement and an absence of guidance on how to determine the optimum pre tensioning level. In this project an extensive field and laboratory study, combined with analytical and numerical modelling, will be undertaken. Results from this research and earlier studies will then be used for extrapolation to field conditions and a guideline developed for the field application.
Current	**Definition and Quantification of Long Term Stability of Coal Pillar Systems C29014** Ismet Canbulat, University of New South Wales $230,000	Peter Corbett, Centennial Coal Russell Thomas, GM-3	There is an increasing emphasis on ensuring that underground pillars are stable and do not cause subsidence. This project aims to define and quantify the long-term stability of coal pillar systems. Using the three pillar system failure modes: (1) pillar failures due to pillar spalling (i.e. reduced pillar width), (2) pillar failures due to continuous roof failures (i.e. increasing mining heights), and (3) pillar failures due to weakened floor. The project's outcomes will enable geotechnical engineers to design long-term pillar systems and to quantify the stability of older pillars.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Mechanical Assessment of Time Dependent (Creep) Behaviour of Coal and Coal Measure Rocks Under Uniaxial and Triaxial Conditions Based on Experimental and Analytical Methodologies C29019** Amin Heidarpour, Monash University $205,000	Brian Vorster, Glencore Coal Assets Australia Elliot Tembo, Centennial Coal	Creep behaviour of coal and coal strata is critical for geotechnical engineering decisions; however, understanding of this phenomenon is limited to the collected field data by different monitoring techniques. The objective of this research is to investigate the time-dependent behaviour of coal and coal measure rocks by conducting experiments under various timeframes ranging from a month to a year or more. Researchers will use creep loading frames in temperature and humidity-controlled conditions which replicate the underground mining environment.
Current	**Mechanical Investigation of Two Critical Standing Support Systems (Timber Chock and Pumpable Crib) in Underground Coal Mines C29022** Hossein Masoumi, Monash University $295,000	Bob Coutts and Dan Payne, BHP Brian Vorster, Glencore Coal Assets Australia Patrycja Sheffield, Centennial Coal	Timber chocks and pumpable crib are two standing supports used in almost all the underground coal operations in New South Wales and Queensland. However, the performance of timber chocks, particularly under complex shear and/or vertical ground movements, is not well understood. Researchers will provide an update on the mechanical behaviour of timber chocks currently in the market and identify the extent to which each type of timber chock and pumpable crib is used in Australia. In addition, a testing standard will be developed for the selected standing supports based on mechanical parameters, such as loading rates, offset loading, torsional loading, compressive and shear loadings.
Complete	**Effectiveness of Shotcrete in Underground Coal Mines C29025** Joung Oh, University of New South Wales $185,000	Ben Forrest, Whitehaven Coal Brian Vorster, Glencore Coal Assets Australia	Shotcrete is a versatile ground support tool that, when applied correctly, enhances safety in underground mines. In this project, researchers quantified the effectiveness, application and benefits of shotcrete, including adhesion strength to coal or other rock surfaces and its interaction with other support elements, such as mesh, rock and cable bolts. The project involved a literature review, laboratory testing, numerical modelling and field monitoring.
Complete	**Monitoring While Drilling Concept on Characterising Coal Mine Roof C33019** Manoj Khanal, CSIRO $279,989	Brian Vorster, Glencore Coal Assets Australia Dan Payne, BHP	A major cause of roof instability in underground coal mines is the variable and uncertain nature of the roof. Researchers investigated the applicability of the monitoring while drilling concept to perform geotechnical characterisation of coal mine roofs and detect 'signatures' of change in roof strata competence. Sensors were installed on the drills to monitor parameters such as toque and penetration rate. Analysis of this data will help develop a predictive methodology for improved coal mine roof characterisation.
Current New	**Improved Model Upscaling of Overburden Hydraulic Conductivity for Input into Groundwater Models C33024** Yvette Heritage, SCT Operations $230,000 Current $390,000 New	Bob Coutts, BHP Gary Brassington, GM-3 Peter Corbett, Centennial Coal	This extension to this project aims to validate a proposed new method of determining relative vertical conductivity above longwall panels in a real application of a mine site groundwater model, in collaboration with groundwater modellers. The anticipated outcome is a new approach to determining site specific hydraulic conductivity above longwall panels for practical input into groundwater models. Providing more realistic site-specific estimates of overburden hydraulic conductivity will improve assessment of aquifer protection and groundwater inflow estimation.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Complete	**User Friendly Computer Program for Modelling Fracture Induced Instabilities in Underground Mining Environments C34012** Anna Giacomini, University of Newcastle $197,350	John Grieves, QCoal Services Matt Tsang, Anglo American Steelmaking Coal Paul O'Grady, Glencore Coal Assets Australia	A significant factor which affects the safety, speed and cost of underground roadway development is the design of the roof support system. An overly conservative design decreases development rates and increases material use, while a nonconservative design may trigger costly work stoppages or result in injuries due to collapse. Computer simulation methods have potential as design tools, but currently they have limited capabilities for modelling the propagation of fractures through brittle rock with pre-existing joints. The aim of this project was to improve the usability and reliability of the phase-field finite element (PF-FE) code developed in a previous project. This research enables the code to be readily employed by geotechnical and mining engineers in analysing and optimising roof support measures for underground roadways, while considering overburden, roadway geometry, support measures and material parameters.
Current	**Carbolt – Pre Commercial Fixed Length Carbolt Prototype C34018** David John, Mining3 $360,088	Alex Wright, Yancoal Bob Coutts, BHP Peter Quinn, GM-3	This project aims to develop a pre-commercial, fixed-length, carbon fibre based roof bolt prototype to provide tensile and shear strata support. The flexible Carbolt will be designed to be installed in a manner similar to standard rebar rock bolts and provide a non-corroding alternative to existing rebar roof bolts, which includes the ability to be re-tensioned. Researchers aim to characterise and statistically analyse the shear and tension load capacity of the Carbolt through a series of trials.
Current New	**Roof Beam Support Assessment Tool C34021** Terry Medhurst, Resource Geotechnical $150,000 Current $80,000 New	Brian Vorster, Glencore Coal Assets Australia Roger Byrnes, Byrnes Geotechnical	In previous projects, an analytical roadway development framework was established for measuring support load and roof convergence. This data can be matched and updated against roof monitoring data. The model relies on inputs from the geophysical strata rating and roof bolt characteristics. In this project, researchers will convert outputs from the previous work into a practical site-based software tool to accompany existing design methods.
Current	**Risk Based Model for Forecasting Longwall Face Cavity Development C34022** Chengguo Zhang, University of New South Wales $173,200	Matt Martin Matt Tsang, Anglo American Steelmaking Coal	Cavity development across the longwall face can cause substantial production losses and pose significant safety risks to mine workers during recovery operations. Previous research into longwall roof cavities has primarily focused on individual causes, such as equipment, shield pressures, geology, in situ stresses and geotechnical setting. In this project, researchers will adopt a holistic assessment of all causes that, in combination, can result in the formation of a roof cavity. The project aims to produce a risk based approach for assessing the likelihood of cavity development; a set of predetermined controls to mitigate the risk of cavity development; and a proposed hierarchy of longwall fall-of-ground severity linked to these controls, based on the escalating level of risk.
Current	**Optimum Design of Pillars with Various Sizes and Shapes at Increasing Stress Environment C35008** Mehdi Serati, University of Queensland $172,000	Brian Vorster, Glencore Coal Assets Australia John Grieves, QCoal Services Peter Corbett, Centennial Coal	Geological conditions in underground operations may require mine designs that incorporate small, irregular-shaped pillars that do not meet factor-of-safety requirements. This project aims to develop a methodology to effectively design small pillars in high-stress environments. The project will include physical and numerical modelling. The large-scale laboratory pillar experiments will be conducted using a multi-axis substructure testing system.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Causes for Swelling and/or Bearing Capacity Floor Failures in a Pillar System Under Varying Geological and Geotechnical Environments C35010** Serkan Saydam, University of New South Wales $298,300	Brian Vorster, Glencore Coal Assets Australia Peter Corbett, Centennial Coal	This is the second stage of a study that aims to develop a framework for reliable assessment, prediction and control of swelling and bearing capacity failures in underground coal mines. The project will use experimental, analytical and numerical methods to conduct multidisciplinary research into the failures of coal mine floors and pillar foundations.
Current New	**Revolutionising the In-Situ Stress Measurement Using a New Generation of Downhole Tools: DilaStress C35011** Hamid Roshan, University of New South Wales $184,500 Current $234,500 New	Brian Vorster, Glencore Coal Assets Australia Patrycja Sheffield, Centennial Coal	Understanding in-situ stress conditions is paramount for the safety, efficiency, and productivity of coal mining operations. Currently, overcoring is he preferred technique to measure-situ stress in underground mining. However, it is often hindered by the considerable time, investment, operational complexities, and high costs. This challenge was tackled in a previous stage of this project by developing DilaStress to create an efficient downhole stress measurement technique and associated Tool. This study will field test the DilaStress tool for insitu stress estimation.
Current	**Next Generation Fibre Glass (FG) Rock Bolts with Robust Shear Strength Properties to Replace Steel Rock Bolts C36010** Ali Mirzaghorbanali, University of Southern Queensland $147,998	Dennis Black, GM-3 Peter Corbett, Centennial Coal	This project aims to improve the shear strength properties of fibreglass (FG) rock bolts, paving the way for large scale manufacture, and replacement of steel rock bolts. The FG bolts would be safer and easier to handle and install and, being corrosion resistant, would significantly improve reliability and safety. The manufacture of FG bolts would also produce fewer carbon emissions than steel bolts. Prototypes will be produced at the advanced facilities at UniSQ.
New	**Field Investigations on the Optimum Design of Pillars at Increasing Stress Environments C37012** Mehdi Serati, University of Queensland $249,720	Brian Vorster, Glencore Coal Assets Australia John Grieves, QCoal Services Matt Tsang, Anglo American Steelmaking Coal Peter Corbett, Centennial Coal	A continuation of a previous project, this project will conduct field trials to test laboratory and numerical modelling that, if confirmed, has the potential to improve underground coal mine pillar design, leading to potential additional revenue of about US$7 million per longwall panel. It's hoped field testing will establish new design principles for deep pillars in increasing-stress environments, which will enable the coal industry to optimise mine layouts at the increasing depths many mines are facing. While pillar design techniques in underground coal have evolved significantly, methods for the estimation of pillar load have remained largely unchanged. There is a clear need for a new design methodology that produces more realistic factor of safety values for pillars.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
New	**Investigation to Determine the Influence of Stress Magnitude on the Growth Rate of Hydraulic Fractures C37015** Ken Mills, SCT Operations $200,000	Brian Vorster, Glencore Coal Assets Australia	Hydraulic fracturing can be used to pre-condition overburden strata to improve longwall face conditions and caving behaviour when mining below massive sandstones and conglomerates. This project hopes to confirm whether the cost of hydraulic fracture pre-conditioning can be reduced by up to 30 % by reducing the number of injection boreholes and optimising the layout of the remaining boreholes.
New	**Cost Effective, Low Water Sensitivity, and Fast Curing Geopolymer Grout for Cable Bolt Encapsulation to Enhance Cable Bolting Installation Practices C37020** Ali Mirzaghorbanali, University of Southern Queensland $148,010	Ben Yang, Anglo American Steelmaking Coal Samantha Grimsey, Kestrel Coal Resources	This project aims to develop an innovative geopolymer grout mixture tailored for coal mining applications, with pumpability and strength properties comparable to conventional grout. Adopting geopolymer technology to develop cost-effective, low-water-sensitivity, and fast curing grout is projected to significantly enhance cable bolting installation practice. The research team believes that the geopolymer grout technology is a suitable alternative to conventional cementitious grout.
New	**Longwall System Health and the Implications to Strata Control and Automation – Improving Industry Understanding, Monitoring Techniques and Numerical Model Validation C37024** Adrian Rippon, SCT Operations $427,200	Samantha Grimsey, Kestrel Coal Resources Stephen Giese, Anglo American Steelmaking Coal	The main objective of the project is to improve the underground coal industry's understanding of the longwall hydraulic system and its impact on strata control. The study aims to highlight the limitations of current hydraulic pressure monitoring techniques that may fail to identify fatal flaws in the longwall system health and may also hinder automation processes leading to poorer longwall conditions and reduced productivity. The study also aims to investigate an alternative monitoring system to accurately measure the force being applied to the roof by the longwall powered supports. Such a monitoring system would also help to validate numerical model outputs, improve longwall automation, reduce production delays, and reduce operator exposure to higher-risk activities conducted on the longwall face for strata control remediation.
Ventilation, Gas Drainage and Monitoring			
Current	**New Approaches to Mine Gas Analysis and Ratios C25072** Gareth Kennedy, Simtars $416,192	John Grieves, QCoal Services	The spontaneous combustion of coal is a serious hazard. A good understanding of the coal gas indicators and how they behave as the coal temperature changes is necessary to detect and effectively treat a coal self heating event. The main objectives of this project are to conduct a survey of the gases found in mine goafs, working areas and gas drainage samples from New South Wales and Queensland mines and compare the gases present with the low temperature heating fingerprint. The researchers will identify any new gas indicators that can be detected using the gas chromatographs.
Current	**Automatic Leak Detection for Tube Bundle Systems C27035** Sean Muller, Simtars $220,000	John Grieves, QCoal Services	Tube bundles are an integral part of gas monitoring systems in underground coal mines. They provide an early warning of spontaneous combustion, validate real time sensor readings and provide invaluable information during a mine fire/exploration. However, the current manual integrity testing of tube bundles is time consuming. In this project, a fully automated integrity testing system prototype is being developed based on information gathered on the flow rates and pressures of tubes. The prototype will be able to be retrofitted to any tube bundle system, regardless of the supplier.
Complete	**Ventsim Goaf Model Development C28016** Qingdong Qu, CSIRO $319,465	Paul Wild, Anglo American Steelmaking Coal Peter Baker, BHP	Mine ventilation officers do not have a tool to model and assess goaf gas behaviours. Ventsim is the industry standard tool for modelling ventilation circuits. A 3D goaf resistance model for Ventsim that predicts reasonable goaf gas flow patterns was developed in a previous project. In this project, researchers developed and calibrated the Ventsim goaf modelling approach against extensive field data to ensure that it is empirically validated and can adequately predict the impact of external stimuli on gas flows through the goaf.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Effect of Occlusions by Coal and Stone Dust on the Sensitivity and Time Response of Methane Gas Detectors in Underground Coal Mines C28027** Ian Webster, Ampcontrol $90,000	John Grieves, QCoal Services Ken Singer, BMA	The accuracy and response time of new machine-mounted and handheld gas detectors is established through compliance to nominated standards; however, the degradation of performance-in-service of these detectors is not well documented. Preliminary work has demonstrated that the build-up of coal and stone dust on catalytic methane sensors reduces the sensitivity of the detector and increases its response time. This project aims to verify and quantify the susceptibility of real-time methane detectors to occlusion by coal and stone dust using two methods: controlled laboratory testing of typical methane sensing devices and a qualitative survey of real-time methane sensors in service in underground coal mines.
Current	**Evaluation of Explosion Resistant Ventilation Control Devices and Determining Explosion Risk Exclusion Zones C29018** Alex Remennikov, University of Wollongong $562,560	David Webb, Glencore Coal Assets Australia John Grieves, QCoal Services Ken Singer, BMA Paul Wild, Anglo American Steelmaking Coal Russell Thomas, GM-3 Tim Huston, Kestrel Coal Resources	The throw of debris and fragments is one of the most dominant effects in underground coal mine explosion events and consequently the required safety distances and exclusion zones around mine entries should be determined. Greater knowledge of the explosion generation of debris inside and outside underground coal mines is required to develop scientifically validated exclusion zones for both blast overpressure and projectile hazards. This project will investigate the propagation of debris within drifts and shafts and outside mine openings and establish the relationship between the angle of incline of portals and projectile/debris risks to mine site infrastructure. Researchers will validate experimentally the existing procedures in DoD Explosives Safety Board and US Army documents for predicting debris velocities for coal mine explosion scenarios and define the appropriate exclusion zones for explosion risk for coal mine infrastructure.
Complete	**Direct Measurements of Effective Diffusion Coefficient of Coal C29036** Peyman Mostaghimi, University of New South Wales $175,000	David Webb, Glencore Coal Assets Australia Paul Wild, Anglo American Steelmaking Coal Russell Thomas, GM-3	In coal mining, the effective diffusion coefficient of gases is a critical factor that determines the magnitude and likelihood of gas-related dynamic failures such as outburst and, in some cases, coal burst. There are a wide range of experimental attempts to determine this coefficient; however, the reported values are inconsistent, varying up to two orders of magnitude. This project developed a fast and reliable method to determine the effective diffusion coefficient in coal at pre-mining stress conditions using X-ray micro-computed tomography (micro-CT) imaging.
Complete	**Strata Gas Content using Geophysical Logs and Laboratory Measurements C33018** Guangyao Si, University of New South Wales $128,560	Mark Laycock, Glencore Coal Assets Australia Russell Thomas, GM-3	An accurate estimation of gas content in coal measures is critical for the prediction of specific gas emissions, design of gas drainage and ventilation strategies, and compliance of gas concentration in tailgates. Researchers integrated geophysical logging data analysis and laboratory measurements to accurately determine the gas content of coal measures and their potential interaction with the mining horizon.
Complete	**Review Longwall Face Ventilation to Mitigate Goaf Gas Emissions onto Walkways and Tailgate End C33029** Ting Ren, University of Wollongong $146,500	Ventilation Task Group	Goaf gas migrating onto the longwall face is causing gas exceedance incidents, particularly on longwall panels extracting multiple gassy seams and where predrainage is not effective. Researchers examined longwall ventilation control practices for mitigating localised, high goaf gas emissions onto the longwall face and associated control measures and practices, particularly in areas around tailgate end.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Complete	**Time Lapse In-Seam Seismic and Resistivity Measurements as an Integrated Component of a Smart Coal Seam Gas Pre-Drainage Practice: Literature Review C34010** Hamid Roshan, University of New South Wales $60,000	Ventilation Task Group	Underground in-seam seismic surveys have shown promising results in mapping coal seam features and temporal changes in coal characteristics. This data is important in maintaining compliance with safety regulations, particularly regarding methane and carbon dioxide content. The objective of this support was to undertake a literature review and provide evidence that the underlying theory would be successful at visualising +300m ahead in the gateroad area.
Current	**Appraisal of Gas Indicators from Goaf Drainage Holes for Spontaneous Combustion and Explosion Risk Management: Stage 2 C34011** Guangyao Si, University of New South Wales $223,254	Ventilation Task Group	The intensive application of goaf drainage has raised concern that strong suction pressure caused by multiple goaf holes may accelerate ventilation air leakage and oxygen migration into the deep goaf, increasing the risk of self-heating. Building upon the extensive goaf drainage data collected in Stage 1, this Stage 2 project aims to investigate the effect of intensive goaf drainage on ventilation airflow leakage and dynamic goaf environment variation using CFD models.
Current New	**Borehole Tools to Deal with Outbursting, Coal Bursting and Gas Drainage C34014** Ian Gray, Sigra $1,678,320 Current $498,256 New	Ventilation Task Group	There are extensive strata data that could be gathered and interpreted automatically during the borehole drilling process. Researchers have been developing a suite of underground in-seam borehole tools to deal with outbursts, coal bursts and gas drainage. The suite of tools is founded on a high-speed electronics communication system which will enable two-way data transfer along the drill string. The system will be compatible with multiple down-hole sensors. In this extension project, researchers will build the calliper log, surface test it and obtain approvals before conducting underground field trials.
Complete	**Optimising Gas Management C35012** Rao Balusu, CSIRO $100,000	Ventilation Task Group	This is an area of high interest within the industry. Looking solely at inertisation may not be a true reflection on the best management strategies, therefore this project will initially look at current management systems and strategies used throughout the industry including areas where high gas drainage rates in goaf holes influence high oxygen concentration levels that may create a significantly increased risk of spontaneous combustion. The main objective of this project was to work with industry on a scoping study for research to implement the development of optimum inertisation strategies to reduce oxygen levels in goaf holes and to minimise oxygen ingress on both maingate and tailgate sides of the longwall goaf.
Current	**Studies of Coal Toughness and Gas Sorption Dynamics for Outburst Risk Management C35015** Ting Ren, University of Wollongong $275,000	Ventilation Task Group	Coal toughness coefficient is used internationally as an indicator of coal and gas outburst risk. To improve confidence in outburst risk assessment, coal toughness and its relationship with other coal mechanical and proximate properties need to be evaluated. In this project, researchers will conduct systematic studies of coal toughness, geo-mechanical properties and gas sorption dynamics with different coals sourced from underground coal mines in New South Wales and Queensland. A standard coal toughness test and coal toughness coefficient index database will be developed.
Current	**Practical Implications of Oxygen Deficiency on the Determination of Graham's Ratio in Longwall Goafs C36003** Sean Muller, Simtars $64,350	David Webb, Glencore Coal Assets Australia John Grieves, QCoal Services	Graham's ratio is a commonly used indicator for measuring the intensity of the oxidation of coal in underground mine atmospheres. The basis of Graham's ratio is the conversation efficiency of oxygen to carbon monoxide. Graham's ratio uses the nitrogen in a sample for the calculation of oxygen deficiency. This allows for dilution by methane and carbon dioxide seam gases. Nitrogen however is commonly added to goaf atmosphere's through inertisation such as nitrogen or exhaust gases, which can cause Graham's ratio to be underestimated. This project will investigate the practical implications for the interpretation of Graham's ratio and other indicators in the presence of an oxygen deficient atmosphere in longwall goafs.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Optimisation of Goaf Management Strategies C36005** Rao Balusu, CSIRO $1,443,557	Ventilation Task Group	Gas emissions from working longwall and the adjacent goaf areas are the major contributors to ventilation air methane in gassy underground coal mines. The main objective of this project is to develop optimum goaf management strategies to maximise goaf gas drainage, reduce oxygen ingress into the longwall goaf, and minimise fugitive emissions. The project will also investigate the feasibility of using proactive inertisation on both MG & TG sides of the goaf and in adjacent goaf areas, and other alternative goaf management strategies to maximise goaf gas capture, reduce oxygen ingress into the longwall goaf and minimise fugitive emissions from coal mines.
Current	**Borehole Tools – Caliper Log C36011** Ian Gray, Sigra $424,160	Ventilation Task Group	This project aims to complete a suite of underground in seam (UIS) borehole tools to deal with the problems of outbursts, coal bursts and gas drainage. Outbursts of coal and gas are a significant risk to the health and safety of mine personnel. The backbone of the suite of tools is a high speed electronic communication system, which enables two way data transfer along the drill string. The components that are part of the project are a drill rig monitoring system, a survey module, a downhole torque and thrust sensor to obtain near-bit information and a packer test system that mirrors the drill stem test tool currently used in surface drilled boreholes. The challenge of this project is to produce a 12-arm caliper that will detect hole ovality and breakout and that will work in a borehole drilled at 96mm diameter and extend to about 130 mm.
Current	**Rotary Steering System Field Trial and Developments C36012** Ian Gray, Sigra $449,600	Ventilation Task Group	This extension project will test the Sigra rotary steering tool (RSS) for use in underground inseam drilling situations, and trial the system in cross-measure drilling. The benefit of an RSS system is that it can prevent the drill string becoming trapped in boggy ground and increase productivity by delivering higher thrust to the bit than current down-hole motors and raise penetration rates during directional cross-measure drilling. The development of this tool could result in significant cost savings by reducing the need to hire equipment.
Current	**Intelligent Integrated Distributed Fibre Optic Sensing Technologies C36015** Yi Duan, CSIRO $568,317	Ben Yang, Anglo American Steelmaking Coal Dennis Black, GM-3 Peter Corbett, Centennial Coal	This project responds to the industry's desire for continued innovation in integrated distributed fibre optic sensing technologies to improve seismic, temperature and strain monitoring in underground coal mines. Distributed fibre optic sensing systems offer comprehensive monitoring and are more cost effective. Outcomes from this research will be demonstration of distributed temperature sensing for continuous temperature profiling of underground roadway for ventilation and spon-com management, the feasibility of strain and microseismic monitoring on pillars, with proper installation procedure and interpretation methods developed, and a deep-learning pipeline-based software prototype for real-time distributed acoustic sensing data processing.
New	**Determination of New Criteria for the Approval of P5 Type Permitted Explosives C37004** Duncan Chalmers, University of New South Wales $273,000	Brad Elvy, Brad Elvy Mining Services Paul Wild, Anglo American Steelmaking Coal Russell Thomas, GM-3	This project aims to develop permitted explosives with a lower power delivery during detonation. If successful, industry with the support of the researcher will engage with the Queensland Explosives Inspectorate to seek permission for P5 permitted explosives to be used in underground coal mines. A change in the criteria would allow for the continued development of emulsion-based permitted explosives, further improving the safety of underground coal mine operations.
New	**Frictional Ignition – Water Spray Standards, their Basis and Effectiveness with Modern Mining Environment C37006** Yong Sun, CSIRO $89,814	David Webb, Glencore Coal Assets Australia Steve Winter, Kestrel Coal Resources	This project aims to identify the requirements for which drums/sprays should be designed to optimise the use of water sprays to minimise the FI risk for modern mining equipment. In the first stage of the work program the researchers will collate the history, base data and type of equipment used to generate the original, subsequent and up to the current generation British Coal standards via literature review and interviewing the relevant personnel involved in drafting the original and subsequent UK standards. Outcomes will develop a program of works that determines the applicability or otherwise of the standards to current operations and formulate understanding of the nature of the variance from the existing standards.

ACARP is focused on research aimed at minimising emissions and reducing the environmental impact of the industry. The Open Cut Committee has identified the following key priority areas to support this goal:

The key open cut research priority areas are:

- Lowering/removing emissions generation activities.
- Alternative land use post mining beyond the traditional vegetation replacement.
- Water contamination, use and efficiency management.
- Tailings management alternatives.
- Precious metals extraction from mining and beneficiation processes.

The primary goal of the open cut research program is to achieve zero fatalities while minimising negative effects on the workforce, environment, equipment and the resource. This is reflected in the targeted occupational health and safety program particularly related to dust and mental health. Rehabilitation activities particularly targeting management of voids and soil regeneration has grown in importance as the broader community and mine owners' expectations increase regarding social licence to operate.

Research that addresses the science on all aspects of rehabilitation and the minimisation of mining impacts on neighbouring communities is a key priority and it will continue to consume a significant component of the open cut research budget.

COMMITTEE MEMBERS

Tony Egan	**Manager, Project Governance (co-chair)**	**Glencore Coal Assets Australia**
Andrew Lau	**Mine Closure Manager (co-chair)**	**Yancoal**
Craig Bancroft	Manager Environment	BMA
Shaun Booth	Group Manager Resource Development and Technology	Glencore Coal Assets Australia
Robert Brown	Principal Mining Engineer	Jellinbah Group
Tyson Burkitt	Engineering and Maintenance Manager (GCAA)	Glencore Coal Assets Australia
Brett Domrow	Mine Planning Manager	New Hope Group
Phillip Enderby	Business Improvement Manager	Hunter Valley Operations
Jason Fittler	Environment Manager	Anglo American Steelmaking Coal
Myf Godfrey	Superintendent Planning and Strategy	BMA
Ravindu Goonawardene	Geotechnical Manager (Open Cut & Underground)	Anglo American Steelmaking Coal
Tim Gray	Engineering Manager – Surface Operations (NSW)	Glencore Coal Assets Australia
Sean Halliday	Lead Operating Excellence	Anglo American Steelmaking Coal
Shaun Hansen	Head of Technical Services	BHP
Chris Kelly	Manager Mine Planning	Whitehaven Coal
Andrew Micallef	Technical Assurance Manager	Anglo American Steelmaking Coal
Brian Neilsen	Director of Engineering - Open Cut Mining	Peabody Australia
Paul O'Loughlin	Technical Services Manager	MACH Energy
Rae O'Brien	Group Executive, Australia East	Thiess
Troy O'Reilly	Risk & Compliance Advisor, Mining Operations	Stanwell Corporation
Ken Singer	Manager Asset Systems & Risk	BMA
Matt Staff	Group Asset Manager	Yancoal
Matt Tsang	Geotechnical Manager – OC & Projects	Anglo American Steelmaking Coal
Peter Walsh	Project Manager	Glencore Coal Assets Australia
John Watson	Director - Environment and Community	Glencore Coal Assets Australia
Brendan Wilkins	Manager Asset Management Open Cut	Anglo American Steelmaking Coal

PROJECTS UNDER MANAGEMENT

Category	No of Projects	ACARP Funding
Drilling and Blasting	4	$1,367,210
Environment	20	$9,843,269
Geology	8	$1,356,652
Health and Safety	2	$396,833
Maintenance and Equipment	9	$1,993,789
Mining and the Community	1	$199,472
Rock Mechanics	7	$2,096,474

NEW FUNDING

ACARP supports projects with immediate need outside the yearly funding round. These projects are included within this report as new funding.

No of Projects	ACARP Funding	Total Funding
11	$2,833,613	$4,209,555

Total Funding includes in-kind support provided by the researcher and host mine as identified in the research proposal.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Drilling and Blasting			
Current	**Evaluation of Production Trials of HP Explosives C27024** Andrew Kettle, Mining3 $477,920	Andrew Lau, Yancoal Brett Domrow, New Hope Group	The aim of this project is to design and manufacture a specialised, inert to hydrogen peroxide (H202), contamination free MMU to produce and deliver bulk quantities of H2O2 based explosives. The MMU targets production rates of 300 kg/min, with a minimum rate of 75kg/min. The MMU will comply to safety and security for mine site scale blast performance. In this project mine site trial blasts of increasing size will be trailed to ensure a successful demonstration of blasting approaching a full-scale blast. The MMU design will ensure that the unit can be subsequently used for further trials and detonation displays.
Current	**Production Trials in Two States of HP Explosives with Custom MMU C33041** Andrew Kettle, Mining3 $342,034	Andrew Lau, Yancoal Brett Domrow, New Hope Group	Researchers have developed a new, stabilised hydrogen peroxide based emulsion explosive with 25 day sleep time. In this project they will use a prototype mobile processing unit to expand demonstrations beyond earlier preliminary trials. Near production scale blasts will be conducted to address technical hurdles.
Current New	**Reactive Ground Testing C35018** Gary Cavanough, Queensland Magnetic Research $250,000 Current $90,000 New	Andrew Micallef, Anglo American Steelmaking Coal Mark Laycock, Glencore Coal Assets Australia	Spontaneous reactions between explosive products and certain ground types can lead to a spontaneous detonation of the explosive in the blasthole, putting personnel and equipment at risk. There are limits to the current procedure for testing reactivity due to the turnaround time of several weeks for analysis. This project aims to develop a ground reactivity assessment method that can be performed on site in less than 90 minutes.
Current	**Mining Explosive Sensitisation using Chemical Free Methods C35028** Andrew Kettle, Mining3 $297,256	Andrew Lau, Yancoal Brett Domrow, New Hope Group	The objective of this project is to further enable and improve bulk hydrogen peroxide (H2O2)-based emulsion mixtures to deliver the benefits of 'green explosives' with lower community and environmental impacts. Researchers will design and manufacture a prototype sealed high-emission UV-radiation static mixer-based unit for workshop-based and small-scale field experimentation to sensitise H2O2-based emulsion mixtures.
New	**Segregation Testing of Category 2 Explosive Transport Boxes C37010** Lee Julian, Blast Ability International $155,750	Ken Singer, BMA Tim Gray, Glencore Coal Assets Australia	The transport and use of explosives at coal mines is a principal hazard. Detonators and high explosives (HE) are typically transported from the magazine to the shot in two dedicated carry boxes on one vehicle. For safety reasons, detonators classified as Division 1.1B and explosives of different explosives classification may not be transported in the same vehicle unless in compliance with the Australian Code for the Transport of Explosives by Road and Rail. This requires an effective means of segregation demonstrated to prevent sympathetic detonation. The main benefit to industry from this project is a demonstrated means to confirm effective segregation to prevent sympathetic detonation of incompatible explosives. This will lead to increased safety in the transport of explosives at coal mines.
Environment			
Complete	**Reducing Uncertainty in Long Term Water Quality Predictions for Final Void Management C29047** Sue Vink, University of Queensland $245,600	Andrew Lau, Yancoal Jason Fittler, Anglo American Steelmaking Coal	Reforms in the financial assurance framework require that mine sites progressively rehabilitate land to agreed outcomes. This includes presenting a life-of-mine plan and scheduled rehabilitation outcomes. Predictive modelling of void water quality is an essential component to ensure outcomes are safe, stable and non-polluting and can support a designated land use. In this project, researchers generated data to assist management and closure of final voids as permanent water bodies. The work combines a desktop analysis of existing water quality and climate data with field data collected from up to four voids on a quarterly basis for 12 months.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Saline Pit Lakes as Aquatic Ecosystems: A Design Manual for Closure C29049** Mark Lund, Edith Cowan University $1,089,226	Andrew Lau, Yancoal John Watson, Glencore Coal Assets Australia	Pit lakes are one of the greatest legacies of open cut mining, but they are not well understood. The broad aim of this extension project is to produce a state-of-the-art design manual for saline pit lakes to assist companies prepare for closure. Researchers will continue and broaden the current biophysical monitoring program to include new pit lakes. They will document the range of interannual variability in the biophysical data and long term trends in lake ecosystem development. They will also investigate how the use of floating vegetated islands could enhance riparian development at closure and during lake fill.
Complete	**High Water Recovery, Low Cost Desalination using PV-Powered Membrane Capacitive Deionisation (mCDI) C33035** David Waite, University of New South Wales $334,340	Kane Eskola and Nash Hancock, BHP	Capacitive deionization is a robust, energy efficient and cost effective technology for desalination of water with moderate salt content. Including ion exchange membranes in front of the electrodes in a process called membrane capacitive deionisation is a promising recent development. This project used an onsite pilot scale trial to assess the viability of membrane capacitive deionisation, in combination with appropriate pre treatment processes, to remove salt and other contaminants from mine water.
Complete	**Best Practice Management and Performance Assessment of Biodiversity Offset Areas C33043** Rachel Murray, Eco Logical Australia $335,540	Mark Nolan, BHP Nigel Charnock, Glencore Coal Assets Australia	The coal industry is required to demonstrate that it can effectively offset its biodiversity impacts through effective rehabilitation of land under its management. Choosing the most sustainable and cost effective management measures for maximising biodiversity outcomes needs to be supported by a sound evidence base. This project developed evidence based decision support tools using the extensive biodiversity offset areas (BOAs) monitoring datasets held by multiple mining operations, in conjunction with desktop and field research. Industry guides for selecting best practice BOA management methods (including a decision support framework) and for selecting BOA monitoring, data collection and data evaluation methods were developed.
Complete	**Rationale for the use of Paired Continuous Real Time Noise Monitors to Reduce Uncertainty in the Quantification of Noise from Open Cut Coal Mines C33046** Tim Procter, Umwelt, Australia $125,000	Ned Stephenson, Glencore Coal Assets Australia	New South Wales has more than 60 continuous real time noise monitors installed either individually or as part of a continuous noise monitoring network. The systems are cumbersome, and the amount of data is overwhelming. While the smart phone application has improved information accessibility, source identification can still be difficult to quantify. This project developed a rationale for using the relationship between various data metrics collected by paired monitors to quantify noise from open cut mines in complex acoustic environments.
Complete	**Best Method for Determining Atmospheric Stability for the Assessment of the Acoustic Environment in the NSW Coal Mining Industry C33047** Tim Procter, Umwelt, Australia $276,000	Ned Stephenson, Glencore Coal Assets Australia	There are two main methods for identifying temperature inversions – the Pasquill-Gifford method and temperature lapse rate method. Both methods are used in New South Wales by the EPA to set noise licence conditions for the coal industry. Researchers aim to establish which method is most appropriate for the assessment of noise enhancing conditions, and the establishment of performance based noise management systems and associated licence conditions for open cut coal mines.
Current	**New Landscape Evolution Model for Assessing Rehabilitation Designs C34025** Greg Hancock, University of Newcastle $875,391	Chris Quinn, Rix's Creek Jason Fittler, Anglo American Steelmaking Coal	This project aims to develop a new set of tools that can be used to assess the long-term sustainability of post mining landforms and reduce environmental risk. As part of this work, researchers will test and develop the State Space Soil Production and Assessment Model (SSSPAM), which will incorporate all features of the SIBERA model. The researchers will develop an accompanying database of parameters that can be used across a range of sites, materials and climates. A further goal is to redevelop the SIBERIA model so that it is available to the industry.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current New	**Microalgae Cultivation as a Low Cost Method for Desalinating Void Water and Generator of Post Mining Bioeconomic Activity from Final Voids C34027** Ben Hankamer, University of Queensland $2,159,848 Current $996,056 New	Andrew Lau, Yancoal Jason Fittler, Anglo American Steelmaking Coal John Watson, Glencore Coal Assets Australia Trudy Mazucco, BHP	The objective of this stage of this project is to fast track the scale-up of micro-algae cultivation as a post mining land use for final voids. These micro-algae systems would generate economic opportunities, regional jobs, lower operational CO2eq emissions, manage void water salinity, extract heavy metals and support adjacent agricultural applications. This is stage three of the project, which has already produced extensive foundational work and is focused on scaling downstream micro-algae biomass processing methods.
Complete	**Guidelines for Assessment of Geotechnically Safe and Post Mining Landforms C34028** John Simmons, Sherwood Geotechnical and Research Services $120,000	Andrew Lau, Yancoal Brian Vorster, Glencore Coal Assets Australia Trudy Mazucco, BHP	There is no consistent methodology for applying current geotechnical observations and stability analysis procedures to the evaluation of potential future ground conditions. This information is required in environmental authorities and progressive rehabilitation and closure plans. A technical framework is needed that considers impacts of uncertain time-dependent strength and groundwater pressure changes, geomorphological processes and future land use changes. This project aimed to distil the landform geotechnical safety and stability experience of leading industry professionals into good practice guidelines, a checklist and consequence assessment process.
Complete	**Optimising Plant Growth and Flood Preconditioning for Tailings Dams C34030** Carmen Castor and Mike Cole, CSER Research $294,583	Andrew Lau, Yancoal Shaun Booth, Glencore Coal Assets Australia	Successfully vegetating the surface of tailings storage facilities is challenging. Tailings behave as a clay-like substrate that shrinks, swells and cracks. The 'substrate' does not freely drain down to the lower levels, causing standing water following heavy rain. When flooding occurs, plants' fine feeding roots, especially those near the surface, become anoxic and die. The objective of this project is to optimise plant survival on tailings by testing growth medium mixes, pot size and pre-conditioning to flooding. Researchers will expand the number of primary species under study to reflect those native to other coal fields.
Current	**High Interest Native Plant Pittosporum Angustifolium for Mine Rehabilitation: Key Strain Identification and Germplasm Propagation Investigation C34035** Ryan Anderson, RNA Environmental Services $197,401	Andrew Lau, Yancoal Andrew Micallef, Anglo American Steelmaking Coal	Pittosporum angustifolium is a drought resistant plant found in semi-arid regions on highly weathered skeletal sandy soils. Pittosporum angustifolium is an ethno-pharmaceutical plant species reputed to have beneficial properties for prostate cancer patients. It also has potential as a mined land rehabilitation species. Two known parent plants have been identified in the Bouldercombe region of Central Queensland. This project will produce Pittosporum angustifolium tubestock suitable for field implementation. Researchers will develop a robust practical methodology for successful propagation of the species and assay anti-cancer properties of phytochemical active ingredients.
Complete	**Literature Review: Creating Viable and Productive Grazing as a Beneficial Final Land Use Through Targeted Design and Land Management C35006** Leigh Trevaskis, Valarion $100,000	Andrew Lau, Yancoal Morné van Zyl, Glencore Coal Assets Australia	This project will assess what research has been done to confirm accelerated achievement and sustainable management of grazing PMLU in the Hunter Valley and Bowen Basin. Work will target the range of grazing PMLU slope gradient and the reliable for guiding commercial practices. The review will utilise ACARP reports and internal company grazing trial reports to develop a gap analysis for future research.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Delineating Water Tables and Flow Pathways Inside Spoil Piles to Support Water Quality Predictions C35021** Mansour Edraki, University of Queensland $297,420	Andrew Lau, Yancoal	Spoil piles have a highly heterogeneous composition and internal structure due to different dumping strategies and overburden material. In this project, researchers will define the spatial distribution of major flow pathways and water tables in spoil piles to support accurate prediction of spoil seepage water flow and quality. They will also produce instructions on how to use the data to improve spoil pile hydrology and water quality prediction models.
Current	**Management Strategies for Invasive Leucaena on Coal Mine Sites C35026** Shane Campbell, University of Queensland $531,528	Andrew Lau, Yancoal Cian Morgan, BMA Craig Bushell and Morné van Zyl, Glencore Coal Assets Australia Hardy Wincen, Stanmore Resources	Leucaena (Leucaena leucocephala) is a leguminous tree introduced to Australia from central America for use as a forage for livestock production. It is a major environmental weed in sub-tropical and tropical regions. This project aims to develop strategies to effectively manage leucaena in rehabilitation on coal mine sites.
Current	**Renewable Energy as Post Mining Land Use C35029** Claire Cote, University of Queensland $186,628	Jason Fittler, Anglo American Steelmaking Coal Raymond Howard and Michael Moore, Yancoal Morné van Zyl and Ned Stephenson, Glencore Coal Assets Australia	Renewable energy produced by solar and wind has vast potential in the Bowen and Surat basins. However, the pathway to implementation is not clear. High-level guidance is available but it is difficult to translate the recommendations into actions on the ground as regulatory barriers and planning constraints are not fully understood. This project will undertake two case studies to examine how renewable energy projects can be established on a mining lease and gain acceptance from regulators and stakeholders. Recommendations will be made on how to update the regulatory and planning frameworks to encourage and accommodate renewable energy as a post-mining land use.
Current	**Erosion and Sediment Control Framework for Queensland Mines – Calibration and Validation C35030** Robynne Chrystal, University of Queensland $347,196	Andrew Lau, Yancoal Jason Fittler and Tim Kendrick, Anglo American Steelmaking Coal	This project will verify and validate the technical guidelines that were developed in a previous ACARP project for the design and implementation of erosion and sediment control plans for Queensland coal mines.
Current	**Predicting the Long Term Erosional Behaviour of High Walls C36018** Greg Hancock, University of Newcastle $443,980	Andrew Lau, Yancoal Chris Quinn, Rix's Creek Jason Fittler, Anglo American Steelmaking Coal	This project seeks to develop a more rigorous understanding of highwall erosion and develop a predictive tool to assess it. This will lead to improved landscape performance and safety, improved environmental outcomes, and improved post-mining landscape design. Models currently exist that can theoretically predict the behaviour of mine highwalls, but there is a lack of reliable model input data to calibrate and validate these models. This work will provide baseline data for advanced understanding of mine highwall erosion and develop parameters for input into numerical models for high wall erosional behaviour and validate a predictive model for the erosion of highwalls.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Semi Autonomous Bulldozers for Mine Site Rehabilitation C36020** Ross McAree, University of Queensland $498,218	Andrew Lau, Yancoal Brian Neilsen, Peabody Australia Coal Ned Stephenson, Glencore Coal Assets Australia Phillip Enderby, Hunter Valley Operations Jonathan Miln and Teo Di Pasquale, Thiess Simon Zillman, Hastings Deering	Challenges facing industry regarding the user of dozer operation for rehabilitation are the financial cost of rehabilitation, availability of skilled people and environmental issues. These challenges could be significantly alleviated through the development and deployment of semi-automated bulldozers. Recent research found that human operated bulldozers achieved 56% of the maximum productivity potential, compared with productivity rates of up to 92% when missions for semi-autonomous bulldozers were autonomously planned. This project will develop, demonstrate, and evaluate the capability to undertake a substantial proportion of the bulk earthwork for mine-land rehabilitation using semi-autonomous bulldozers with enhanced mission planning to optimise performance.
Current	**Validation of a Landform Design and Management System for Sloped Grazing PMLU C36042** Leigh Trevaskis, Valarion $688,080	Andrew Lau, Yancoal Hardy Wincen, Stanmore Resources Morné van Zyl, Glencore Coal Assets Australia	This project will address knowledge gaps in the effect of grazing on sloped rehabilitated land. The work aims to help mining companies to justify the approval of grazing as a post mining land use (PMLU) based on stability indicators, rather than a one-size-fits-all slope gradient ceiling. Currently there is little confidence in grazing as PMLU on slopes greater than 12% in the Bown Basin, and this project aims to obtain robust data on livestock behavioural patterns and their impact on slope gradients up to 30 %. The project will also assess the feasibility of developing a grazing PMLU landform evolution model that accounts for the impact of livestock behavioural patterns on a range of slopes up to 20 % and develop best practice guidelines for managing livestock on sloped grazing PMLU.
Current	**Using Large Floating Islands to Promote Aquatic and Terrestrial Biodiversity in Pit Lakes C36043** Mark Lund, Edith Cowan University $697,290	Andrew Lau, Yancoal John Watson and Ned Stephenson, Glencore Coal Assets Australia	The main objective of this project is to evaluate the use of large aquatic floating islands (AFI) to enhance aquatic and terrestrial biodiversity in pit lakes, particularly during prolonged lake filling. Previous research has demonstrated that pit lakes as aquatic ecosystems are potentially a viable, sustainable, and economically responsible option for post-mining land use. However, these ecosystems cannot be established before the lake is full, creating a long period where the aquatic ecosystem is unlikely to meet regulator and public expectations. The broad goal of this research is to develop the use of large-scale AFIs as a tool for miners to develop or improve biodiversity in their pit lakes, making them suitable for closure as aquatic ecosystems or demonstrating improvement for non-use management areas.
General			
New	**Thermally Enhanced Floating Solar Still System for Reducing a Mine's Reliance on Raw Water Allocations and Achieving a Drought Resilient Post Mining Land Use for Final Voids C37013** Leigh Trevaskis, Valarion $83,000	Andrew Lau, Yancoal Angus Ball, Jellinbah Group Shaun Booth, Glencore Coal Assets Australia	This project aims to design, manufacture, and performance test a scalable, thermally enhanced floating solar still and rain harvester prototype on a Bowen Basin mine site. The proposed technology aims to unlock saline mine affected void water to reduce a mine site's reliance on raw water allocations and deliver a resilient post mining land use for sustainable food production from final voids.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Geology			
Complete	**Elements in Coal – A Start-to-End Analysis C34016** Jane Hodgkinson, CSIRO $119,035	Raymond Howard, Yancoal Shaun Booth, Glencore Coal Assets Australia	Most coal waste is considered an industrial overhead that must be managed at substantial cost. Some coal waste contains critical minerals, metals and elements. The fate of these elements in coal value chains is poorly understood. This project provided elemental analyses of coal as it moves through its value chain, from seam to end use and waste. The project delivers a framework showing the behaviour and fate of 50 elements that started in the coal seam, where they end up and how or why the composition may have altered.
Current	**Guideline for Standardising Structure Interpretation in ATV/OTV Logs C34020** Mojtaba Rajabi, University of Queensland $163,415	Brian Vorster, Glencore Coal Assets Australia Matt Tsang, Anglo American Steelmaking Coal	Borehole image logs, such as ATV and OTV, provide accurate orientated images from borehole walls that are considered replacements for manual cores. However, there is no accepted guideline nor nomenclature for the interpretation of structures from ATV/OTV logs for Australian coal basins. This project aims to develop a guideline for processing, analysis and interpretation of structures in ATV/OTV as a means of reducing the inconsistencies and misinterpretations from image log interpretations.
Complete	**Laser Induced Breakdown Spectroscopy (LIBS) as a Rapidly Deployable Field Technology to Estimate Coal Quality C34029** Joe Perkins, CSIRO $135,510	Mark Laycock, Glencore Coal Assets Australia	Laser induced breakdown spectroscopy (LIBS) is well established and shows promise as an analytical method for coal characterisation; however, it has yet to be used successfully to analyse and quantify uncrushed coal samples in the field. Recent developments now enable rapid collection of LIBS spectra via handheld units and smartphone connectivity. The aim of this project was to assess LIBS as a viable, safe, low-cost, rapidly implementable coal quality assessment technology to improve resource characterisation in the field. Researchers calibrated LIBS spectra data using historic samples and diverse lab analysis results and establish a field test protocol.
Complete	**Statistical Analysis of Methods for selecting Lithology Boundaries from Density and Natural Gamma logs and assessing their ability to select Lithology Boundaries in Blast Holes C34037** Brett Larkin, GeoCheck $76,000	Mark Laycock, Glencore Coal Assets Australia	Determination of top-of-coals from blast hole data is often undertaken by geophysically logging the blast holes, manually interpreting the density log and then physically entering data into mine models and schedules. This project extends previous research on semiautomatically determining coal boundaries from density logs. Researchers delivered a system for deriving top-of-coals from blast hole data and developed a methodology for checking lithology type and deriving boundaries between non-coal lithologies from geophysical logs.
Current	**Recovery of Critical Minerals from Coal and Coal Production Waste C35023** Nerrida Scott, CSIRO $154,000	Andrew Lau, Yancoal Caroline Lang and Shaun Booth, Glencore Coal Assets Australia	There are currently global supply chain challenges for heavy rare earth elements (REE), particularly dysprosium. In this project, researchers will utilise research that is currently being undertaken to assess the potential of coal, coal bearing strata and production waste as unconventional sources of REEs and other critical minerals. They will use advanced characterisation techniques to develop innovative and environmentally benign recovery technologies for minerals that are found in Australian waste streams to be economic.
Current	**CSR Predictions and Correlations Definition C35025** Chris McMahon, McMahon Coal Quality Resources $35,880	Alison Burke, BHP Maurizio Tonelli and Tomaoki Nagata, Glencore Coal Assets Australia	In this project, researchers will define the effectiveness of coke strength after reaction (CSR) predictors for product coals of varying coal quality characteristics. To support this work, they will conduct a comparative analysis of published equations, chart data (that can be converted to formulas), data obtained from existing research and estimators produced in that research. Several deposits and coal types will be evaluated. The outcome will be a guide for improving CSR predictor accuracy and thereby improving resource / reserve / marketing product accuracy.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current / New	**Real Time Prediction of Coal Top Through Guided Borehole Radar Wave Imaging for Open Cut Blast Hole Drilling C35047** Wayne Stasinowsky, CSIRO $396,792 Current $99,938 New	Jack Woollett, Glencore Coal Assets Australia Troy O'Reilly, Stanwell Corporation	Damage to the top of coal seams caused by incorrect blast stand-off distances is a significant issue within the Australian coal industry with annual losses estimated at AUD$4 billion. There is currently no technology available in the open cut environment to remedy this issue. Three previous project stages have demonstrated that a conventional borehole radar (BHR) can be integrated onto a drill string to generate look-ahead waves for imaging and predicting the coal seam top in real-time, while drilling blast-holes. This final stage seeks to deliver a commercially ready real-time coal-top guidance system prototype for blast-hole drilling that will allow a protective layer of overburden.
Current	**Validation of LIBS Technology for Downhole Resource Evaluation C36022** Joe Perkins, CSIRO $276,020	Jason Schumacher, Yancoal Mark Laycock, Glencore Coal Assets Australia Sudipta Nag, BHP	Laser Induced Breakdown Spectroscopy (LIBS) shows promise as a rapid method to evaluate coal properties. However, it has yet to be successfully adapted for use downhole. LIBS can provide real time measurements, making it highly valuable for on-site and in-situ analysis of coal. This project will fast track the adaptation of a downhole LIBS sensor for coal by developing a comprehensive coal core derived calibration model, integrating LIBS spectral information into washability models using processed core samples, and conducting field testing using a pre-commercial LIBS downhole tool.
New	**Automated Optical and Acoustic Televiewer Drill Data Mapping for Improved Subsurface Analysi C37027** Simit Raval, University of New South Wales $206,875	Ben Forrest, Whitehaven Coal Matt Tsang, Anglo American Steelmaking Coal Myf Godfrey, BHP	Acoustic and optical televiewer (ATV and OTV) tools enhance the understanding and management of geotechnical environments in mining operations.These tools provide high-resolution, oriented images of borehole walls, enabling the detailed assessment of structural geology and borehole stability. The manual interpretation of ATV and OTV data, however, is both time-consuming and subject to human error, presenting a significant bottleneck in data processing.This project aims to leverage machine/deep learning algorithms for the examination of ATV/OTV drill data to improve the efficiency and accuracy of data interpretation and reduce costs and labour intensity.
New	**Multiscale Fracture Analysis and Modelling for Improved Geomechanical Assessments C37028** Michael Munro, GMEK $197,250	Leigh Bergin, Stanmore Resources Matt Tsang, Anglo American Steelmaking Coal	The main objective of this proposal is to provide a more realistic and quantifiable methodology to assess the principal geotechnical hazards in highwall slopes, ultimately improving the safety and efficiency of mining operations. The aim is to significantly enhance the understanding of fractured rock masses at coal mines by integrating more data and key geologic drivers into modelling. This study builds upon several previous geotechnical studies supported by ACARP.
Health and Safety			
Complete	**Relevance and Applicability of Inhalable Dust and Current Issues with AS3640 C33008** Mehmet Kizil, University of Queensland $244,833	Andrew Lau and Sharif Burra, Yancoal Kevin Rowe and Tony Egan, Glencore Coal Assets Australia	This research focused on investigating the relevance of inhalable dust particulates and its adverse health effects associated with exposure of these particulates to coal mine workers. It validates the applicability of the inhalable dust monitoring program currently implemented and identify issues with AS3640 (Workplace atmospheres - method for sampling and gravimetric determination of inhalable dust), and examines the suspension of inhalable dust person exposure limits in USA.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Live Monitoring of Workplace Exposures In Surface Mobile Equipment C36033** Andrew Westaway, SafeOperate $152,000	Shane Apps, Peabody Australia Coal	This project will establish and deploy a system that enables continuous live monitoring of exposures to various hazardous workplace agents at mines with the data recorded and transferred to a centralised database. The information generated by the system will be used to identify exposure exceedances and trigger real-time alerts. More effective management of these health hazards including proactive detection of changes in exposure and faster responses will reduce injuries and illnesses and, subsequently, cost.
Maintenance and Equipment			
Complete	**Preventing Fatigue Cracking Via Proactive Surface Dressing C26020** Simon Krismer, Bureau Veritas AIRS $126,940	Shane Saunders, Yancoal	Condition monitoring mining equipment and structures for fatigue cracking is costly. Proactively dressing surfaces susceptible to fatigue cracking could be significantly cheaper than condition monitoring in terms of labour costs and downtime. This project assessed the effectiveness of using surface linishing to remove accumulated fatigue damage. Surface linishing is a cheap, readily accessible technique that requires no special tooling.
Complete	**Vibration Energy Harvesting for Self Powered Sensors at Mine Sites C33033** Binghao Li, University of New South Wales $145,860	Brendan Wilkins, Anglo American Steelmaking Coal Peter Walsh and Tim Gray, Glencore Coal Assets Australia	Replacing batteries in the many sensors used in underground and open cut mines is a time consuming process. Self powered sensors using energy harvesting could be a viable alternative. Energy harvesting captures small amounts of energy that would otherwise be lost as heat, light, sound, vibration or movement. This project assessed the potential of using vibration energy harvesting to power underground mine sensors.
Current	**Dozer Suspension Seat to Reduce Body Vibration C33034** Danellie Lynas, University of Queensland $83,107	Shane Apps, Peabody Australia Coal Tim Gray, Glencore Coal Assets Australia Troy O'Reilly, Stanwell Corporation	Long term exposure to whole body vibration causes a range of adverse health effects, particularly back disorders. Dozers operate on a variety of surfaces, including the coal floor, basalt and softer overburden, which expose operators to whole body vibration transmitted through the seat. This project will evaluate the effectiveness of an innovative passive vibration and movement cancelling seat prototype in reducing dozer operator exposures to excessive whole body vibration during normal operation at surface coal mines.
Complete	**Radar Tyre Monitor System C33036** Luke Powell, CSIRO $132,382	Brendan Wilkins, Anglo American Steelmaking Coal Rob Fraser and Tim Gray, Glencore Coal Assets Australia	Early detection of tyres at risk of zipper failure – a rapid progressive failure of the cords and explosive rupture of the tyre carcass – is needed. Researchers developed a low cost, continuous monitoring and warning system prototype to detect tyres exhibiting signs of fatigue. They also trialled a radar based tyre monitoring prototype technology to detect damaged radials and other catastrophic tyre failure indicators.
Complete	**Human Aspects of Automation and New Technology in Mining: Integrating People and Technology Through Human Centred Design C34026** Robin Burgess-Limerick, University of Queensland $375,573	Belinda Martin, David Martin ands Leveson Sutton, BHP Tony Egan, Glencore Coal Assets Australia	Achieving the productivity and safety improvements expected from automation requires careful consideration of the capabilities and limitations of humans as well as the characteristics of the technology. This project explored how the automated subsystems and other new technologies being introduced to coal mines can fully accommodate human abilities and limitations and be fully integrated into overall operational technology systems. Researchers will describe, demonstrate, and disseminate the tools and techniques required for this transition.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Reducing Noise Emitted by Heavy Vehicles in Open Cut Coal Mines C34031** Mahmoud Karimi, University of Technology Sydney $231,645	Brendan Wilkins, Anglo American Steelmaking Coal Tim Gray, Glencore Coal Assets Australia	Dump trucks, excavators and other turbomachinery are major causes of noise in open cut mines. Because most noise attenuators in mining machinery use old technology, their performance is poor. This project aims to develop advanced mathematical models to optimise noise attenuators in the intake and exhausts of cooling systems used in turbo machinery.
Complete	**Development of Innovative Lock Ring Free OTR Wheel C34038** Lenny McInnes, University of Queensland $60,000	Brendan Wilkins, Anglo American Steelmaking Coal Rob Fraser and Tim Gray, Glencore Coal Assets Australia	Large off road mining equipment employ wheel designs that use lock ring retainers which are a safety hazard. A new wheel concept has been designed which removes the lock ring and controls release of the compressed gas hazard in the event of a failure. In this project, researchers undertook detailed design and validate the function and operation of the fail-safe OTR wheel.
Complete	**Human Centred Interactive Training Experiences in OTR Tyre Handling C35020** Sara Pazell, ViVA! Health at Work $688,282	Brendan Wilkins, Anglo American Steelmaking Coal Rob Fraser, Tony Egan and Tim Gray, Glencore Coal Assets Australia	The nationally recognised competency requirements for tyre servicing do not adequately address the human factors required in handling off-the-road mining equipment tyres and rims. This project provides a safety-critical task-based training needs analysis to inform tyre handling learning experiences. An ethnographic, qualitative human factors approach with cognitive task analysis was undertaken to examine the training and learning needs of tyre technicians in handling tyre equipment.
Current	**In-situ Slew Bearing Scanner for Shovels C36019** Matthew Robinson, Ascribe Engineering $150,000	Brendan Wilkins, Anglo American Steelmaking Coal Tim Gray and Tyson Burkitt, Glencore Coal Assets Australia	This project aims to develop a miniaturised scanner to examine slew bearing rails on shovels to provide mine sites with more accurate assessment of their condition and remaining life. Improved knowledge of the condition of the slew bearing enables longer operation of the bearing, while reducing the operational risk of a sudden failure. The miniature scanner will also improve safety by removing the need for manual inspection in the shovel's confined space. Such scanners are already available for draglines but are too large for installation on shovels. The project will develop the scanner and undertake a trial scan as proof of concept.
New	**People and Process: Case Review on Human Systems Integration and OTR Tyre Handling Mobile Plant in Mining Operations C37007** Sara Pazell, ViVA! Health at Work $150,162	Brendan Wilkins, Anglo American Steelmaking Coal Rob Fraser, Tony Egan and Tim Gray, Glencore Coal Assets Australia	Off-the-road (OTR) tyre handling operations expose technicians to fatal hazards. An approach that adequately considers people and processes when selecting and using tyre-handling equipment leads to safer working conditions by mitigating fatal hazards and improving the design of systems or equipment. This project aims to improve the understanding of how decision makers influence the integration of OTR tyre handling equipment in mining maintenance services, and to address the needs of current and future mines with a person-centred, systems view on resilient and reliable tyre handling operations.
New	**Concept to Produce Pure Plant Oil Economically for Captive use at Mine Site to Replace Diesel C37021** Charles Easton, Green Biofuels Australia $265,000	Andrew Lau, Yancoal Myf Godfrey, BHP Shaun Booth, Glencore Coal Assets Australia	The Australia Government has introduced a financial penalty mechanism to encourage facilities that have Scope 1 emissions above 100,000 T CO2-e per year to reduce their emissions by 4.9 % annually. For most mines, most Scope 1 emissions come from the use of diesel fuel. This project will provide an economically viable way to reduce Scope 1 emissions by using a locally grown Pure Plant Oil (PPO) to replace mineral diesel in haul trucks and other mining equipment. The project focusses on production of PPO from Pongamia, and to encourage uptake of PPO production, methods will be developed to enable oil production in year one and increase as the Pongamia trees mature through innovative intercropping of oil seed species.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Mining and the Community			
Complete	**Broader Contribution of Coal Sector Employment to Indigenous Individuals, Families and Communities C28046** Michael Limerick, Myuma $199,472	Andrew Lau, Yancoal	The Queensland coal industry more than tripled the number of Aboriginal and Torres Strait Islander employees between 2006 and 2016, but the impact of employment on the life circumstances of these people has not been quantified. This project documents changes in the life outcomes of a cohort of individuals employed in the coal industry over a sustained period and the flow-on benefits to their families and communities. Statistical data, surveys and in-depth interviews were used.
Rock Mechanics			
Current	**System for Rock Fall Analysis Field Trial C29005** Marc Elmouttie, CSIRO $321,268	Matt Tsang, Anglo American Steelmaking Coal	Systems to detect, monitor and analyse rock falls in open cut mining operations have the potential to improve operational safety, improve calibration of rock fall simulators and provide quantitative data to justify current standoff designs. A monitoring system that can accumulate a large database of rock fall events across the full strike length of highwalls was designed in an earlier stage of this project. In this extension, the prototype system underwent a field trial. The overall project aim was to support development of a commercially available rockfall monitoring system capable of accurately identifying rockfall events, locations and trajectories across the full strike of highwall, potentially in real time.
Complete	**Image Based Automated Characterisation of Waste Materials C29048** Simit Raval, University of New South Wales $279,540	Ned Stephenson, Glencore Coal Assets Australia	The stability of waste dumps is influenced by many factors, including dump geometry, geological and geotechnical conditions of the landscape, hydrological condition, physical and chemical composition of the dumped waste rock. High-resolution imaging and photogrammetric algorithms are being used to map the 3D shape and structural details of mining landscapes, including dumps, at the required scale and interval. However, given the scale of the generated image data and the need to instantly convert this data into useful information, an automated approach is required for better dump management. This project aimed to develop machine learning-based automated waste material classification system using high resolution imagery collected from the airborne (drone) and ground sources.
Current	**Machine Learning for Rockfall Analysis C33040** Klaus Thoeni, University of Newcastle $342,240	Matt Tsang, Anglo American Steelmaking Coal	Rockfall is a major safety hazard in open pit mines. The ability to gather extensive rockfall data along a full strike length of highwall and effectively use this data to predict the rock trajectory and the associated hazard is challenging as their variability can significantly influence rockfall motion characteristics. This project will expand the previously developed machine learning and artificial intelligence approaches to include more site-specific information, such as stratigraphy, geology and geostructural mapping and using such data for both training and validation purposes.
Current New	**Quantifying Hoek-Brown Disturbance Factor (D) for Coal Measures Through an Integrated Laboratory and Numerical Modelling Approach C35022** Italo Onederra, University of Queensland $355,776 Current $316,386 New	Matt Tsang, Anglo American Steelmaking Coal Peter Chern, Coronado Coal	At present, in slope stability analysis, the Hoek-Brown Disturbance Factor (D) is assumed to remain constant, failing to reflect expected variability. In response, the previous stage of this project sought to refine techniques for defining D by establishing more realistic blast-induced damage profiles. This project extends that work, focusing on the validation of our new blast damage predictive model. The primary objective is to conduct targeted blast monitoring campaigns to validate the model's accuracy.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**From Open Pit to Pumped Hydro Energy Storage, a Focus on Low Wall Stability C36017** Olivier Buzzi, University of Newcastle $405,500	Andrew Lau, Yancoal Shaun Booth and Tyron Domenici, Glencore Coal Assets Australia Troy O'Reilly, Stanwell Corporation	This project is a first step to transforming residual voids on open cut mines into viable pumped-hydro energy schemes as it answers questions of low-wall stability that are specific to their operation. This project aims to determine why a low-wall might fail due to water level fluctuations associated with pumped hydro and provide guidance on mitigating geotechnical failure risks. This project could provide the industry with a viable post mining alternative land use beyond traditional vegetation replacement.
Current	**Measuring the Tensile Strength of Thin Units in Coal Measure Rocks using a Comminution Approach C36021** Katerina Savinova, University of Queensland $214,100	Andrew Lau, Yancoal Jianping Li, BHP Matt Tsang, Anglo American Steelmaking Coal	This project will provide valuable insights and tools to geotechnical engineers and mining professionals, enabling them to better characterise and understand coal measures, ultimately leading to safer and more efficient mining practices. Most slope failures and ground instability in Australian coal mines occur due to extension strain and tensile fracture initiation and propagation. However, commonly used rock mass strength criteria assume shear failure. There is a need to measure intact tensile strength to develop site-dependent properties for design. Core sampling difficulties often preclude sourcing and measuring the strength of thin units in coal measure rocks. To address this problem, a solution can be borrowed from comminution and applied to the mining/geotechnical sector, which has the potential to derive rock tensile strength from rock chips or drilled mini core of a representative sample.
Current	**"SCANDY" - A handheld Imaging System for Real Time Spoil Categorisation C36023** Simit Raval, University of New South Wales $178,050	Jacques Strydom, Anglo American Steelmaking Coal Ned Stephenson, Glencore Coal Assets Australia Tim Vangsness, BHP	This handheld imaging system will aid the assessment of coal spoil piles in real time to enable proactive risk management and timely interventions to prevent failures. This would contribute to long term dump stability. Once implemented, the system could also offer real time guidance to operators through ground inspections about optimal unloading areas to further enhance stability and prevent imbalanced dumping. The long term sustainability of rehabilitation efforts in dump environments is a critical concern within the mining industry and successful rehabilitation is reliant on accurate material characterisation and mapping.
New	**Improved Change Detection for Low Cost Terrestrial Photogrammetric Monitoring Based on Deep Learning C37011** Klaus Thoeni, University of Newcastle $273,196	Ben Forrest, Whitehaven Coal Gareth Johnson, Hunter Valley Operations	The main objective of this research is to develop an improved change detection algorithm that can accurately detect rockfall events and slope instabilities by utilising deep learning techniques. It follows on from a previous project, which developed a low-cost photogrammetric monitoring system that enables identification of rockfall sources on the rock surface and measure detached volumes. However, the system requires improvements to enable more efficient and flexible application on site. Rockfall and slope stability hazards can have significant safety and financial consequences in open cut mines. Cost efficient monitoring of tailing dams, waste dumps and highwalls during and post mining is of paramount importance to current operations and for future use of remaining voids and rock faces beyond the life of the mine.

ACARP is focused on research aimed at minimising emissions and reducing the environmental impact of the industry. The Coal Preparation Committee has identified the following key priority areas to support this goal:

- Optimal tailings management and closure practices.
- Energy and water efficiency.
- Remote and autonomous development technologies on stockpiles.
- Asset utilisation, maintainability and reliability.

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

Increase in yield of fine coal through agglomeration is particularly targeted while maintaining research that seeks to minimise the contribution of coal processing on the environment, e.g. by reusing tailing for soil enhancement, 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.

COMMITTEE MEMBERS

Luke Dimech	**BMA Principal Process Engineering (co-chair)**	**BHP**
Kevin Rowe	**Group Manager (co-chair)**	**Glencore Coal Assets Australia**
Spencer Brien	CHPP Process Engineer	Yancoal
Thomas Buckby	-	Glencore Coal Assets Australia
Dan Delahunty	Coal Quality and Logistics Superintendent	Yancoal Australia
Chris Denyer	Coal Processing Specialist	Anglo American Steelmaking Coal
Araz Ejtemaei	Specialist System Dynamics	BHP
Nathan Evans	CHPP Manager	Peabody Australia
Jenny Goh	Group Process Engineer	Glencore Coal Assets Australia
Alistair Harriman	Group Manager – CHPP	Whitehaven Coal
David Hensley	Principal Process Engineer	Kestrel Coal Resources
Han Hooi	Principal Process Engineer	BHP Minerals Australia Projects
Chris Huth	Electrical and Controls Advisor, Operations	Sedgman
Josh Kowalczuk	CHPP Manager, Mt Owen CHPP	Glencore Coal Assets Australia
Jack Lauder	Group Process Engineer (North)	Glencore Coal Assets Australia
Chris March	CHPP Projects Manager	Glencore Coal Assets Australia
Frank Mercuri	Coal Processing Manager	Anglo American Steelmaking Coal
Dan Mujic	Senior Process Engineer Thiess Lake Vermont	Thiess
Ben Murphy	Manager Engineering	Coronado Global
Chris Nethercott	Manager Systems and Innovation	Sedgman
Jenny Park	Process Engineer (South)	Glencore Coal Assets Australia
Dan Perkins	CHPP Manager Lake Vermont	Thiess
Jimmy Pollack	Principal Process Engineer	Golding
Ed Provan	Senior Process Engineer – Oaky Creek CHPP	Glencore Coal Assets Australia
Naresh Racha	Coal Chain Superintendent	Meandu Mine - Stanwell Corporation
Mel Robbins	Superintendent Quality Governance	BHP
Chloe Scholtz	Process Engineer	Bengalla
Jason Schumacher	Coal Quality Engineer	Yancoal
Nigel Seto	Senior Process Engineer	Pembroke
Colin Surawski	Senior Process Engineer	Yancoal
Clinton Vanderkruk	Capcoal CHPP Manager	Anglo American Steelmaking Coal
Penny Walker	CHPP Superintendent	Malabar Resources
Tom Wilson	CHPP Manager	MACH Energy

PROJECTS UNDER MANAGEMENT

Category	No of Projects	ACARP Funding
Dewatering	10	$2,444,984
Environmental Improvement	4	$2,274,897
Fine Coal	16	$7,104,686
General	5	$1,209,629
Gravity Separation	6	$1,140,494
Maintenance and Equipment	3	$1,278,397
Process Control	5	$1,310,483

NEW FUNDING

ACARP supports projects with immediate need outside the yearly funding round. These projects are included within this report as new funding.

No of Projects	ACARP Funding	Total Funding
6	$1,804,867	$1,999,588

Total Funding includes in-kind support provided by the researcher and host mine as identified in the research proposal.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Dewatering			
Complete	**Surface Alloying of Centrifuge Baskets and Sieve Bends Screen Surfaces to Increase the Service Lifetime C28056** Teresa Kittle, CSIRO $131,644	Caitlin Campbell, BHP	Wear of centrifuge baskets and sieve bends is a significant maintenance cost and can result in plant downtime. A laser technique was used to test hardening the surface of stainless steel wedge wire in the screening media of these components in order to extend surface wear.
Current New	**Tailings Management - Dewatering Flume Site Trials C29060** Craig Wheeler, University of Newcastle $242,500 Current $36,000 New	Kevin Rowe and Peter Schumack, Glencore Coal Assets Australia	Dewatering of tailings can be a complex and expensive process. An open flume provides a simple method for dewatering slurries at a disposal site. Using this method, concentration of solids entering the tailings dam is increased and water recovered and recycled back to the preparation plant before deposition into the dam. A pilot scale open flume was tested in a previous project, successfully dewatering coal slurries without the addition of flocculent. The aim of this project is to design and build a full-scale flume to be trialled on site.
Complete	**Capability for Dewatered Tailings and MPR Testing in Support of a Critical State Soil Mechanics Framework for Potential Liquefaction Assessment C33048** Jubert Pineda, University of Newcastle $232,600	Jianping Li, BHP Kevin Rowe, Glencore Coal Assets Australia	Testing of fine coal materials in the unsaturated state, such as dewatered tailings, is inherently complex and requires precise measurement of both pore air and pore water volume changes to accurately evaluate the changing degree of saturation. Researchers aim to commission laboratory testing equipment to generate quality data, from which a new state-of-the-art model for the mechanical characterisation of preparation plant wastes can be developed. This project developed the capacity to test fine waste materials across the saturated and unsaturated regimes. It produced sufficient preliminary data to evaluate the potential to serve as the basis of a predictive model for unstable liquefaction behaviour of mixed plant rejects, that can be used in geotechnical stability assessments for open cut spoil dumps.
Current	**Emerging Pulsed Power Technology for Dewatering Mineral Tailings C33049** Mansour Edraki, University of Queensland $277,630	Dan Delahunty, Yancoal Jack Lauder, Glencore Coal Assets Australia	Mechanical dewatering of wet tailings is expensive and eliminating final moisture remains challenging. A new dewatering method is proposed that uses pulsed electric fields to liberate water bound within, or to, the mineral component. A bench top study will be undertaken to test the system at two scales (1L and 5L).
Current	**Dewatering Efficiency of Fine Flotation Concentrates by De-Aerating Froth Products - Plant Demonstration C33050** Yongjun Peng, University of Queensland $677,923	Frank Mercuri, Anglo American Steelmaking Coal Naresh Racha, Stanwell Corporation Shivank Vijayakumar, BHP	The presence of tenacious froth in coal preparation plants significantly decreases the dewatering efficiency in thickening and filtration. To address this issue, two pilot scale froth deaeration units were designed, manufactured and successfully tested in coal preparation plants. In this project, large, fully automated, demonstration scale mechanical and vacuum deaerators will run continuously in selected plants to identify optimum operating conditions and control strategies.
Current	**Hybrid Microwave Technology for Dry Stacked Tailings Applications C33051** Christian Antonio, University of Queensland $121,335	Frank Mercuri, Anglo American Steelmaking Coal Kevin Rowe, Glencore Coal Assets Australia Naresh Racha, Stanwell Corporation	Dry stack tailings are an alternative method to storing wet tailings in dams; however, conventional dewatering techniques, such as thickeners and filtration, do not sufficiently reduce tailings moisture. This project will use hybrid microwave technology to reduce the tailings moisture content to the level required for dry stacking. This technique has less operational and capital costs than traditional methods.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Complete	**Improving Centrifugal Dewatering via Modelling and Analysis C33053** Liguang Wang, University of Queensland $149,400	Clinton Vanderkruk, Anglo American Steelmaking Coal Colin Surawski, Yancoal Josh Kowalczuk, Glencore Coal Assets Australia	Existing processes used to dewater ultrafine coals are inefficient in terms of moisture reduction and/or solids recovery. This project aimed to improve the operation and control of centrifugal dewatering by developing a model for pilot scale and full scale screen bowl centrifuges that focused on filtration within the screen section, including cake formation and transportation.
Current	**Cost Effective Approach for Coal Tailings Dewatering using Semi Inverted (SIV) Hydrocyclones C34051** Christian Antonio, University of Queensland $174,500	Jenny Goh, Glencore Coal Assets Australia Naresh Racha, Stanwell Corporation Tom Wilson, MACH Energy Australia	Dry stack tailings reduce the space required for waste storage and decrease the potential environmental and geotechnical risks of tailings storage facilities. However conventional technologies to dewater tailings are ineffective. This project will use semi-inverted hydrocyclone technology to split the thickener's underflow into a coarse stream (underflow product), with reduced moisture content, and a fines stream (overflow product). This process will enable fine clay particles to be captured in the fines stream and, consequently, improve the efficiency of downstream dewatering units.
Current	**Improving the Dewatering of Fine Coal Tailings by Minimising Micro-Nano Bubbles C35032** Yongjun Peng, University of Queensland $238,470	Han Hooi, BHP Naresh Racha, Stanwell Corporation Tom Henshaw, Glencore Coal Assets Australia	Dewatering fine coal for tailings disposal and water recycling has been a major challenge in the coal industry. In this project, researchers will focus on minimising micro-nano bubbles to improve the dewatering of fine coal tailings. They aim to increase water recycling by reducing cake moisture from mechanical dewatering and improve the handability and stability of dewatered tailings for improvements in pit disposal.
Current	**Green and Effective Reagents for Centrifugal Dewatering C36025** Liguang Wang, University of Queensland $198,982	Chris Denyer, Anglo American Steelmaking Coal Jenny Park, Glencore Coal Assets Australia Naresh Racha, Stanwell Corporation	This project will help minimise greenhouse gas emissions and the environmental impact of the Australian coal industry by improving the dewatering of fine and ultra-fine coals and tailings. This will be achieved by finding more effective and environmentally responsible reagents to reduce product moisture and improve solids recovery of fine and ultrafine coal in the dewatering processes. This would reduce tailings disposal and maximise water recovery and recycling. The existing processes result in loss of valuable fresh fine coal to effluents, loss of profit for Australian coal producers and the creation of a potential environmental liability with increased burden to tailings disposal. Specialty dewatering aids have been developed, but there is no clear guide to reagents suitable for dewatering of Australian black coals and tailings.
Environmental Improvement			
Current	**Tailings to Topsoil C29042** Ken Williams, University of Newcastle $765,300	Bill Baxter, Yancoal Paul O'Loughlin, MACH Energy Australia Phillip Enderby, Hunter Valley Operations	This project aimed to develop and deliver a transformational alternative technology to the management of coal tailings; that is, an integrated bulk material emplacement technology tailored for soil improvement. A purpose built mobile dewatering plant was central to the interface between the tailings to topsoil emplacement. The delivery system integrates the conventional slurry tailings transport mechanisms with an innovative high efficiency solids separation mobile tailings handling plant. In the extension to the project plant growth measurement, soil profile analysis and microbial identification was used in greenhouse and in-situ field trials to identify the benefits and challenges of using tailings and the effect on dfferent plant species during site rehabilitation.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Complete	**Utilisation of Coal Mining Tailing in Australian Cement Production C35019** Hassan Baji, Central Queensland University $277,017	Kevin Rowe and Shaun Booth, Glencore Coal Assets Australia Luke Dimech, BHP	This project tested the feasibility of incorporating coal mine tailings as an alternative raw material in cement and concrete production. The project was a laboratory based study, in which coal tailings from different sites across the Bowen and Sydney Gunnedah basins were used as pozzolanic materials in concrete production and as raw materials in clinker production.
Current	**Non-invasive and Real Time Monitoring of Slurry Tailings Density and Velocity in the Transmission Pipeline using Electrical Resistance Tomography Method C35033** David Williams, University of Queensland $259,000	Naresh Racha, Stanwell Corporation Peter Shumack, Glencore Coal Assets Australia	The most common in-situ method of measuring slurry coal density and velocity in a transmission pipeline uses Gamma rays which have a high radioactive risk. This data is used to assess water use efficiency to enhance water recycling. In this project, researchers aim to develop a holistic monitoring solution to measure the density and velocity of transported slurry coal tailings directly from the transmitting pipeline using electrical resistivity tomography.
Current	**Cost Effective Rehabilitation of Tailings Dams C35048** Mike Cole and Carmen Castor, CSER Research $973,580	Andrew Lau, Yancoal Brooke York and Shaun Booth, Glencore Coal Assets Australia	Ecological factors and the physics and chemistry of soil media are critical to the success of flora species in mine rehabilitation. This project aims to develop a final landscape plan for tailings dams and surrounds by testing tailings and rehabilitation amelioration techniques to maximise plant diversity. Researchers also aim to maximise the root-microbe associations in key plant functional groups that are linked to sustainable nutrient acquisition and cycling on spoil placement areas and tailings dams.
Fine Coal			
Complete	**Reflux Classifier to 4mm Top Size - Full Scale Trial (Construction of Test Rig) C22046** Kevin Galvin, University of Newcastle $1,261,754	Kevin Rowe, Glencore Coal Assets Australia	This project moved an innovative process improvement from the laboratory to a trial in an operating plant. A larger size feed, up to 4mm, was directed to the Reflux Classifier, thereby reducing the load to dense medium cyclones. The work shoed the potential to increase plant throughput for a given capital expenditure.
Complete	**Improving Flotation Recovery and Throughput with a Combined Method C29061** Liguang Wang, University of Queensland $199,000	Clinton Vanderkruk, Anglo American Steelmaking Coal Doug Field-Akred, BHP Kevin Rowe, Glencore Coal Assets Australia	This project developed and evaluated a new method of using oscillatory air supply and vibrators to further improve flotation recovery. Microbubble generation (using an external sparging system with oscillatory air supply) was combined with dynamic stabilisation of bubbles (using waterproof speakers or other vibrators). Laboratory-scale, pilot-scale and full-scale trials were carried out for Australian coals of different properties and size ranges.
Complete	**Wash Plant Fines Testing Methods Enhancement C29065** Chris McMahon, McMahon Coal Quality Resources $197,330	Frank Mercuri, Anglo American Steelmaking Coal Jason Schumacher, Yancoal	Accurately estimating the proportion of expected fine coal from bore core is critical to the design and operation of preparation plants and predicting economic potential of the resource. This project devised and tested an enhanced alternative drum tumbling apparatus to better determine predictive size distribution. The outcomes were the design and testing of currently available laboratory preparation apparatus, for additional breakage definition.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Complete	**Optical Profiling of Coal and Mineral Particles in the Ultrafine Circuit for Online Analysis C33055** Rohan Stanger, University of Newcastle $157,387	Clinton Vanderkruk, Anglo American Steelmaking Coal Jason Schumacher, Yancoal Michael Carnell, Glencore Coal Assets Australia	This project aimed to improve the measurement of ultrafine coal and mineral particles for online analysis in flotation and thickener streams in relative time (within minutes). Researchers upgraded their particle profiler system to provide better resolution of smaller particles (currently limited to a minimum of 100µm) and enhanced the software to enable ID tagging of multiple mineral phases. This provides a rapid quantification of rejected coal in tailings streams, minerals in product coal, and other performance indicators for plant control.
Complete	**Full Scale Studies of Diesel Emulsification by Ultrasonication for Fine Coal Flotation C33058** Anh Nguyen, University of Queensland $180,000	Clinton Vanderkruk and Frank Mercuri, Anglo American Steelmaking Coal Luke Dimech, BHP	Because coal is naturally hydrophobic, diesel and kerosene are used to increase coal hydrophobicity for flotation. It is common for these oil based collectors to be dispersed mechanically, which is an inefficient process. Ultrasonic emulsification is a novel and efficient technology which produces fine collector droplets for increased flotation recovery, particularly for weakly hydrophobic coal particles. In this project, researchers designed and constructed an ultrasonic unit for full scale studies at an Australian coal preparation plant. They evaluated and benchmarked the technical and financial benefits of the adapted oil-in-water emulsification technology for coal flotation.
Current New	**Full Scale Beneficiation of Coal Fines by Novel Agglomeration C34002** Kevin Galvin, University of Newcastle $3,339,000 Current $1,285,256 New	Jason Schumacher, Yancoal Jenny Goh, Kevin Rowe and Paul Sainsbury, Glencore Coal Assets Australia Luke Dimech, BHP	Concentrated water in oil emulsion can be highly effective in achieving ultrafast and ultrafine particle recovery while delivering a low ash and moisture product. This project will investigate the scale-up of a novel fine coal agglomeration technology through a study at full-scale. The work to be undertaken involves the design, commissioning and operation of the novel agglomeration technology known as 3D Binder Flotation. The feed source is expected to be a fine coal tailings stream suitable for the thermal market. The study seeks to quantify the scale-up using feed rates of up to 500 m3/h in terms of yield, ash, moisture and economic benefits. The novel agglomeration technology offers the prospects of a low capital investment for processing the fine coal tailings stream normally sent to the thickener.
Current	**Optimising the Diesel Droplet Size in Coal Preparation Plants C34040** Yongjun Peng, University of Queensland $231,157	Chris Denyer, Anglo American Steelmaking Coal Han Hooi, BHP Jason Schumacher, Yancoal	Optimising the droplet size of diesel emulsion in coal flotation can improve flotation, reduce diesel consumption and quickly mix the diesel and coal slurry without the need for conditioning tanks. This project seeks to determine the optimal diesel droplet size in coal preparation plants and then implement the most suitable diesel emulsification system with online droplet size measurement and control in the plants.
Complete	**Coal Spiral for the 2020s C34041** Wendy Nutt, Mineral Technologies $199,646	Dan Delahunty, Yancoal Naresh Racha, Stanwell Corporation Phillip Enderby, Hunter Valley Operations	Researchers aimed to develop an enhanced coal processing spiral based on learnings from improvements in spiral designs used in other mineral processing operations. The new spiral design was to be tested and evaluated on both thermal and coking coal spiral circuit feeds. Overall, all the project did not meet original objectives, despite an expansive test work program and the number of circuit configurations trialled.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**In Plant Demonstration of the Next Generation Flotation System C34043** Liguang Wang, University of Queensland $258,347	Kevin Rowe and Nic Roberts, Glencore Coal Assets Australia	A recent research breakthrough shows that microbubbles smaller than 100µm can be cheaply generated under oscillatory flow by connecting a diffuser/sparger to the outlet of a fluidic oscillator. The technique significantly reduces reagent use and energy consumption. In this project, researchers will develop a prototype fluidic oscillator to optimise the sparging system and provide detailed scale-up information.
Current	**Real Time Automatic Measurement of Frother Distribution in a Coal Preparation Plant C34045** Liguang Wang, University of Queensland $124,560	Chris Denyer, Anglo American Steelmaking Coal Peter Shumack, Glencore Coal Assets Australia	A new frother concentration measuring technique, based on quantifying the specific interaction between frother molecules and a formulated liquid, was developed in a previous project. This project will further assess and demonstrate a cheap and simple prototype system for real-time, automatic measurement of frother concentrations. The aim of the system is to manage frother consumption and water reuse to maximise coal recovery and prevent the overfrothing ('froth out') problem.
Current	**Froth Flotation Predicted v Actual Definition C35024** Chris McMahon, McMahon Coal Quality Resources $41,360	Jason Schumacher, Yancoal Jenny Goh, Glencore Coal Assets Australia Mel Robbins, BHP	Correct outcomes in froth flotation yield predictions for product ash from bore core exploration is critical to resource predictive potential, market evaluation and economic mining outcomes. This project aims to produce a guide for estimating accuracy of froth flotation predicted data by type of testing. Using existing data, several froth flotation methods from bore cores, including the pseudo-density method (with efficiency factors trialled to fit data) will be evaluated against actual data.
Current	**Demonstrating Better Classifying Cyclones C35031** Andrew Vince, Elsa Consulting Group $377,475	Clinton Vanderkruk, Anglo American Steelmaking Coal Jack Lauder and Jenny Park, Glencore Coal Assets Australia Jimmy Pollack, Golding	In the late 1990s, the Rong classifying cyclone concept (RCCC) demonstrated significant improvement in cyclone performance, but the design technology was not progressed. A three-month assessment of the RCCC in 2022 concluded that small changes in the way it is tested could lead to a successful industrial demonstration. This project will produce Tromp curves for different particle sizes which can be used to objectively compare the RCCC with any other device.
Current	**Working Effectively with Swelling Clays in Fine Coal Flotation to Improve Product Quality and Recovery C35034** Ngoc Nguyen, University of Queensland $200,304	Ed Provan and Jack Lauder, Glencore Coal Assets Australia Jason Schumacher, Yancoal Luke Dimech, BHP	Fine clays in coal flotation can negatively impact the recovery, ash content and moisture of fine coal concentrates. This project aims to use wash water bias and clay suppressants to reduce the product ash (clay) thus increasing yeild.
Current	**3D Particle Surface Composition Analysis for Flotation Using Micro CT C35035** Rohan Stanger, University of Newcastle $81,730	Araz Ejtemaei, BHP	Micro computed tomography (micro-CT) is a non-destructive, X-ray-based technology that provides 3-dimensional information on the internal structure of solid objects. This project will determine the efficacy of using micro-CT 3-dimensional analysis for flotation characterisation. If successful, the technique will provide an avenue for faster and more representative characterisation of ultrafine particles for the flotation circuit.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Side-by-Side Analysis of Coal by Automated Micro-CT and Commercial Laboratory Testing C36026** Rohan Stanger, University of Newcastle $167,432	Mel Robbins, BHP Michael Saxby, Glencore Coal Assets Australia Tom Wilson, MACH Energy Australia	The outcome of the project will be a robust evaluation of automated coal analysis by micro-CT. Analysis time, accuracy, and uncertainty will be compared against standard commercial laboratory testing to provide a basis for commercial investment in this technology. The benefits to industry would be faster analytical services for size and density distributions, potentially at much lower cost. Other benefits are reduced exposure to heavy organic liquids for laboratory personnel and improved data, reducing uncertainty across the coal industry from borecore evaluation through to process diagnostics.
Current	**Testing a Novel Flotation Concept for Coal C36029** Nerrida Scott, CSIRO $88,204	Frank Mercuri, Anglo American Steelmaking Coal Jenny Goh and Michael Saxby, Glencore Coal Assets Australia	Most existing flotation equipment consumes considerable space in coal handling and preparation plants. The drawback of existing designs is that, as the scale of flotation equipment becomes larger, costly inefficiencies are introduced. This project's flotation concept augments the performance of existing units without the need for a high cost upgrade. The project will test a low cost, prototype flotation unit for floating coal on a very small footprint, suitable for applications such as tailings fine coal recovery or similar space-restricted applications. Benefits include cost effective recovery of fine coal tailings on a small footprint, and after further development, retrofitting into existing plant as an auxiliary flotation system.
New	**Industrial Particle Sampling Systems for the Particle Profiler in Fine and Ultra-Fine Circuits C37016** Rohan Stanger, University of Newcastle $178,404	Chris Denyer, Anglo American Steelmaking Coal Jenny Goh and Michael Saxby, Glencore Coal Assets Australia	Particle Profiler technology has been developed over successive ACARP projects to measure particle size and density distributions in a dilute stream. For online monitoring of fine coal circuits, the technology now needs to be implemented in a coal preparation plant. This project will develop two small sampling systems and make two particle profiler units more durable for online analysis of fine coal and ultrafine coal streams. This is considered the final stage of development to evaluate the technology's operation in-plant. The benefits to industry will be a new level of precision in monitoring the fine circuits of a coal preparation plant.
General			
Complete	**CSIRO Instruments at Multiple Plants C26011** Teresa Kittel, CSIRO $427,798	Frank Mercuri, Anglo American Steelmaking Coal Luke Dimech, BHP	Instrumentation to monitor the stability of Dense Medium Cyclones has operated successfully under production conditions in one plant producing thermal coal products. Researchers have used the data to determine the effect of changes in plant conditions on DMC operation. In this project researchers determine the effect of changes in plant conditions on the operation of the DMC circuit over a range of mining companies, plant designs and product coal types.
Complete	**Benefits of Online Thickener Underflow Rheology Measurements C26016** Noel Lambert, Clean Process Technologies $251,000	Michael Carnell, Glencore Coal Assets Australia	Although the thickener underflow monitor is able to generate information about the rheology of coal thickener underflow, plant operators are not using this data. This project will determine how these rheology measurements can be applied to standard thickener operations, paste thickener operations, secondary thickening operations, belt filter presses and other mechanical dewatering devices. There are no existing online rheology measurements of thickener underflow and it may be possible with online measurement to reduce flocculant dose rates, particularly where flocculant is dosed after the thickener.
Current	**Quantitative Based Structural Integrity Evaluations Using Modal Parameters Estimation C28061** Fidel Gonzalez, Mincka Engineering $363,651	Chris Jackson, Kevin Rowe and Peter Shumack, Glencore Coal Assets Australia Phillip Enderby, Hunter Valley Operations	Structural integrity of equipment and infrastructure is a significant risk for coal mining operations. Evaluations of structural conditions are conducted using subjective methods, such as visual inspections. This project aims to develop a technique for reliable, cost-effective and objective structural condition assessments of mining infrastructure. The technique uses a set of tools that enable data capture, structural simulation, visualisation of structural parameters and analysis to be categorised based on the level of risk to the organisation.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Complete	**Coal Quality Borecore Methods Amalgamation Guide C33042** Chris McMahon, McMahon Coal Quality Resources $42,180	Clinton Vanderkruk, Anglo American Steelmaking Coal Jason Schumacher, Yancoal John Kelly, BHP	This project has produced a guide that amalgamates the various Australian and ISO Standards for borecore sampling and testing (preparation and measurement) to enable more effective and efficient definition of resources and reserves.
Current	**Coal Tailings and Co-disposal Literature Study C34032** Ben Gill, Excalibur Mining Systems $125,000	Kevin Rowe and Peter Walsh, Glencore Coal Assets Australia	Global tailings dam failures have put the spotlight on coal tailings and storage. A coal tailings and co-disposal literature review will be conducted to summarise key learnings and identify research gaps. This data will help ACARP committees to direct future research.
New	**Coal Dangerous Goods Determination - Road and Rail Transport Industry Guidance C37005** Ben Gill, Excalibur Mining Systems $15,000	Kevin Rowe, Glencore Coal Assets Australia	Coal has been transported by road and rail in Australia for many decades without formal classification as dangerous goods. Available incident data does not indicate that self-heating of coal has been a prominent risk factor during transport. Although some Australian coal does meet the criteria for classification as a division 4.2 dangerous goods, test results are highly variable and not reproducible. Recent peer-reviewed research has demonstrated that the standard international tests for the classification of dangerous goods with self-heating properties are not valid for coal and cannot be relied upon. The outcome of this project will be a technical briefing paper on the technical requirements to meet the determination and ensure that black coal remains as a non-dangerous goods under the formal classification system.
New	**Improved Measurement of Coal Bulk Density C37017** Dusan Ilic, University of Newcastle $90,377	Mel Robbins, BHP Thomas Buckby, Glencore Coal Assets Australia Tom Wilson, MACH Energy Australia	This project will develop an improved method for determining coal bulk density. The Australian Standard (AS 3899-2002) test is not widely used as it is deficient in its applicability to Australia's higher ranked coals and can result in erroneous measurements. This project will result in the definition of a new method for determining coal bulk density and a draft update of the AS 3899 standard will be proposed.
Gravity Separation			
Complete	**Measurement of DMC Wear Using 3D Laser Technology C33054** Andrew Taylor, CSIRO $173,022	Luke Winkelman and Peter Shumack, Glencore Coal Assets Australia Phillip Enderby, Hunter Valley Operations	There is no scanning device available that has been specifically designed to measure wear of the dense medium cyclone (DMC). The task is undertaken manually. The objective of this project is to adapt current laser 3D technology to produce a device capable of mapping the internal dimensions of the DMC to an accuracy better than 1mm without the need for the instrument operator to enter an enclosed space.
Complete	**Modelling and Control of Classifying Cyclones C33056** Andrew Swanson, Ausenco Services $227,080	Colin Surawski, Yancoal Michael Carnell, Glencore Coal Assets Australia Naresh Racha, Stanwell Corporation	Coal grain analysis (CGA) allows fine coal samples to be very accurately characterised with respect to size, density and maceral group composition, which facilitates ash value estimation for each particle analysed. This project investigateD whether CGA can be used to validate and improve cyclone models and whether it can be used in conjunction existing online instrumentation to establish procedures that will maintain cyclone performance and efficiency, contributing to overall plant recovery.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Clay Type Effect on Magnetite Medium Properties in Dense Medium Cyclones C34046** Clint McNally, CSIRO $155,488	Chris Denyer and Frank Mercuri, Anglo American Steelmaking Coal	Dense medium cyclone operation relies on the correct density and viscosity of the dense medium to efficiently separate material in the cyclone. This project will investigate the effects of different types of clays, typically found in Australia's coal seams, on the stability of the correct medium and the resulting impact of DMC operation.
Current	**Using Clay Stabilised Medium for the Separation of Small Coal in a Dense Medium Cyclone C34048** Andrew Taylor, CSIRO $204,432	Chris Denyer and Frank Mercuri, Anglo American Steelmaking Coal	Recent technical advances in circuit control instrumentation and magnetic separation devices have led to a resurgence of small dense medium cyclones in South Africa and China. DMC circuits for cleaning small coal (-2mm by 0.1mm) can produce higher yields than equivalent gravity-based circuits. They can also provide better control over the separation density of the process. This project aims to demonstrate that small coal can be successfully processed in a DMC with good cut point control, good magnetite recovery and high yields compared with the same coal processed through a spiral circuit and Reflux Classifier. The focus of the research is to develop a business case for the operation of a small coal circuit in Australian plants.
Current	**DMC Efficiency Improvement Using an Applied Magnetic Field C36024** Quentin Campbell, Julius Kruttschnitt Mineral Research Centre $205,050	Araz Ejtemaei, BHP Frank Mercuri, Anglo American Steelmaking Coal Jack Lauder, Glencore Coal Assets Australia	This project will evaluate the economic and performance benefits of integrating a magnetic field into a dense medium cyclone (DMC) utilising magnetite medium for coal processing. This "magnetic" DMC technology could help the coal industry to produce better quality coal and potentially reduce carbon emissions.
Current	**Measurement of DMC Wear using 3D Laser Technology C36030** Nerrida Scott, CSIRO $175,422	Dan Perkins, Thiess Kevin Rowe, Glencore Coal Assets Australia Luke Winkelman, Glencore Coal Assets Australia	Following on from proof-of-concept work, this project extension aims to further develop the precision and practical use of 3D laser technology to measure wear in a Dense Medium Cyclone (DMC). Follow-up scanning for internal wear in the DMC used in the previous project will provide before and after wear comparisons over the course of the DMC's life. The project will also compare the performance of hand-held and mounted scanners to see if sufficient data can be obtained to overcome the need for a mounting system. Use of this instrument will improve the health and safety of personnel performing these measurements by removing the need to enter the confined space of the DMC. The technology could also improve equipment design to improve maintenance practices, reducing risk to maintenance personnel and preventing downtime. Another benefit could be the development of data analytical tools including AI, machine learning, and digital twins.
New	**Banana Screen Capacity and Efficiency C37008** Chris Thornton, CTE Coal $199,830	Dan Delahunty, Yancoal Jenny Park, Glencore Coal Assets Australia Naresh Racha, Stanwell Corporation	A better understanding of the critical factors in the use of banana screens will help mines make better decisions on screen selection. This will improve efficiency, control of the circuits, and reduce magnetite consumption for plants. This proposal builds on previous work performed at QCAT on a test screen and aims to refine insights from that work.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Maintenance and Equipment			
Current	**Autonomous Stockpile Dozing: Quantifying Viability C35036** Ross McAree, University of Queensland $352,797	Chris Jackson and Peter Shumack, Glencore Coal Assets Australia Frank Mercuri, Anglo American Steelmaking Coal Chris Huth, Sedgman Jimmy Pollack, Golding	When constructing and reclaiming coal stockpiles, dozer operators are at risk of engulfment. Semi-autonomous dozers have comparable productivity to human-operated dozers without the risk to people. This project addresses the viability of utilising automated bulldozers for coal stockpile operations. Researchers will quantify the effort dozers expend in material movement, develop planning algorithms for semi-autonomous dozer movements then compare planning algorithms with human operator practice.
Current	**Coal Stockpile Management for Remote Bulldozers through Enhanced Situational Awareness C36027** Ross McAree, University of Queensland $734,000	Araz Ejtemaei and Bryce Ayscough, BHP Clinton Vanderkruk, Anglo American Steelmaking oal Kevin Rowe and Michael Booth, Glencore Coal Assets Australia Naresh Racha, Stanwell Corporation	This project aims to enhance the safety, efficiency, and accuracy of managing coal stockyards by improving remote operator situational awareness and decision making on stockpiles. This will be done by providing real time topography maps and material movement decision support. This assistance would guide operators in making informed decisions on how best to extend and reclaim stockpiles under non-line-of-site remote control. The expected outcome of the work is pre-commercial technology demonstrating the potential benefits of enhanced situational awareness for stockpile management.
Current	**Continuous Stockpile Cavity Warning System - Feasibility Assessment C36028** Wayne Stasinowsky, CSIRO $191,600	Kevin Rowe and Michael Booth, Glencore Coal Assets Australia Naresh Racha, Stanwell Corporation	Dozer accidents on coal stockpiles continue to occur despite safety guidelines. They most often occur when the dozer operator cannot see any indication of a void hazard. There have been several incidents in Australia and overseas where a stockpile dozer has fallen, or been inadvertently driven, into a draw-down hole with serious consequences. A warning system in the dozer cab would reduce the likelihood of a dozer traversing a dangerous area. The objective of this project is to examine and report on the feasibility of an upwards-looking radar system to detect stockpile voids and improve the safety of dozer drivers on stockpiles. The system could also inform the operators of water content and location. The logistics of installation and operation of the system will also be included in the research.
Process Control			
Complete	**Foreign Contaminants Detection on Conveyor Belts Using Digital Imaging Processing Techniques and Coal Penetrating Sensors C33057** Fidel Gonzalez, Mincka Engineering $365,000	Dan Delahunty, Yancoal Dave Young, Centennial Coal Kevin Rowe, Glencore Coal Assets Australia Phillip Enderby, Hunter Valley Operations	Non-ferrous foreign objects are not detected via current state-of-the-art conveyor belt detection technology used in Australian coal mines. Researchers adapted proven technologies used in other industries, such as x-ray technology, other sensor types and image processing algorithms, to more effectively detect and locate solid foreign objects on coal conveyor belts.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Soft Sensor for Predicting Dense Medium Cyclones Performance C34039** Gordon Forbes, University of Queensland $189,300	Araz Ejtemaei and Rick Jeuken, BHP Frank Mercuri, Anglo American Steelmaking Coal Peter Shumack, Glencore Coal Assets Australia	Even with the increasing level of instrumentation and data generation in modern minerals processing plants, some key process variables cannot be measured or are only measured on shift basis. The lack of real-time data prevents process control strategies and process optimisation to be carried out for some processes. This project aims to develop a soft sensor model for monitoring the performance of dense medium cyclones (DMCs), including yield, water split and partition efficiency in real time. Once developed, the soft sensor data can be linked to the process control system to stabilise the operation of the DMCs and manipulate operating parameters for optimum performance, based on the requirements of the operation.
Current	**Real Time Monitoring and Control of Froth Flotation C34044** Liguang Wang, University of Queensland $262,437	Chris Denyer, Anglo American Steelmaking Coal Chris Huth, Sedgman Josh Kowalczuk, Glencore Coal Assets Australia Rick Jeuken, BHP	Many coal flotation plants experience large daily variations in recovery but do not have effective real-time flotation performance measurement tools for process control and optimisation. In this project, researchers will assess and demonstrate an affordable, safe, accurate and easy-to-use real-time monitoring system that can be integrated into autonomous control of coal preparation. They will combine drag sensor and AI-based machine vision.
Complete	**Hand Held Sensor for Real Time Measurement of Fluorine Mineral Contamination in Coal C34050** Nigel Spooner, University of Adelaide $261,215	Jack Lauder and Jenny Park, Glencore Coal Assets Australia Mel Robbins and Rick Jeuken, BHP	The release of fluorine from contaminated coal interferes with metallurgical processes. It can also produce hydrogen fluoride, which is toxic to humans and the environment, and can damage equipment. There are no real-time, hand held fluorine mineral sensor techniques of sufficient sensitivity for coal applications. In this project, researchers exploited near infrared 'novel fluorescence' from the fluorine bearing minerals fluorite and fluorapatite to develop a prototype hand held sensor.
Current	**Simulation Enabled Digital Twin for the Control, Design and Optimisation of a Teeter Bed Separator C34052** Kym Runge, Julius Kruttschnitt Mineral Research Centre $232,531	Chris Denyer, Anglo American Steelmaking Coal Chris Jackson, Glencore Coal Assets Australia	Up to a fifth of in-plant material in Queensland metallurgical coal preparation plants is too fine to be efficiently upgraded using a dense medium cyclone and too coarse to be separated using froth flotation. This middling fraction (typically -2+0.35mm) is processed using hydraulic classifiers, such as teeter bed separators. In this project, researchers will use a combined experimental and simulation-based approach to develop a computational model that can be used as the basis of a performance-maximising advanced control strategy for the teeter bed separator.

ACARP is focused on research aimed at minimising emissions and reducing the environmental impact of the industry. The Technical Market Support Committee has identified the following key priority areas to support this goal:

- Research using the pilot-scale HELE testing facility with complementary techniques.
- Metallurgical coke and PCI to support low-carbon blast furnace ironmaking.
- Coal to coke conversion and coke performance linked back to properties of coal.
- Laboratory-scale demonstration of potential new large-scale products from coal and waste products.

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

The Technical Market Support Committee continues to support research regarding the safe transport and shipping of coal.

COMMITTEE MEMBERS

Graeme Harris	**Manager Technical Marketing and Logistics (co-chair)**	**Kestrel Coal Resources**
Lauren North	**Principal Sustainability Partnerships (co-chair)**	**BHP**
Nick Andriopoulos	Principal - Technical Marketing	Anglo American Steelmaking Coal
Morgan Blake	Director Sales	Peabody Australia
Shaun Booth	Group Manager Resource Development and Technology	Glencore Coal Assets Australia
James Bottle	Principal, Technical Marketing	Jellinbah Group
Stephen Brant	Principal Technical Marketing	BHP
Jeremy Byrnes	Technical Specialist and Coal Quality Manager	Glencore Coal Assets Australia
Anthony Edwards	Process Engineer	Whitehaven Coal
Sean Flanagan	Director Delivery and Coal Quality	Coronado Global
Caroline Lang	Coal Quality and Technical Superintendent	Glencore Coal Assets Australia
Jane Lawson	Product Analyst	Yancoal
Steve Lempereur	Strategy & Technical Marketing Manager	Anglo American Steelmaking Coal
Geoff O'Meley	Coal Technical Officer	M Resources
Oliver Scholes	General Manager Marketing - Technical	Whitehaven Coal
Cameron Tasker	Manager Technical Marketing	Xcoal Energy & Resources Australia
Chris Urzaa	GM Marketing & Logistics	Pembroke
Greg Wickman	General Manager - Marketing	New Hope Group

PROJECTS UNDER MANAGEMENT

Category	No of Projects	ACARP Funding
General	4	$1,330,858
Maritime Regulation	1	$4,169,012
Metallurgical Coal	31	$4,472,528
Thermal Coal	2	$804,850

NEW FUNDING

ACARP supports projects with immediate need outside the yearly funding round. These projects are included within this report as new funding.

No of Projects	ACARP Funding	Total Funding
10	$1,879,874	$2,451,721

Total Funding includes in-kind support provided by the researcher and host mine as identified in the research proposal.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
General			
Current New	**Coal Sample Bank C25053** Aedita Crouch and Lauren Williamson, CSIRO $451,801 Current $217,138 New	Graeme Harris, Kestrel Coal Resources Lauren North, BHP	CSIRO has been operating the ACARP coal sample bank since early 2017, providing management services, sample storage facilities, receipt and provision of the samples, and the provision of a confidential database. A coal sample bank enables common samples to be used by researchers so that results from different studies on the same coal can be compared directly.
Current New	**Management of SA and ISO Coal Technical Committees Work Programs C26003** Barry Isherwood, Carbon Connections Consulting $351,150 Current $106,600 New	Graeme Harris, Kestrel Coal Resources Kevin Rowe, Glencore Coal Assets Australia Lauren North, BHP	This project provides funding for a coal industry representative to continue working on ISO coal technical committees work programs.
Current New	**Australian Participation in Development of ISO Methods for Sampling, Analysis and Coal Preparation and National Technical Committee Support C26037** Ben Russell, Standards Australia $330,370 Current $127,072 New	Graeme Harris, Kestrel Coal Resources Kevin Rowe, Glencore Coal Assets Australia	Since 2005 ACARP has co-funded Australian representation on key International Standard Organization (ISO) committees of relevance to coal exports and to the Standards Australia National Mirror Committee MN-001. This investment enables Australia to influence and shape the international development of methods for sampling, analysis and coal preparation standards.
Current	**Digital Petrographic Atlas of Australian Coals - Maintaining the Knowledge C33065** Joan Esterle, University of Queensland $197,537	Graeme Harris, Kestrel Coal Resources Sean Flanagan, Coronado Coal	Researchers will create a digital petrographic atlas of Australian coals that includes data on maceral, micro lithotype and mineral composition at different ranks, and case studies that assist with conceptual mine scale models of coal quality variation. A library of scanned petrographic images of product coals from different Australian basins and formations will also be developed to illustrate the variation in rank, grade and type. The main reference point and framework for this project will be the ACARP coal sample bank.
Maritime Regulation			
Current	**Maritime Regulation Project C27001** Ash Goodwin, Goodwin Port Solutions $4,169,012	Technical Market Support Committee	The project includes research to investigate the accuracy, repeatability and reliability when testing coal cargoes for self-heating potential. Experimental work was finalised in 2022 with the project report and recommended regulatory responses provided to the Australian Maritime Safety Authority and the International Maritime Organisation's Sub-Committee on Carriage of Cargoes and Containers (CCC) for consideration. AMSA continues to lead work to progress amendments to the International Maritime Solid Bulk Cargoes (IMSBC) Code via informal correspondence group discussions with IMO stakeholders. As an interim measure, AMSA has issued Certificate of Approval No. 8024, allowing coals meeting specified criteria to be classified and shipped as materials hazardous only in bulk (MHB). This approval is available on the AMSA website and is valid until 31 December 2026.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Metallurgical Coal			
Complete	**Washability and Distribution of Sulphur and Trace Elements for Different Sizes and Densities of Product Coals C33066** Rohan Stanger, University of Newcastle $128,550	Caroline Lang, Glencore Coal Assets Australia Jane Lawson, Yancoal Shaun Booth, Glencore Coal Assets Australia	Australian coals generally have lower sulphur and toxic trace element content than their international competitors, although some product coals exceed acceptable levels. This project investigated whether sulphur (total, inorganic and organic) and trace element content varies with different coal particle sizes and densities, and to what extent. The results could be used to reduce sulphur and trace element content in coal preparation and blending processes.
Complete	**Design of Cokes from Biomass Coal Blends for Sustainable Blast Furnace Ironmaking: Scoping Study C34054** Pramod Koshy, University of New South Wales $181,700	Shaun Booth, Glencore Coal Assets Australia Stephen Brant, BHP	To address growing concerns about the environmental impact of cokemaking/ironmaking processes, steelmakers are investigating whether biomass could be used to partially replace coal in blends. This preliminary scoping study assessed the impact of blending biomass with coal blends on the high temperature properties and behaviour of the coke blends after gasification under blast furnace conditions.
Complete	**Factors Underpinning the Reactivity of Coke RMDC and IMDC C34055** Hannah Lomas, University of Newcastle $171,436	Morgan Blake, Peabody Australia Coal Sean Flanagan, Coronado Coal	Building on research into the factors influencing microtextural and interface strength, this project focussed on the factors controlling the reactivity of the individual coke microtextures rather than their strength controlling attributes. Researchers used thermogravimetric analysis to measure the rate of reaction with carbon dioxide of the individual coke microtextures under CSR test conditions. A series of experiments was designed to isolate the impacts of coke carbon structure and accessibility of reaction sites.
Complete	**Real Time Three Dimensional In-Situ Imaging of Structural Evolution of Coal During Coke Making Process Using Adaptive Electrical Capacitance Volumetric Tomography C34056** Behdad Moghtaderi, University of Newcastle $128,755	Graeme Harris, Kestrel Coal Resources	In terms of coke characterisation, the shortage of detailed and quantitative data, especially for challenging coals with higher levels of impurities, has been a barrier to the development of accurate predictive models of the plastic layer structural evolution and coke strength. This project used adaptive electrical capacitance volumetric tomography, a new non-intrusive and non-optical imaging technique, to examine the conversion of coking coal-to-coke with the aim of developing a deeper understanding of the evolution of the plastic (fluid) layer during the coking process.
Complete	**Impact of Co-Injecting Hydrogen and Australian PCI Coals on Overall Blast Furnace Performance Using a Heat and Mass Balance Model C34057** Yansong Shen, University of New South Wales $166,200	Cameron Tasker, Xcoal Energy & Resources Australia Geoff O'Meley, M Resources Peter Austin, BlueScope Steel	The co-injection of coal and hydrogen is regarded as the most feasible way to reduce carbon use in the blast furnace as it requires very low modification of the blast furnace operation and facilities. Research is required to understand the impact of co-injection on blast furnace operation, particularly in terms of in-furnace phenomena at the lower part of blast furnace. This project used the heat and mass balance model to evaluate the impact of the co-injection of Australian PCI coals and hydrogen on overall blast furnace performance.
Complete	**Coke Reactivity with CO2 and H2O and Impacts on Coke Microstructure and Gas Diffusion C34059** Arash Tahmasebi, University of Newcastle $170,700	Shaun Booth, Glencore Coal Assets Australia Stephen Brant, BHP	While injecting hydrogen gas into the blast furnace has the potential to reduce the energy intensity of steelmaking, it will also increase the water content, which is expected to impact the structure and metallurgical properties of coke. This project examined the impacts of carbon dioxide and water on the mechanism of coke gasification and degradation under conditions relevant to conventional and hydrogen blast furnace environments. In undertaking the project, researchers combined coke microstructure characterisation and mathematical modelling with micro-CT imaging and image processing.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Complete	**In-situ Investigation of Coke Structure Formation Under Stamp Charged Coking Conditions C34060** Arash Tahmasebi, University of Newcastle $158,900	Graeme Harris, Kestrel Coal Resources Stephen Brant, BHP	Stamp charging is increasingly being used by coke making operations in India, China, and Southeast Asia to improve oven productivity and reduce raw material cost through increased use of poor quality coking coals. In this project, Australian premium coals were blended with low premium coals, typically used in stamp charged coke making operations. Researchers gained insights into the coke formation mechanism under stamp charge coking conditions to understand how higher caking densities affect the microstructure, microtexture and, ultimately, coke reactivity and strength.
Complete	**Improving the Classification of Microstructure Distribution in Coke CT Images using Deep Learning and Lineal Path Calculations C34062** Bishnu Lamichhane, University of Newcastle $111,020	Nick Andriopoulos, Anglo American Steelmaking Coal	This project builds on a number of recent projects that have helped explain and characterise the 3D distribution of coke microstructure and the link to coke strength, reactivity and the formation of the microstructure in the plastic layer. The project improves the fundamental understanding of coal-to-coke conversion and coke performance by combining statistical techniques with a deep learning approach.
Current	**International Round Robin for Coke Reactivity Index, Coke Strength after Reaction and I600 C34063** Lauren Williamson, CSIRO $120,000	Caroline Lang, Glencore Coal Assets Australia Graeme Harris, Kestrel Coal Resources	Modified coke drum tests have been developed to overcome the challenge of producing the 50kg of coke needed for a full suite of coke testing. I600 is one of these tests, but it is not yet covered in any national or international standard. In this project, researchers will update the understanding of CSR and CRI practice across a group of international laboratories by conducting a round robin using two cokes produced in a pilot scale coke oven. They will also investigate the extent that I600 is used in coke testing laboratories and determine its potential as a standard test.
Complete	**Impacts of Plastic Layer Permeability and Internal Gas Pressure on the Formation of Coke Microstructure and Coke Quality C34065** Soonho Lee, Royal Melbourne Institute of Technology $158,900	Cameron Tasker, Xcoal Energy & Resources Australia Morgan Blake, Peabody Australia Coal Nick Andriopoulos, Anglo American Steelmaking Coal	Due to limited techniques for in-situ observations of the complex coking phenomena, the extent to which plastic layer permeability and internal gas pressure (IGP) influence coke microstructure and strength development are unclear. This project addressed this issue using 3D microstructure analysis software. An advanced permeability apparatus was used to conduct synchronised measurements of permeability, swelling/contraction displacement and the composition of pyrolysis gases. In addition, in-situ permeability and IGP measuring probes, fitted to the 4kg coke oven, were used to monitor the variation in the permeability and IGP across the plastic layer under practical coking conditions.
Current	**Examination of Contraction Pre and Post Resolidification using a High Temperature Dilatation Rig C35037** David Jenkins, University of Newcastle $99,250	Cameron Tasker, Xcoal Energy & Resources Australia Graeme Harris, Kestrel Coal Resources	A clear understanding of coke contraction can help to better predict key factors associated with coke quality. A mismatch in contraction and chemical processes around re-solidification may affect IMDC-RMDC bonding, which has been linked to coke strength issues. This project will assess the contraction behaviour of various coals, covering a range of rank and coal measures, to identify how prevalent this phenomenon is and its utility in coal blends.
Current	**Microalgae Blending for Low Carbon Metallurgical Coke Production C35038** Arash Tahmasebi, University of Newcastle $172,000	Nick Andriopoulos, Anglo American Steelmaking Coal Stephen Brant, BHP	Biomass is being used in blast furnace ironmaking to reduce environmental impacts and production costs. In this project, researchers will evaluate the impact of microalgae blending on the coking behaviour, coke properties and coke gasification performance of selected coals. In particular, it will assess the impact of microalgae on thermoplastic and rheological behaviour, internal gas pressure development and the quality of coke.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Impact of Coal Grain Composition and Macerals Association on Fluidity Development in the Plastic Layer of Australian Coals C35039** Arash Tahmasebi, University of Newcastle $141,600	Graeme Harris, Kestrel Coal Resources Stephen Brant, BHP	A better understanding of fluidity development in coal with representative particle size distributions is key to improving coke quality prediction models. This project aims to improve the fundamental understanding of thermoplasticity development in a wide range of Australian coals. By determining the drivers of "real" fluidity in these coals, researchers expect to improve coke quality prediction models. They will combine coal grain analysis and micro-CT expertise.
Current	**Changes in Combustibility of Coal when Co-Combusted with Hydrogen Rich Fuels in PCI C35040** Liza Elliott, University of Newcastle $218,367	Cameron Tasker, Xcoal Energy & Resources Australia Caroline Lang, Glencore Coal Assets Australia James Bottle, Jellinbah Group Oliver Scholes, Whitehaven Coal	Hydrogen-rich fuels are starting to be injected into the blast furnace via the tuyere. Little is known about the consequences of adding these fuels, which are expected to be more reactive than coal. This project aims to determine coal reactivity impacts of co-combusting hydrogen rich fuels (e.g. biomass, plastics, coke ovens gas, ammonia and hydrogen). The combustibility of solid fuels will be assessed using the drop tube furnace technique then a thermo-gravimetric analyser will be used to measure the reactivity of these materials individually and when co-combusted with coal.
Current	**Effect from the Co-Combustion of Coal and Biomass on Production of Fine Particles (<PM10) C35041** Liza Elliott, University of Newcastle $228,531	Cameron Tasker, Xcoal Energy & Resources Australia Caroline Lang, Glencore Coal Assets Australia Oliver Scholes, Whitehaven Coal	Many power stations are looking to reduce their carbon dioxide emissions with the addition of biomass to the feed coal for combustion. The proportion of fine particles produced during co-combustion is expected to increase dramatically. This project aims to assess the scope of fine particle emissions produced during combustion of biomass and the interactions expected between biomass and coal when these fine particles are forming during co-combustion.
Current	**Physical and Chemical Interactions Between Charcoal and Coal During Coking C35042** Karen Steel, University of Queensland $135,694	Graeme Harris, Kestrel Coal Resources Morgan Blake, Peabody Australia Coal	The blending of biomass in coking blends has been largely unsuccessful because its raw and charcoal forms cause a loss of fluidity. The loss of liquid then prevents the blend from undergoing expansion and fusion, leading to a loss of coke strength. The porosity also makes the coke more reactive. In this project, researchers aim to overcome this constraint by blending charcoal with specific coals that have high volatile matter content and high fluidity so that the volatiles adsorb into the micro- and meso-pores and carbonise, thereby filling the pores. The high fluidity will enable the coal to interact with the charcoal, flowing into its rough macropore surface and curing to form a bond via a "lock and key" mechanism.
Current	**Abrasion Resistance of Coke Under Hydrogen Reduction Blast Furnace Conditions C35043** Hannah Lomas, University of Newcastle $159,416	Nick Andriopoulos, Anglo American Steelmaking Coal Oliver Scholes, Whitehaven Coal Stephen Brant, BHP	The hydrogen enriched blast furnace is emerging as a viable technology that reduces the carbon footprint of blast furnace ironmaking, but little is known about its impact on coke quality. This project will evaluate the impact of reaction conditions that simulate both the conventional and the hydrogen reduction blast furnace on coke abrasion resistance. Correlations between conventional coke quality indices and abrasion resistance will be developed.
Current	**What We Now Know about Coking Coals and Coke C35044** Lauren Williamson, CSIRO $96,284	Lauren North, BHP Morgan Blake, Peabody Australia Coal	Decarbonising ironmaking requires cutting edge research on coke formation and structure. Since 2014, 35 ACARP projects have been completed on the technical marketing of coking coals and their outcomes have influenced the industry's understanding about what makes a good coke. The primary objective of this project is to integrate these research findings into one collection to determine future areas of research.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Impacts of Chemical Structure Transformation in the Plastic Layer on the Microtexture Development during Coking C35045** Soonho Lee, Royal Melbourne Institute of Technology $158,900	Morgan Blake, Peabody Australia Coal Nick Andriopoulos, Anglo American Steelmaking Coal	There have been many attempts to study correlations between coke microtexture and coke quality. However, there has been a lack of understanding of the underlying chemistry of microtexture formation during coking. This project aims to investigate the underlying mechanisms of microtexture development during coking and the role of chemical structure change during plastic layer formation. Pearson petrography analysis and micro-FTIR chemical mapping techniques will be used.
Current	**Gasification Reactivity and Degradation of Coke Lumps Under Simulated Conventional and Oxygen Rich Blast Furnace Processes C35046** Apsara Jayasekara, University of Newcastle $98,500	Lauren North, BHP Nick Andriopoulos, Anglo American Steelmaking Coal	Interest in oxygen-enriched blast furnaces (OBF) is escalating although little is known about the coke reactivity and coke degradation mechanisms under these conditions. This project will investigate the coke quality requirements to support OBF using laboratory-scale experiments under controlled OBF reaction environments.
Current	**Physical and Chemical Structure Characterisation of Biomass for Biocoke Production C36004** Arash Tahmasebi, University of Newcastle $54,100	Cameron Tasker, Xcoal Energy & Resources Australia Lauren North and Stephen Brant, BHP Morgan Blake, Peabody Australia Coal Nick Andriopoulos, Anglo American Steelmaking Coal Shaun Booth, Glencore Coal Assets Australia	This project is the initial part of an integrated program of research to better understand the biomass and coal quality requirements for biocoke production for blast furnace ironmaking. The findings of this scoping study are expected to inform biomass selection to produce pilot oven coke samples to be used in a suite of projects being undertaken in 2024.
Current	**Structural Optimisation and Reactivity Evaluation of Ferro Coke Produced using Australian Coals C36031** Arash Tahmasebi, University of Newcastle $167,000	Cameron Tasker, Xcoal Energy & Resources Australia Graeme Harris, Kestrel Coal Resources Nick Andriopoulos, Anglo American Steelmaking Coal Stephen Brant, BHP	The use of highly-reactive ferro-coke is among strategies proposed to reduce production costs and the environmental impact of blast furnace ironmaking. The objective of the project is to examine the suitability of Australian coals for ferro-coke production and to develop a new understanding of the mechanism of microstructure formation and reactivity of ferro-coke.
Current	**Impact of Biomass on Coke Microstructure Evolution and Gas Diffusion During CO2 Gasification C36032** Arash Tahmasebi, University of Newcastle $169,000	Graeme Harris, Kestrel Coal Resources Lauren North, BHP Morgan Blake, Peabody Australia Coal Nick Andriopoulos, Anglo American Steelmaking Coal Sean Flanagan, Coronado Coal Shaun Booth, Glencore Coal Assets Australia	A previous project revealed limited success in biomass blending due to the negative impacts on coke quality, and recommended further research on optimising species, biomass pre-treatment, coking technology, and coal blend design. This project forms part of an integrated program of research to improve the knowledge of the impacts of biomass addition on the coking performance and quality of coke generated from Australian coals. The aim of this project is to examine the impacts of biomass addition on the mechanism of carbon conversion during CO2 gasification and to evaluate the changes in coke microstructure during gasification reactions. This new knowledge will contribute to the understanding of how biocoke can be effectively utilised in blast furnace ironmaking.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current New	**Sugar Coated Coal: Determining if Glucose Addition Can Improve Coke Quality of Coal-Biomass Blends C36034** Callum Mainstone, ALS Coal $105,310 Current $6,312 New	Caroline Lang and Shaun Booth, Glencore Coal Assets Australia Graeme Harris, Kestrel Coal Resources Lauren North, BHP Morgan Blake, Peabody Australia Coal Nick Andriopoulos, Anglo American Steelmaking Coal Sean Flanagan, Coronado Coal	Including biomass in coal blends for coke production is a preferred method to achieve reduced carbon emissions, as changes to key metallurgical infrastructure are not required. However, adding plant dry matter biomass to coke reduces its quality, even in low concentrations. Adding glucose to other forms of biomass such as lignin prior to blending with coal may result in improved coke strength. Glucose can be sourced from agricultural, textile and forestry waste that does not compete with food production for land or water. This project will conduct a series of coking trials to determine the effectiveness of using glucose to contribute bio-carbon to coking coal blends and the potential to enable higher ash coals to be utilised.
Current	**Microstructure Characterisation and Simulation of Bio-additives in Coke C36035** David Jenkins, University of Newcastle $114,200	Graeme Harris, Kestrel Coal Resources Lauren North, BHP Morgan Blake, Peabody Australia Coal Nick Andriopoulos, Anglo American Steelmaking Coal Sean Flanagan, Coronado Coal Shaun Booth, Glencore Coal Assets Australia	With the increasing interest in ”sustainable coke making” there is a need to understand the impact of biomass on coke microstructure, and which coke microstructures best accommodate the addition of biomass. A recent PhD project developed novel techniques for characterising coke microstructure and simulating microstructures of cokes. Extending this to coke microstructures containing biomass is a step towards a predictive tool for optimal biomass blending. This project addresses priorities including the development of metallurgical coke and PCI to support low-carbon blast furnace ironmaking, the impact on coking-coal quality requirements and steelmaking emissions through coal blend additives and better understanding of coal to coke conversion and coke performance to support the technical marketing of Australian coking coals.
Current	**Biochar-Coke Integration for Improved Coke Strength and Performance C36036** Pramod Koshy, University of New South Wales $244,400	Graeme Harris, Kestrel Coal Resources Lauren North, BHP Morgan Blake, Peabody Australia Coal Nick Andriopoulos, Anglo American Steelmaking Coal Sean Flanagan, Coronado Coal Shaun Booth, Glencore Coal Assets Australia	The addition of biochar from Australian hardwood plant species will help to improve the environmental sustainability of the coke making and ironmaking processes. This project aims to enhance biomass utilisation in coal blends to improve environmental sustainability, without compromising the properties and performance of the resultant cokes in ironmaking. It will assess the impact of blending biochars in high-addition ratios with coals of varying properties to prepare pilot-oven cokes and to determine the high-temperature properties and performance of the cokes under blast furnace conditions. The research is part of a suite of projects aimed at understanding the effects of biomass addition on the properties and performance of biocokes to ensure the long-term market viability of Australian coals and cokes.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Exploring the Effects of Bio-char and Torrefied Biomass Addition on the Microtexture of Bio-coke C36037** Soonho Lee, Royal Melbourne Institute of Technology $155,000	Graeme Harris, Kestrel Coal Resources Lauren North, BHP Morgan Blake, Peabody Australia Coal Nick Andriopoulos, Anglo American Steelmaking Coal Sean Flanagan, Coronado Coal Shaun Booth, Glencore Coal Assets Australia	One strategy to reduce carbon emissions in blast furnace ironmaking is to incorporate sustainable biomass such as biochar and torrefied biomass as a substitute energy source. However, studies have shown the utilisation of woody biomass in coke making reduces coke strength. This project builds upon significant advancements in understanding the development of coke microtexture and microstructure from a series of previous projects and will be simultaneously explored in other projects proposed by the researchers. It is a vital aspect of a research initiative aimed at better understanding changes in coal quality requirements for biocoke production in blast furnace ironmaking.
Current	**Effects of Ash Minerals on Coke Reactivity under Hydrogen Injection, Low CO2 Blast Furnace Conditions C36038** Raymond Longbottom, University of Wollongong $51,290	Cameron Tasker, Xcoal Energy & Resources Australia Nick Andriopoulos, Anglo American Steelmaking Coal	As low CO2 blast furnace practices are adopted by steelmakers, the use of hydrogen in the furnace will increase. It is therefore imperative to understand coke quality requirements and performance under these new conditions. The main objective of this project is to quantify the impact of mineralogy on the reactivity of metallurgical coke using a laboratory tool called a coke analogue, at temperatures of 1,100°C and higher using hydrogen-containing gas mixtures. The secondary objective is to use the coke analogue to assess the temperature at which the reaction between hydrogen-containing gases and coke becomes significant.
Current	**Alternative Thermal Processing of Coal Pilot Extruded Coke and Supercapacitor Demonstration C36039** Rohan Stanger, University of Newcastle $157,178	Graeme Harris, Kestrel Coal Resources Lauren North, BHP Morgan Blake, Peabody Australia Coal Nick Andriopoulos, Anglo American Steelmaking Coal Peter Austin, BlueScope Steel Sean Flanagan, Coronado Coal Shaun Booth, Glencore Coal Assets Australia	The objectives of this project are to produce extruded cokes at pilot scale with mixtures of coal and hydrothermal liquefaction biocarbons, and to produce a prototype supercapacitor for energy storage. The pilot extruded cokes will be assessed for coke strength and provide the first evidence for a new type of biocarbon additive. The prototype supercapacitor unit will provide metrics on charging rates and response, efficiency, and overall footprint. Extruded cokes are expected to have improved mixing qualities, particularly with bio-materials, and coal based supercapacitors could open new markets in stationary energy storage and reduce overall emissions associated with its use.
Current	**Tracking the Carbonisation Performance of Vitrinite Macerals C36040** Karen Steel, University of Queensland $108,664	Lauren North, BHP Oliver Scholes, Whitehaven Coal	Knowledge of the specific vitrinite properties that give rise to the best quality coke would be beneficial to coke-makers for their blend formulations and could help identify which Australian coals could attract a higher price, owing to their superior properties. The objective of this project is to reveal the composition of vitrinite that leads to optimal coke properties. The project will compare coals of different rank from three different Australian coal measures, as well as overseas coals, for comparison. The knowledge gained on vitrinite behaviour during coking is also expected to assist biocoke research that is trying to overcome the detrimental effects that the addition of biomass has on coal fluidity.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Quantifying Biochar Interactions with Coal for Coke Making C36041** Lauren Williamson, CSIRO $141,683	Graeme Harris, Kestrel Coal Resources Lauren North, BHP Morgan Blake, Peabody Australia Coal Nick Andriopoulos, Anglo American Steelmaking Coal Sean Flanagan, Coronado Coal Shaun Booth, Glencore Coal Assets Australia	In a bid to reduce greenhouse gas emissions, biomass is being trialled to determine how much can be blended with coal and still produce satisfactory coke. Usually, the more biomass added, the decreased coke strength, limiting the amount of biomass that can be used. The goal of this project is to systematically study biomass addition. As part of a suite of proposed ACARP research, this project will quantify the relationship between biomass char surface area, size distribution and their impact on coke properties. If it were shown that the particle size and surface area of the chars produced by biomass were the main factors determining how much biomass could be added to the blend, this would increase the flexibility in supply of the raw materials.
New	**Mechanism of Biocoke Formation in Stamp Charged Cokemaking C37018** Arash Tahmasebi, University of Newcastle $170,200	Jane Lawson, Yancoal Morgan Blake, Peabody Australia Coal Stephen Brant, BHP	Partial substitution of coking coal with renewable biomass is identified as a promising way to reduce emissions in blast furnace (BF) ironmaking. However, use of biomass can weaken the coke microstructure and accelerate coke degradation in the BF. This research will test whether these shortcomings can be mitigated by reducing porosity and improving the bonding to the coke matrix. This project is part of a current integrated program of ACARP-funded research to improve understanding of raw material requirements for biocoke production for BF ironmaking.
New	**Reactivity of Coke RMDC, IMDC and Biochar with H2O Under Hydrogen Reduction Blast Furnace Conditions C37019** Arash Tahmasebi, University of Newcastle $169,900	Lauren North, BHP Stephen Brant, BHP	The introduction of hydrogen gas into the blast furnace (BF) is emerging as a viable method of reducing the carbon footprint of BF ironmaking. However, it is important to understand how the degradation of coke under such conditions differs in comparison with conventional BF ironmaking and identify the effect on coke quality. This project aims to further develop findings of a previous project.
New	**Fate of Bio-alkalis During the Carbonisation of Coal and Biomass Blends C37022** Salman Khoshk Rish, University of Newcastle $95,740	Graeme Harris, Kestrel Coal Resources Lauren North, BHP Nick Andriopoulos, Anglo American Steelmaking Coal	One of the promising avenues for reducing emissions during blast furnace (BF) iron making is the partial substitution of coking coal with renewable biomass. However, woody and grass biomass resources contain high concentrations of alkali and alkaline earth metals (AAEM), which negatively impact the reactivity and structural strength of coke within the blast furnace. The selection of appropriate biomass entails consideration of several factors, including the alkali content of the biomass. The proposed project will further the research the retention of AAEMs during coking. In addition, we aim to further understand the retention mechanisms of the detrimental ash concentrates in bio-coke.
New	Mechanism of Reactivity and Microstructure Evolution of Stamp Charged Cokes During Reaction with CO2 C37025 Ai Wang, University of Newcastle $169,825	Graeme Harris, Kestrel Coal Resources Lauren North, BHP Nick Andriopoulos, Anglo American Steelmaking Coal	Because of strong demand and decreasing reserves of premium coking coals, stamp charging is a promising approach to improve utilisation of low-quality coal. A previous ACARP project improved the understanding of the mechanism of coke formation under stamped conditions. The main objective of this project is to examine the impacts of stamp charging on the mechanism of coke degradation under CO2 and corresponding gas diffusion. The expected outcomes will benefit the Australian coal industry through an improved understanding of how cokes made from Australian coals under stamp charging behave in blast furnace ironmaking, thus increasing the sales confidence of Australian coals in relevant markets.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
New	Coal and Biomass Properties Affecting Cokemaking for Coal-Biomass Blends C37026 Karen Steel, University of Queensland $127,047	Geoff O'Meley, M Resources Nick Andriopoulos, Anglo American Steelmaking Coal Stephen Brant, BHP	The blending of biomass in coking blends has been largely unsuccessful. Biomass in its raw form or charcoal form causes fluidity losses leading to a loss of coke strength. The knowledge gained from this project is expected to help technical marketers communicate with cokemakers attempting to blend biomass with coal. This project relates to the importance of ensuring the long-term viability of Australian metallurgical and thermal coals in a carbon constrained world.
Thermal Coal			
Complete	Strength Development in Fouling Deposits C34058 Liza Elliott, University of Newcastle $213,600	Caroline Lang, Glencore Coal Assets Australia Oliver Scholes, Whitehaven Coal	In steelmaking, deposition within the convective pass of boilers can significantly affect gas and heat flows and alter boiler performance. Regular cleaning is required to ensure optimal boiler efficiency and ease of ash removal. Timeframes required for cleaning depend on the time it takes for strength to develop in the ash deposits. Researchers developed a model which allows deposit strength to be predicted from a simple SEM-TIMA analysis (an automated scanning electron microscope technique).
Current	Feasibility Study, Upgrade and Commissioning of ALS-ACIRL Pilot Scale Combustion Test Facility C35005 Luke Beattie, ALS Coal $591,250	Caroline Lang, Glencore Coal Assets Australia Greg Wickman, New Hope Group Jane Lawson, Yancoal Oliver Scholes, Whitehaven Coal	There is no pilot scale facility within Australia that can evaluate combustion performance under HELE conditions, whilst co-firing with biomass. This project undertook a feasibility study to upgrade the current subcritical pilot scale combustion facility so that it mimics HELE combustion and allows co-firing with biomass. HELE coal/biomass combustion research will be undertaken in the upgraded facility by studying HELE combustion of two previously tested coals, along with evaluation of combustion performance when co-firing with 5% & 10% biomass.
New	Comparison of Ash Deposition of Coal and Biomass Blends in Laboratory, Pilot Scale and Industrial Scale C37023 Liza Elliott, University of Newcastle $690,040	Caroline Lang, Glencore Coal Assets Australia Chris Urzaa, Pembroke Resources Jane Lawson, Yancoal	One way to reduce net carbon emissions from the combustion of coal is by replacing a proportion of the coal with biomass in steel making furnaces. However, technical issues mean replacement is typically limited to less than 4 %. Even small additions can lead to issues with milling and handleability. Heating the biomass (Torrefaction) to remove moisture and some of the lighter volatile matter overcomes milling issues however, whether raw or torrefied, little is known about the impact on ash deposition during co-combustion. This study aims to assess the deposition of ash during the co-combustion of Australian coal and biomass and biochar at laboratory, pilot, and industrial scale.

ACARP is focused on research aimed at minimising emissions and reducing the environmental impact of the industry. The Mine Site Greenhouse Gas Mitigation Committee has identified the need for innovative means for safe mitigation and accurate measurement of fugitive mine site gas emissions as a key priority area to support this goal.

Australian coal producers need to report greenhouse gas emissions from mining operations and where possible reduce those emissions. Fugitive seam gases have been identified as the largest contributor of greenhouse gas emissions from coal mines. The Mine Site Greenhouse Gas Mitigation Committee supports a range of activities in this area and is increasingly targeting the measurement and mitigation of the methane in underground mine ventilation air.

COMMITTEE MEMBERS

Ben Klaassen	**Principal Environment (GHG) (chair)**	**BMA**
Sam Anderson	Global Head of Corporate Sustainability	Peabody Australia
Angus Ball	Manager Sustainability	Jellinbah Group
Nathan Bongers	Engineer Low Emission Technology	LETA
Andrew Boyd	Managing Director and CEO	Qmetco
Sharif Burra	EGM - Health, Safety & Sustainability	Yancoal
Lynden Cini	Group Superintendent - Environment	Whitehaven Coal
Dev Gil-Senchez	Sustainable Development Manager	Anglo American Steelmaking Coal
John Grieves	Tenements Manager	QCoal Services
Iain Hornshaw	Manager, Sustainability	Yancoal
Nick Linacre	Principal Advisor - Climate Change	MCA
Steve Malss	Director Low Emission Technologies	LETA
Helen McCarthy	Principal Carbon Transition	Kestrel Coal Resources
Peter Morris	Principal Advisor - Coal	MCA
Scott Nairn	Head of Sustainability and Environment	Stanmore Resources
Brendan Newham	Senior Engineer - Emissions	Whitehaven Coal
De Nicholls	Principle Gas	BMA
Jim Sandford	Technical Advisor	
Ned Stephenson	Manager Environment and Climate Change	Glencore Coal Assets Australia
Russell Thomas	Technical Services Manager	GM3
Sandy Tickell	Group Manager Carbon Planning and Abatement	Glencore Coal Assets Australia

PROJECTS UNDER MANAGEMENT

Category	No of Projects	ACARP Funding
Mine Site Greenhouse Gas Mitigation	9	$4,604,794

NEW FUNDING

ACARP supports projects with immediate need outside the yearly funding round. These projects are included within this report as new funding.

No of Projects	ACARP Funding	Total Funding
3	$2,394,402	$3,007,344

Total Funding includes in-kind support provided by the researcher and host mine as identified in the research proposal.

STATUS	PROJECT, FUNDING	MONITORS	OVERVIEW
Current	**Technical Development Unit (TDU) for Catalytic Conversion of VAM C28078** Michael Stockenhuber, University of Newcastle $1,040,592	Russell Thomas, GM-3 Jim Sandford	Two barriers to the implementation of VAM technologies are the significant ongoing energy input requirements, especially the additional energy loads imposed on ventilation systems, and stringent heat recovery requirements. Omitting the need for an external heat source to the VAM mitigation system when it is operating at steady-state is challenging due to the high gas flow rates and the normally high operational temperature. This project will investigate the operation of a VAM unit at temperatures as low as 300 degrees C using a suitable catalyst, air pulse and heat recovery system. The air pulsing system regenerates the catalyst under operating conditions to enable low temperature operation of the VAM treatment system. The extension aims to develop a technical development unit for catalytic conversion of ventilation air methane, targeting the maintenance of high levels of conversion (>90%) at low temperature (<500 degrees C) for extend operational periods. The project will examine scalability, operating parameters and other development issues.
Current	**Airbag Inspired Explosion Suppression System for Mitigation of VAM Explosions C33068** Behdad Moghtaderi, University of Newcastle $583,073	David Webb, Glencore Coal Assets Australia Russell Thomas, GM-3 Jim Sandford	Previous research has shown that in typical capture ducts a VAM explosion must be suppressed in less than 1.2 seconds to avoid flashbacks into the mine. There are no existing systems that can meet this threshold. In this project researchers aim to develop a simple, low cost system to suppress VAM explosions – rapid action inflation nitrogen bag obstruction explosion suppression (RAINBOES). Preliminary calculations suggest that RAINBOES could fully control a deflagration event in 0.7 seconds.
Current New	**Satellite Remote Sensing - A New Tool for Coal Mine Emissions Management C34008** Damon Roddis, Zephyr Environmental $816,725 Current $1,280,000 New	Andrew Lau, Yancoal Ben Klaassen, BHP John Watson and Ned Stephenson, Glencore Coal Assets Australia Scott Nairn, Stanmore Resources Jim Sandford	Preliminary research indicates that two types of satellite data sets may be useful in measuring emissions: low earth orbit satellite imagery for methane detection and geostationary earth orbit satellite imagery for particulate matter. An extensive literature review will be undertaken of high spatial and temporal observations of methane and particulate matter using satellites. This review will include worked examples of technology applications, with performance evaluation against ground level monitoring and technological limitations.
Complete	**Safe Operation of Catalytic Reactors for the Oxidation of VAM Operating Under Abnormal Reaction Conditions C34066** Michael Stockenhuber, University of Newcastle $406,740	Russell Thomas, GM-3 Jim Sandford	Catalytic oxidation technologies offer potential for mitigating low concentration, fugitive methane emissions. For catalytic systems to become a viable commercial option, extended catalyst activity needs to be achieved, maintaining high levels of methane conversion for extended periods of time on stream. Key mechanisms for deactivation have been identified, most notably water poisoning and carbon deposition. The aim of this project was to examine the safety implications associated with the use of a catalytic oxidation system exposed to high excursions of methane in the stream.
Current	**Optimisation of Operational Parameters of Catalytic Reactor for the Oxidation of Ventilation Air Methane C35049** Michael Stockenhuber, University of Newcastle $238,464	Russell Thomas, GM-3 Jim Sandford	Catalytic oxidation offers a potential technology for the mitigation of ventilation air methane (VAM) emissions. A VAM catalytic system has been developed over several projects. In this project, researchers will explore how the system reacts to potential changes in feed conditions and how it will be implemented in a pilot-scale reactor. Researchers will determine the requirements to achieve the desired VAM conversion with a structured catalyst support and assess the inherent safety under such conditions.

STATUS	PROJECT, FUNDING	MONITORS	OVERVIEW
Current	**Open Cut Fugitive Greenhouse Gas Emissions C36001** Andy Self, Australian Coal Mining Consultants $227,500	Ben Klaassen and De Nicholls, BHP David Webb and Sandy Tickell, Glencore Coal Assets Australia Iain Hornshaw, Yancoal Jim Sandford	This project will analysis of the possible methods of reducing fugitive gas emissions and identify and document the next phase of research which would lead to a plan for the minimisation of fugitive gas emissions from open cut coal mines. The benefits to industry will be to develop a more detailed identification and analysis of viable predrainage strategy options in order to mitigate against fugitive open cut gas emissions which will deliver a path forward for effective open cut gas fugitive emissions management.
Current	**Investigation into the Technical Feasibility of In-Pit Gas Capture for Open Cut GHG Mitigation C36002** Christian Boucher, GeoGAS Yvette Heritage, SCT Operations $404,000	David Webb and Sandy Tickell, Glencore Coal Assets Australia De Nicholls, BHP Iain Hornshaw, Yancoal Jim Sandford	In this project researchers will determine how open cut mining modifies the coal seam gas reservoir and how these changes could be leveraged to provide a more cost effective way of capturing gas from within the operating pit for the purpose of fugitive emission mitigation.
Current	**Assessment of Sensors and Airflow Modelling for their Suitability to Quantify Methane Emissions in Open Cut mines C36007** Simit Raval, University of New South Wales $534,880	Ben Klaassen, BHP Iain Hornshaw, Yancoal John Grieves, QCoal Services Ned Stephenson and Sandy Tickell, Glencore Coal Assets Australia Jim Sandford	This project addresses the problem of accurately measuring fugitive mine site gas emissions to help maintain the industry's social and environmental license to operate. Traditional point based instruments are unable to capture methane concentrations over a wide area. To address this issue, it's proposed to conduct a comprehensive desktop study to investigate capabilities of various sensors and then subject the selected sensors to comprehensive testing. The project will provide an evidence based outcome for the coal industry covering selection of sensors, strategies for data capture, and influence of airflow modelling through to utilisation of machine learning based mathematical models to estimate total methane emissions.
Current	**Low Cost Precious Metal Free Honeycomb Monolithic VAM Catalysts and their Catalytic Activity and Stability Under Water and Dust Bearing Conditions C36008** Yonggang Jin, CSIRO $352,820	Paul Wild, Anglo American Steelmaking Coal Russell Thomas and Victoria Longley, GM-3 Jim Sandford	Catalytic oxidation of ventilation air methane (VAM) shows promise in the development of effective technologies to mitigate VAM emissions, with substantial advantages in safety and cost over conventional thermal mitigation technologies. This project aims to develop low cost honeycomb monolithic catalysts (HMC) based on the high performance precious-metal-free catalyst material newly developed by the CSIRO, and evaluate HMCs' catalytic activity and stability with a simulated VAM stream. The direct benefits to the coal industry are accelerated development of high performance cost effective catalytic VAM mitigators and greatly lower the cost of VAM abatement.
New	**Methane Matters: Updates on Relevant Advances for Coal Mine Emissions C37002** Simit Raval, University of New South Wales $161,890	Mine Site GHG Mitigation Committee	The coal mining industry is increasingly focused on estimating greenhouse gas emissions, a priority for both operators and regulators. Scientific challenges in methane measurement are gaining attention worldwide. To navigate this complex landscape, this project will monitor advances in methane emission estimates across sensors, models, and policy frameworks. It will conduct a comprehensive search of scientific literature, white papers, workshops, and news articles, also examining relevant regulatory policies at global and local levels. Special emphasis will be placed on the applicability and significance of these technologies and policies for the coal mining sector, where accurate methane estimation is crucial and under scrutiny.
New	**Effect of Reactor Size and Operating Parameters on Intrinsic Safety of Catalytic Oxidation Systems for Mitigation of VAM Emissions C37014** Michael Stockenhuber, University of Newcastle $952,512	Helen McCarthy, Kestrel Coal Resources Russell Thomas, GM-3 Sharif Burra, Yancoal	This project seeks to progress recent ACARP studies on the safe operation of catalytic systems for the mitigation of Ventilation Air Methane (VAM) emissions. VAM emissions are one of the major greenhouse emissions associated with the mining sector, and technology to significantly reduce them is critical for the financial viability of coal mining. The methane concentration in the VAM stream is typically below 1 %, and unable to be combusted by conventional means, resulting in the emission of large volumes of methane. Thermal reactors have been proposed to mitigate the emissions; however, these operate at very high temperatures, initially require large energy input and footprints and are unable to process very lean methane streams. Catalytic oxidisers have the potential to overcome these challenges.

The industry sees ACARP's support for PhD scholarship program as having many benefits, from the outcomes of the research itself which is of great interest to producers, through to what is seen to be more important; being the long term sustainability of the workforce. Scholarships support those who have worked within industry for more than 3 years who wish to upgrade their skills to this higher academic level, which in turn produces very highly trained people working back in the industry.

The support is in the form of a tax free scholarship awarded on the recommendation of the Research Committee.

UNDER MANAGEMENT

Category	No of Projects	ACARP Funding
Scholarships	6	$1,980,000

NEW FUNDING

No of Projects	ACARP Funding	Total Funding
1	$330,000	$330,000

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Environmental Noise Assessment and Management C25076** Tim Procter, Griffith University $330,000	John Watson, Glencore Coal Assets Australia	Environmental noise is recognised by the World Health Organization as one of the most common pollutants and is becoming a greater community concern. There has been a divergence between how mining companies manage noise impacts and the process used by approval/regulatory agencies. This project will determine the most appropriate 'best practice' approach for the predictive noise modelling of mining operations and then the subsequent measurement and assessment of noise compliance for the respective operations.
Complete	**Use of Thin Spray Liners in Underground Coal Mines: Mechanism, Testing and Design Methodology Development C29079** Claire Pirona, University of Queensland $330,000	Wesley Noble, Anglo American Steelmaking Coal	TSL is the term used to describe a fast setting, multi-component, polymeric material that is designed to be spray applied to a rock surface and provide areal support; yet to become a preferred support element in coal mining operations. The use of TSLs can potentially significantly improve the advancing speed of development face, in addition to offering a reduction in manual labour and reduced exposure to ground conditions for personnel, if it can be demonstrated that its technical performance is as good as current systems, if not better. There is a need for developing standard tests and testing procedures on TSLs as their application will potentially grow soon. The focus of this project is to provide methodology for testing and then apply a design methodology that is simple, repeatable, practical, cost effective and relates to actual behaviour of the TSL product when applied.

STATUS	PROJECT, RESEARCHER, FUNDING	MONITORS	OVERVIEW
Current	**Coal Mass Rating with regards to Outburst and Coal Burst C29080** James Anderson, University of New South Wales $330,000	Brad Elvy, Brad Elvy Mining Services	The aim of this PhD is to prove that carbonate bonded coal has an increased mass strength, influencing the potential of coal to outburst and coal burst. The hypothesises tested, suggest that the bonding of the coal mass with carbonate mineralisation increase the coal mass rating (CMR). The CMR of a coal seam is the controlling factor that controls the ability of the coal mass to hold en masse energy. Two hypotheses will be tested. With the supporting evidence from a literature review of a link between carbonate mineralisation and historical bursting events, the collection of coal samples from various seams will be conducted for analysis and testing. A comparison of the testing results will provide supporting evidence as to the relationship between the occurrence of carbonates within the coal and the resultant CMR.
Current	**Understanding Horizontal Closure and its Impact on Deformation and Height of Fracture C33073** Adam Lines, University of Newcastle $330,000	John Grieves, QCoal Services Klaus Thoeni, University of Newcastle Matt Tsang, Anglo American Steelmaking Coal	Currently most Australian underground coal mines estimate the height of fracture when designing ground support using suspension methods. This estimated height of fracture is often only a range and is based on several assumptions. This research will look to validate these assumptions and provide design tools using recent advancements in technology that allow more precise and accurate methods of prediction. The benefits to industry include increased understanding of the relationship between horizontal closure and height of fracture, application and interpretation methods of state-of-the-art technology, and the development of design tools to incorporate in suspension methods to ensure more accurate estimations of height of fracture.
Current	**Mission Planning for Autonomous Dozers C33074** Benjamin Peacock, University of Queensland $330,000	Brian Neilsen, Peabody Australia Coal Ross McAree, University of Queensland Shaun Booth, Glencore Coal Assets Australia	The mining industry is increasingly embracing automation as a means of enabling safer, more efficient, and cheaper production. Ongoing research and development of automation within the industry helps to provide sustainability for the future. This research addresses the challenge of mission planning for autonomous dozers, specifically in the application of stockpile dozing operations with the incentive to increase safety, increase productivity, and decrease operating cost.
Current	**Optimisation of Ground Consolidation Practices in Longwall Coal Mining Applications C34067** Richard Campbell, University of New South Wales $330,000	Dan Payne, BHP	This project addresses several of the industry priorities, from improved technical understanding of the deposit to improved productivity through targeted strata control and management especially around the longwall. The outcomes from this PhD will provide quantification in the improvement in rock mass conditions as a result of ground consolidation using various polymeric resins, microfine grouts and other products currently available. The work will mechanically test each of the products including injection pressures, permeability and flowrates in the lab and then undertake detailed examination of the results within the fracture network prior to validation in the underground environment.
New	**Optimisation of Pre-Driven Recovery Road Design for Improved Longwall Relocation Efficiency C37031** Marc Henderson, University of Queensland $330,000	Dan Payne, BHP Matt Tsang, Anglo American Steelmaking Coal	Pre-Driven Recovery Roads (PDRRs) are increasingly utilized in Australian coal mining to expedite longwall recovery, with substantial productivity benefits reported. However, broader industry acceptance remains limited due to perceived strata risk and costs associated with mitigating controls. This project outlines research aimed at overcoming limitations in current PDRR design by providing the industry with a forward-looking, standardized design framework. This framework will enable PDRR design that is optimised for the specific geological environment - leading to improved safety, reduced cost and enhanced longwall recovery efficiency.

INCOME

	23/24	22/23	21/22	20/21
Levy	**$18,024,703**	$17,234,490	$18,303,574	$18,693,880
Interest	**$1,297,300**	$899,746	$187,608	$367,089
Other	**$10,735**	$210,909	$4,637	$312,847
Total	**$19,332,738**	$18,345,145	$18,495,819	$19,373,817

EXPENDITURE

	23/24	22/23	21/22	20/21
Research Projects	**$21,693,557**	$21,063,972	$19,524,279	$19,684,242
Program Management	**$983,994**	$759,343	$689,053	$598,971
Project Administration	**$2,085,693**	$1,989,300	$1,855,743	$1,786,120
Total	**$24,763,244**	$23,812,615	$22,069,075	$22,069,333

OUTSTANDING COMMITMENT FOR RESEARCH AT 30 JUNE 2024

	23/24	22/23	21/22	20/21
Projects Started	**$23,255,098**	$29,830,064	$30,314,885	$27,820,517
Projects Yet to Start	**$6,947,921**	$3,896,587	$4,286,805	$10,176,035
Total	**$30,203,019**	$33,726,651	$34,601,690	$37,996,552

March 22	**Call for Proposals** - Announcement in "The Australian" - Distribution of Research Priorities Newsletter
April 30	**Closing Date for Short Proposals**
July	**Short Proposal Selection Meetings**
July 18	**Call for Long Proposals**
August 20	**Closing Date for Long Proposals**
October	**Long Proposal Selection Meetings**
December (mid)	**Proposal Outcomes Advised**

PROGRAM Management

- **Stakeholder engagement**
- **Levy collection**
- **Board secretariat**

Suite 23, Level 9, 307 Queen Street,
Brisbane Qld 4000
Phone 07 3532 4077

Matthew Fellowes
Executive Director
matt@acarp.com.au

Marilyn Keenan
Levy Administrator
accounts@acarp.com.au

PROJECT Administration

- **Project administration**
- **Distribution of outcomes**
- **Committee secretariat**

12th floor 167 Eagle Street,
Brisbane Qld 4000
Phone 07 3225 3600

Anne Mabardi
Manager Projects - Operations
anne@acarp.com.au

Patrick Tyrrell
Manager Projects - Technical
patrick@acarp.com.au

Nicole Youngman
Projects - Administration
nicole@acarp.com.au

Peter Bergin
Project Coordinator
peter.bergin@icloud.com

Ashley Conroy
Project Coordinator
ashley@ashleyconroy.com.au

David Drakeley
Project Coordinator
ddrakeley@fieldcrew.com.au

Ben Gill
Project Coordinator
ben@excaliburgroup.com.au

ACARP

ACARP.COM.AU