Australian Government
Australian Trade Commission

Australia
UNLIMITED

UNDERGROUND MINING

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Cover image: 'Gates of Mordor' by Greg Tossel. Snowden Photo Competition 2011. Image courtesy of Snowden.

SETTING GLOBAL BENCHMARKS FOR PRODUCTIVITY AND SAFETY

'Geo's find it, Engineers design it and Surveyors keep it in line' by Greg Tossel. Snowden Photo Competition 2011. Image courtesy of Snowden.

› INTRODUCTION
INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
COMPANIES AND CAPABILITIES
FURTHER INFORMATION

Australian expertise and innovation in underground mining has been developed over many years of domestic and export success.

Australia's large and diverse local underground mining industry produces a significant proportion of its coal, gold, nickel, copper, zinc, lead, tin, uranium and diamond exports.

The size and scope of Australia's underground mining industry, its safety culture, high production rates, the technical challenges associated with depth, geology, seismicity, and mining methods, and a history of transition from large-scale openpits and associated mine infrastructure to underground operations, have also fostered a thriving services and technology sector.

It has some of the world's most productive and technologically advanced longwall coal mines, and many mature, deep base and precious metal underground operations accessed by both declines and shafts.

Australia is the largest single market in the world for large underground articulated dump trucks, load-haul-dump (LHD) loaders, and technologically advanced development and production drills, and one of the top five markets for high-powered longwall shearers, face conveyors and ancillary coal mining machines.

Much of this expertise and intellectual property is now being exported around the world.

This industry capability statement provides an overview of Australian capability in the underground mining sector, including examples of some of the many Australian companies with specialist expertise.

Talk to your local Austrade representative for more tailored advice and information about connecting and partnering with the Australian mining industry.

Abbott Point Port. Image courtesy of North Queensland Bulk Ports Corporation

INTRODUCTION
› INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
COMPANIES AND CAPABILITIES
FURTHER INFORMATION

Australian underground coal and metal mine safety and productivity benchmarks are among the world's best.

In 2011-12, thirty underground coal mines in New South Wales (including 20 longwall operations) produced 27.4 per cent of the state's 221 million tonnes of raw coal output, while in Queensland, eleven underground longwall mines (out of 55 operating mines in total) produced 35.4 million tonnes of the state's 249 million total raw coal output.[1,2]

Australia-wide, about 70 operating underground hard-rock mines used open stoping, sub-level caving, various narrow stoping, and block caving methods to produce ore containing gold, nickel, copper, diamond, uranium, silver, lead, zinc, tin and molybdenum-rhenium in 2012.

Most of the mines (65 per cent) are in Western Australia and Queensland, with a number also in NSW (15 per cent), Tasmania and South Australia (each 6 per cent), Victoria (4 per cent) and the Northern Territory (3 per cent).[3-9]

These mines include one of the world's largest block caving projects at Cadia East in New South Wales.

Some of the large companies involved in underground mining in Australia are BHP Billiton, Rio Tinto, Xstrata, Anglo American Australia, Glencore Coal Investments, Peabody Energy and Fortescue Metals.

The Australian mining industry's strong equipment, technology and services (METS) sector has made an important contribution to its record of safety and international cost competitiveness.

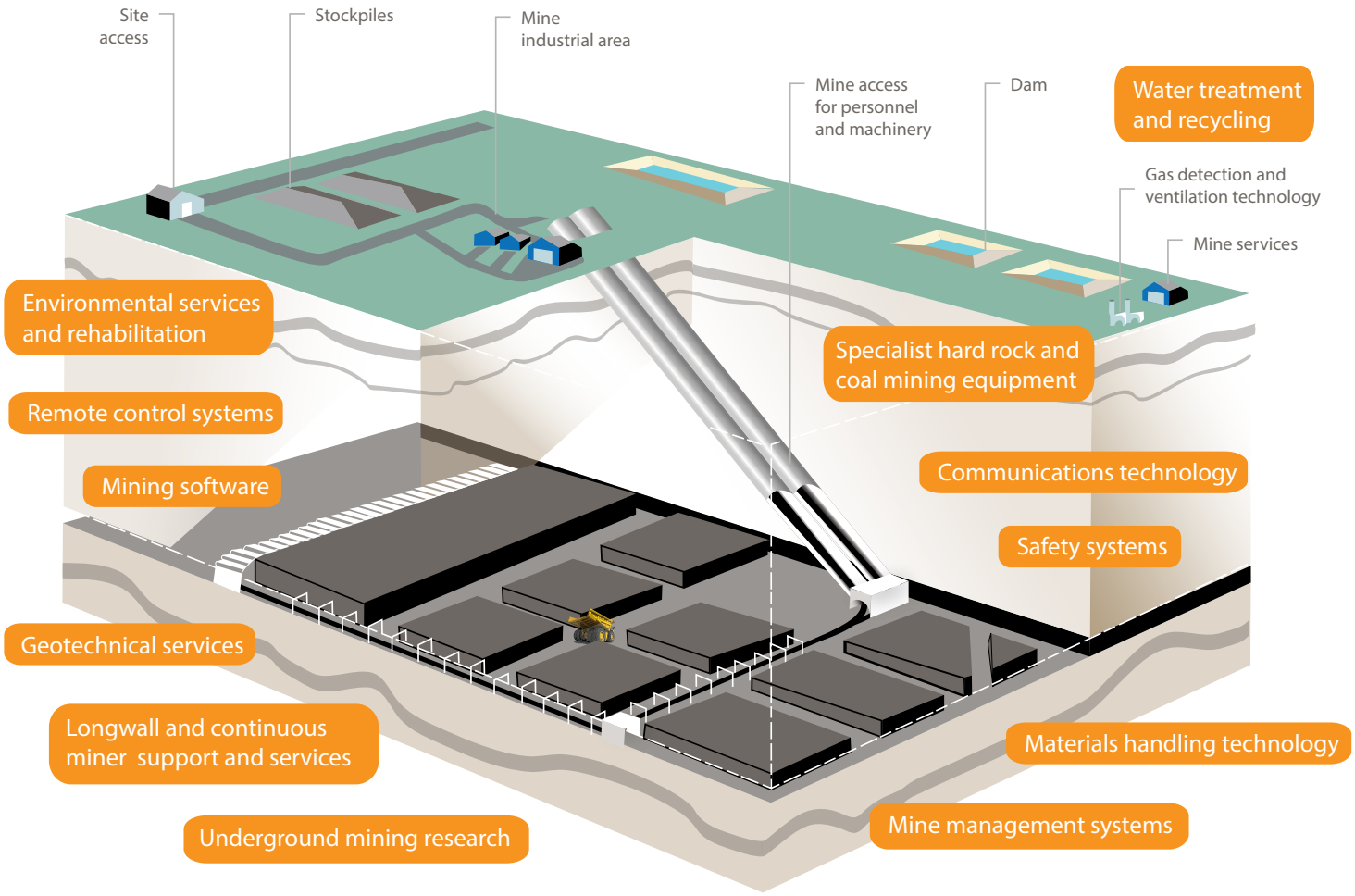
More than 200 companies in Australia supply specialised products and services developed specifically for underground mines.[10]

The Australian mining industry has developed products that are delivering safety, efficiency and cost benefits at mines around the world. A number of factors have helped drive growth in this area:

- stringent government safety and health regulations
- strict mining company safety codes
- ground support and monitoring requirements of deep and seismically active mines
- demand for innovative ventilation, remote control, mine dewatering and rock fragmentation solutions
- calls for better, more reliable communication systems in underground environments.

INTRODUCTION
› INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
COMPANIES AND CAPABILITIES
FURTHER INFORMATION

ADDING VALUE AT EVERY STAGE –
Australian underground mining areas of expertise



INTRODUCTION
INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
COMPANIES AND CAPABILITIES
FURTHER INFORMATION

Customised software. Image courtesy of MST

INTRODUCTION
INDUSTRY OVERVIEW
› INDUSTRY STRENGTHS
COMPANIES AND CAPABILITIES
FURTHER INFORMATION

METS companies have created a number of world-leading products, technologies and services to help miners around the world deal with the challenges of harsh and sometimes hazardous environments.

Rising mine development and operating costs during a period of declining average ore grades and generally increasing mine depths and geological complexity have meant that clever design, technology and innovation have become increasingly important in Australian mines.

Building on a long history of working with the country's export-focused underground mines to meet technical challenges and maintain high safety and environmental standards, Australia's METS sector has accumulated a wealth of valuable expertise and know-how to bring to international markets.

MINE PLANNING, DESIGN AND OPTIMISATION

The specific challenges of the underground mining environment have led to the development of some unique innovations. Australian consulting companies, contractors and engineering, procurement and construction management experts provide input into all aspects of mine planning.

Underground mine ventilation modelling software has been designed to simulate airflows, pressure, heat and refrigeration, radon, fire and other critical ventilation data from a model of mine airways. The software is currently being used by more than 1000 mines, universities, consultants and research organisations worldwide.[11]

Despite the sophistication of design capabilities and outputs, ease of use is a feature of this software and also a range of mine planning, advanced numerical modelling and simulation, and ground-surface mapping software developed by Australian companies for underground miners.

'The mining industry stands to benefit greatly from high-performance computing.

There is capacity and opportunities that could be turned on now in simulation, optimisation, forecasting and design.'

Dr David Beck
General Manager
Beck Engineering

INTRODUCTION
INDUSTRY OVERVIEW
› INDUSTRY STRENGTHS
COMPANIES AND CAPABILITIES
FURTHER INFORMATION

Software developers have focused on improved program display features with logical workflow layouts, new auto-population tools and streamlined menus, increased file size handling and outputting, customisable settings, and simpler integration with complementary programs. This has resulted in improved operational efficiencies in the industry.

Similarly, mine production reporting and management systems have been developed for underground mines, with the capacity to allow users to easily scale up from simple voice and tag data logging to advanced automated systems as required.

Numerical modelling and simulation is an increasingly important field. Specialists in geomechanics, in particular, are using advanced software to tackle complicated geotechnical problems with the aim of increasing mining safety and productivity.

EARTH, WATER AND BLASTING

Increasing depths, higher mining rates and complex geology are some of the challenges that rock mechanics experts, drill and blast engineers and hydrogeologists face in modern underground mining.

Australian companies have led the way in the application of new blasting techniques and technologies, including advanced blast management software, initiation systems and underground tunnel perimeter control methods that improve rock fragmentation control and costs and enhance safety.

In the field of geomechanics and ground support, there have been rapid advances over the past decade in support testing methods and support products, as well as breakthroughs in ground stabilisation and strata control, geotechnical monitoring and analysis and surface support (e.g. shotcrete and mesh) application.

Australian researchers, consultants, ground support product manufacturers and technology companies continue to be at the forefront of these developments.

In mine water management, Australia is a global leader in the application and development of dewatering systems, water recycling methods and also, in more recent times, liquid solidification technologies purposely formulated for the underground mining environment.

INTRODUCTION
INDUSTRY OVERVIEW
› INDUSTRY STRENGTHS
COMPANIES AND CAPABILITIES
FURTHER INFORMATION

SAFETY AND PRODUCTIVITY

Automation now plays an important role in surface and underground mines. As part of this shift, Australian mines have tested and proven vital technologies that have helped the industry achieve new productivity and safety benchmarks.

Remote and tele-remote control technologies, sophisticated machine guidance, fit-for-purpose, reliable one and two-way underground communication, and state-of-the-art vehicle collision avoidance and detection systems are major foundation technologies. Australia has an advanced engineering, manufacturing and services base, and global supply presence in these areas.

Although automation is increasing, most of the advanced machinery working in mines today is still operated by people.

Two areas in which Australia has developed state-of-the-art expertise and technology are personnel fatigue monitoring and management devices, and simulation training for underground equipment operators. The leading companies in these fields have customers in all significant mining regions of the world.

‘Some mines are opting for higher levels of automation than others.

We are working with a number of customers to implement equipment semi-automation projects. At the same time we have a roadmap for implementing full automation as well.

The really important thing with this type of technology is that the support is the number one concern of customers, and I think that’s where we are recognised as having an edge in the market.’

Noel Northcott
Commercial Executive
Remote Control Technologies

INTRODUCTION
INDUSTRY OVERVIEW
› INDUSTRY STRENGTHS
COMPANIES AND CAPABILITIES
FURTHER INFORMATION

MINING SERVICES

The need to maximise the efficiency of decline truck haulage and maintain its competitiveness with shaft haulage has made Australia a major market for high-capacity underground mine trucks and technologies that improve efficiency. It has also created demand for specialised expertise and resources.

Delineation and integration of replacement and 'satellite' underground orebodies to sustain production from large, high-cost processing plants on the surface has also helped drive innovation in the contracting, consulting and engineering fields.

Australia is home to several of the world's largest underground hard-rock mining contractors, such as Byrnecut Mining and Barminco leading geotechnical and mining consultancies.

In addition, specialist underground engineering services are available through firms such as AMC Consultants, RungePincockMinarco, Snowden, CSA Global and Mining Plus.

Systems and equipment to improve in-mine drilling efficiency and safety is another area where Australian companies have developed expertise.

Australian companies also have proven expertise in vertical and horizontal shaft development and strong project delivery track records, as well as experience operating coal and hard-rock mines in all conditions.

Australian contractors offer skills across all aspects of mine development and production techniques. In addition, the industry demonstrates expertise in occupational health and safety, equipment management and maintenance, global purchasing, and contract administration.

These skills and expertise all contribute to optimising mine efficiency, safety and profitability.

MST keeps miners around the world safe and productive

Case study: mine communications

Mine Site Technologies (MST) has a long track record of installing its underground and surface mine communication technologies and products throughout Australia and internationally. The 'digital age' for mine communications has seen MST expand even further.

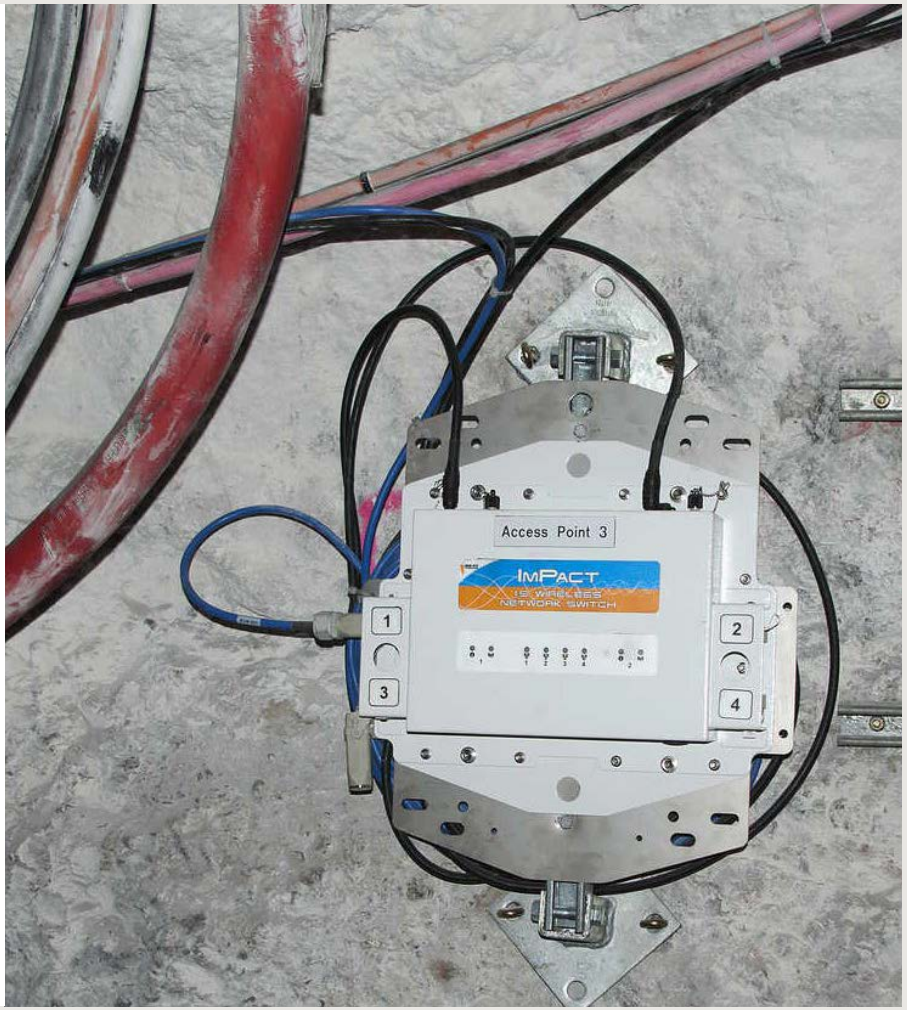
Established by mining engineer Gary Zamel in 1989, MST deployed the first commercial personal emergency device (PED) using 'through-the-earth' technology developed in conjunction with Australia's national science organisation, Commonwealth Scientific and Industrial Research Organisation (CSIRO).

MST has subsequently built an international presence with VDV leaky feeder radio systems and responded to demand for Wi-Fi based digital communications with its ImPact 'One Network' product suite.

Today, PED systems are carried by 85 per cent of Australia's underground coal miners and its technologies are deployed in hundreds of mines around the world, including groups in South America, Europe and Asia.

MST's office network now extends throughout the US, South America, Europe, Africa and Asia and its technical support and sales teams speak German, Russian, Spanish, Portuguese and Chinese.

'We've been able to demonstrate that we've got fit-for-purpose kit, and that we're available to service it, but more importantly, it goes underground into a harsh environment and it works, it functions and it delivers them value for money,' says Zamel, now managing director of MST.



Mine communications system. Image courtesy of MST

Remote Control Technologies delivers an integrated solution

Case study: automation and remote control

Australian company Remote Control Technologies (RCT) offers a wide range of mobile equipment safety, guidance and control products.

Best known for remote and tele-remote control technologies that have helped transform underground mine safety and productivity in Australia.

RCT has recently worked closely with Rio Tinto and others on projects focused on advanced equipment control and guidance.

RCT has also supplied remote control packages, training and support for surface mining equipment all over the world and has sold its products in more than 60 countries.

For RCT's remote control, guidance and automation technologies, 'the size of [mining] projects both nationally and internationally has grown, and there is greater demand for project remote control solutions – for example, stockpile dozers which require the remote control solutions, operator accommodation, communications infrastructure and operator aids such as obstacle detection,' says founding managing director Bob Muirhead.

'If a task is inherently unsafe it should be remote-controlled; if it is repetitive it should be automated,' he adds.

'Being an independent supplier means that our integrated solution will operate reliably across all equipment platforms, which does not lock the customer into a single supplier.'

Swick Mining Services drills down to greater efficiency

Case study: underground drills

Kent Swick, a mechanical engineer and fourth generation driller, runs one of the world's leading underground drilling contractors from the company's Western Australian base. Swick Mining Services has operations in North America, Asia and Europe, a large fleet of purpose-built rigs, and more than 600 staff.

Swick now produces 95 per cent of its unique underground drills internally after switching from outside sourcing. The company invests A$3 million a year into research and development and is determined to introduce design changes, technology and contract management methods that are expected to significantly enhance the productivity of its drill fleet within a few years.

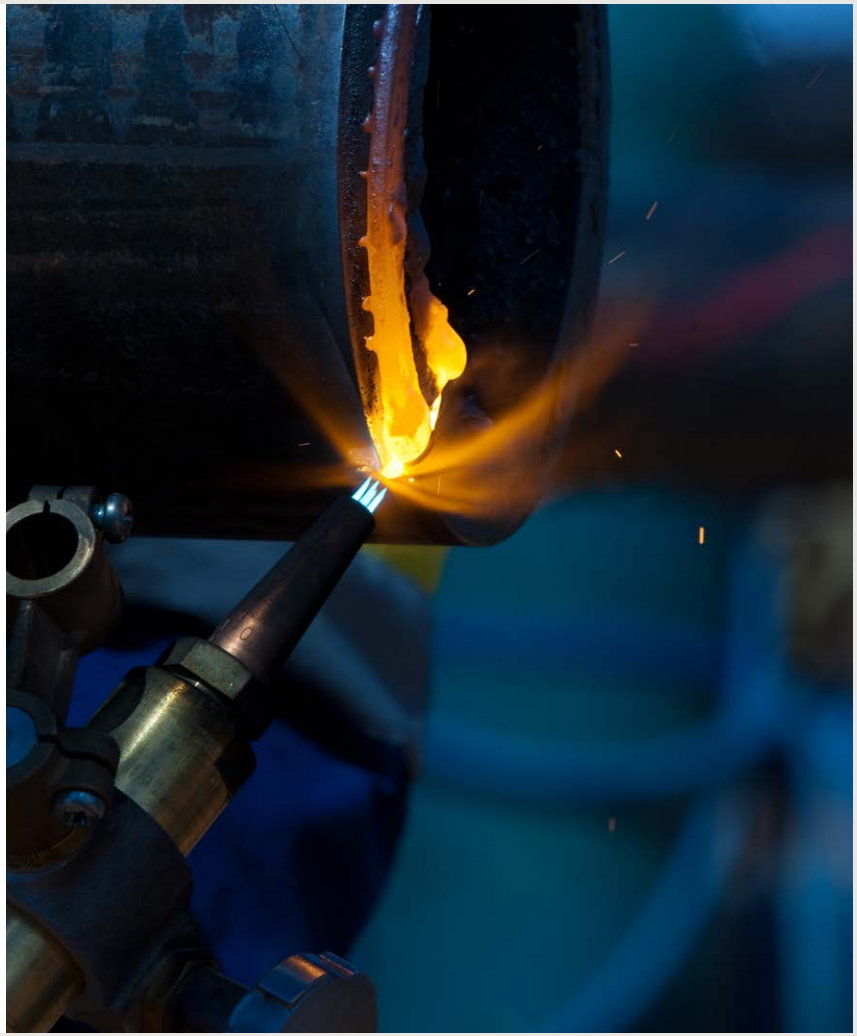
The introduction of new rod handling and automation systems is set to follow the installation of high-pressure, high-flow pumps on all the company's drill rigs as part of its 'high-speed core recovery' project.

An automation package has been developed specifically for the company's mobile, purpose-built drill rigs, separating it from existing drill automation systems. It is said to be simpler and more reliable than current systems.

'What we're looking for is a 30 per cent increase in productivity and a 35 per cent reduction in man-hours, and these three projects should be able to deliver that,' Kent Swick says.

Developments such as bringing rig engineering and production in-house, developing new technology, and the company's use of a customised business intelligence platform which has given management clearer, immediate insights into operations and potential operational management improvements, are part of Swick's focus on its global competitiveness.

In contrast to many of its competitors, Swick Mining Services is almost completely focused on underground mine drilling. 'I think we'll just become more and more competitive, and offer greater and greater value to the marketplace,' Swick says.



Python unit on site. Image courtesy of Gekko

Gekko's Python gets to grips with underground ore processing

Case study: automated systems

Australian high-tech manufacturer Gekko Systems has designed and built hundreds of its innovative gravity separation, leach reactor and feed preparation plants over nearly 20 years of operation, exporting to around 40 countries. Five years ago, it introduced a new offering, the Python.

With its origins in an Australian Government sponsored R&D effort which started some 10 years previously, Python is a modular, automated plant that crushes, grinds and pre-concentrates ore – ideally underground where it is actually mined – leaving only 5-30 per cent of the material, now in concentrate form, to be pumped to the surface.

'Tailings are disposed in voids, haulage, operating and processing costs are substantially reduced, and environmental impacts are minimised,' Gekko technical director Sandy Gray says.

Ventilation savings on diesel equipment are also substantial, he adds.

'Then there is the cost of energy and, in some places such as South Africa, the actual reliability of supply. There is a tremendous level of energy intensity in areas of mining that won't be able to sustain that level of use and certainly in underground gold mining in Western Australia, where we're seeing that transition from oxide ores, and simple processing plants, to deeper, more complex ores, there is a lot more thought going into processing options and energy efficiency.'

As well as initial sales in South Africa, Gekko is now receiving Python enquiries from all around the world. New Python units, double the size of the original ones, have also been sold.

HunterNet has the numbers for success

Case study: equipment and services

From its base in one of Australia's longest-established mining regions, HunterNet is taking an innovative approach to competing globally in mineral processing and major resource projects.

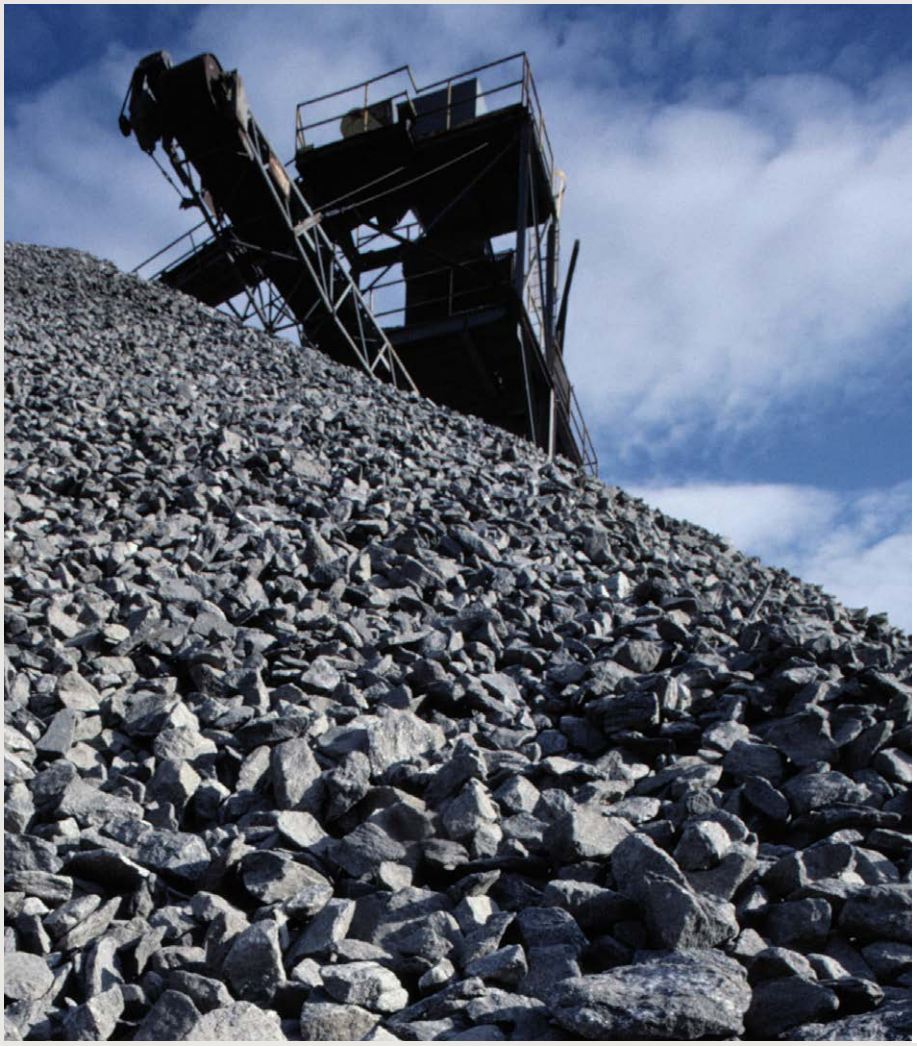
Formed in 1992 as a response to the shifting economic climate of the 1990s, which saw many of the smaller manufacturing and engineering companies competing in a more limited market, HunterNet is a network of small and medium-sized manufacturing, engineering and consulting companies. It is located in the Hunter region of NSW, traditionally known for its coal mines.

Leveraging their skills, expertise and the power of many, HunterNet markets the combined capability of its members, provides business development and training opportunities, and promotes the Hunter as a manufacturing and engineering region of excellence.

Today, Hunternet member companies can offer a range of products and services to underground mining clients:

- coal drilling and mining equipment
- face mining equipment
- hard rock drilling and mining equipment
- longwall mining equipment
- ancillary services such as compressed air and bulk material handling systems
- mine planning tools and advisory services
- mine operations support
- safety systems and equipment such as emergency response and gas detection systems
- support infrastructure such as power, water, communication, ventilation and man-access systems
- underground mobile equipment such as man transporters and LHDs.

Coal trains in the Hunter Valley. Image courtesy of HunterNet



Palaris review delivers productive results

Case study: mine management

When the key stakeholders of a major southern hemisphere coal producer decided to undertake a comprehensive review of their operations, they engaged Australian consultants Palaris.

The project involved examining the technical, operational and financial aspects of their open cut mines, underground mines, port facilities and tenement areas.

Taking a multi-disciplinary approach, Palaris appointed a team of specialists in geology, mining engineering, maintenance management, environment, finance, marketing, processing and operations management. Using a portfolio of business review tools, the team focused on:

- reducing operating costs
- reducing or deferring capital expenditure
- improving revenue via additional coal sales and blending.

After extensive consultation, site visits and data analysis, the review identified significant opportunities:

- operating cost reductions across operations of between 15 and 24 per cent
- capital expenditure reductions of 19 per cent
- revenue improvements of 6 per cent.

The team also provided recommendations and advice on achieving the reductions and improvements.

Originally established in the Hunter Valley coal mining region of NSW, Palaris now has offices around Australia and a presence in London. It provides project management, business analysis and specialist consultancy services to mining companies in existing and emerging markets around the world. Palaris expertise spans coal, metals, coal seam gas and ventilation, and its services cover the mining life cycle from geology and exploration through to sustainability management when the life of a mine is complete.

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INTRODUCTION
INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
› COMPANIES AND CAPABILITIES
FURTHER INFORMATION

The following table lists some examples of companies and their capabilities.

Contact your local Australian Trade Commission representative for assistance with connecting with the Australian businesses that best suit your requirements.

Company name	**Support infrastructure** - power, water, communication, ventilation fans, man-access systems (shaft or drift winders)	**General mine access equipment and services** (drift or shaft)	**Face mining equipment** - (production equipment) Longwall, continuous miner support equipment and services	**Hard rock drilling** - mining equipment and services	**Coal drilling / mining** - equipment and services	**Ancillary services** - compressed air, bulk material handling systems
Allcover products	●			●	●	
Alminco					●	
AMC Consultants						
Ampcontrol	●		●	●	●	
APC Technology			●		●	
Ausproof Pty Ltd	●					
Auto Control Systems	●		●	●		●
Beck Engineering						
Big Tyre Pty Ltd					●	
Bortana Pty Ltd	●	●				
Byrnecut				●	●	
Coffey Mining	●					
Cove Engineering Pty Ltd		●				●
CRCMining	●		●	●	●	
CSIRO						
DMS Mining Services	●					
DSI		●	●	●	●	
DTH Drilling Solutions Pty Ltd				●		
Elliott Ventilation Systems		●				
Eyre and Smith	●			●	●	●
GE Industrea	●			●		
GeoConsult Pty Ltd					●	●

INTRODUCTION
INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
› COMPANIES AND CAPABILITIES
FURTHER INFORMATION

Company name	**Underground mobile equipment** - man transporters, LHDs	**Management systems** Planning and support systems - mine planning tools and advisory services, mine operations support	**Safety systems and equipment** - emergency response systems / equipment, gas detection	**Environmental Services** - rehabilitation services, water management services, treatment of discharge water	**Underground mining research** - organisations and institutes
Allcover products					
Alminco		●			
AMC Consultants		●			
Ampcontrol		●	●		●
APC Technology	●				
Ausproof Pty Ltd					
Auto Control Systems	●			●	
Beck Engineering		●			
Big Tyre Pty Ltd	●				
Bortana Pty Ltd			●		
Byrnecut		●			
Coffey Mining		●	●	●	
Cove Engineering Pty Ltd		●	●		
CRCMining	●	●	●		●
CSIRO					●
DMS Mining Services	●				
DSI					
DTH Drilling Solutions Pty Ltd					
Elliott Ventilation Systems					
Eyre and Smith	●				
GE Industrea	●				
GeoConsult Pty Ltd		●			

INTRODUCTION
INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
› COMPANIES AND CAPABILITIES
FURTHER INFORMATION

The following table lists some examples of companies and their capabilities.

Contact your local Australian Trade Commission representative for assistance with connecting with the Australian businesses that best suit your requirements.

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Geographe		●	●	●		
Geomole Pty Ltd						
GeoRes						
GMC Global						
Gordon Brother Industries Pty Ltd	●					
IMC Mining Solutions					●	
Immersive Technologies						
Immersive Technologies Pty Ltd						
IntierraRMG Resource Sector						
IQ LINK						
JKTech						
John Holland				●		
Keech Australia			●	●		
Leighton Contractors Pty Ltd	●	●		●	●	●
Linc Energy						
Lovells Technology Pty Ltd	●				●	
Macmahon Underground Pty Ltd				●		
Maddison Safety						
Maptek						
McLanahan Corporation			●			●
Micromine						
Mine Site Technologies Pty Limited	●					

INTRODUCTION
INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
› COMPANIES AND CAPABILITIES
FURTHER INFORMATION

Company name	**Underground mobile equipment** - man transporters, LHDs	**Management systems** Planning and support systems - mine planning tools and advisory services, mine operations support	**Safety systems and equipment** - emergency response systems / equipment, gas detection	**Environmental Services** - rehabilitation services, water management services, treatment of discharge water	**Underground mining research** - organisations and institutes
Geographe	●				
Geomole Pty Ltd		●			
GeoRes		●			
GMC Global		●			
Gordon Brother Industries Pty Ltd					
IMC Mining Solutions					●
Immersive Technologies			●		
Immersive Technologies Pty Ltd			●		
IntierraRMG Resource Sector					●
IQ LINK		●	●		
JKTech					●
John Holland			●		
Keech Australia					
Leighton Contractors Pty Ltd	●	●	●	●	
Linc Energy					●
Lovells Technology Pty Ltd		●	●		
Macmahon Underground Pty Ltd	●				
Maddison Safety			●		
Maptek		●			
McLanahan Corporation					
Micromine		●			
Mine Site Technologies Pty Limited		●	●		

INTRODUCTION
INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
› COMPANIES AND CAPABILITIES
FURTHER INFORMATION

The following table lists some examples of companies and their capabilities.

Contact your local Australian Trade Commission representative for assistance with connecting with the Australian businesses that best suit your requirements.

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MineARC Systems						
Minemax						
Minetec	●					
Modular Mining System						
NEPEAN Engineering & Innovation	●	●				
NEPEAN Mining			●			●
Nepean Power Technology						
NLT Australia Pty Ltd				●	●	
Orica Australia Pty Ltd			●	●	●	
Palaris Mining Pty Ltd	●	●	●			●
PBE Australia	●					
Pentair Southern Cross			●	●	●	●
Pit N Portal Group		●		●	●	
Polylok Products		●	●	●	●	
Quarry Mining & Construction Equipment Pty Ltd				●	●	
Rambor Pty Ltd					●	
Reliance Hexham Pty Ltd		●				
Remote Control Technologies	●					
Rodgers Bros NCLE Pty Ltd	●					●
Rutherford Global Power	●	●	●	●	●	●
SAFEgroup						
SDV Longwall Support					●	
Sinclair Knight Merz	●					●

INTRODUCTION
INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
› COMPANIES AND CAPABILITIES
FURTHER INFORMATION

Company name	**Underground mobile equipment** - man transporters, LHDs	**Management systems** Planning and support systems - mine planning tools and advisory services, mine operations support	**Safety systems and equipment** - emergency response systems / equipment, gas detection	**Environmental Services** - rehabilitation services, water management services, treatment of discharge water	**Underground mining research** - organisations and institutes
MineARC Systems			●		
Minemax	●	●			
Minetec		●			
Modular Mining System		●			
NEPEAN Engineering & Innovation					
NEPEAN Mining		●			
Nepean Power Technology			●		
NLT Australia Pty Ltd			●		
Orica Australia Pty Ltd					
Palaris Mining Pty Ltd	●	●	●	●	
PBE Australia		●	●		
Pentair Southern Cross					
Pit N Portal Group		●			
Polylok Products	●				●
Quarry Mining & Construction Equipment Pty Ltd					
Rambor Pty Ltd					
Reliance Hexham Pty Ltd	●				
Remote Control Technologies	●				
Rodgers Bros NCLE Pty Ltd			●		
Rutherford Global Power			●		
SAFEgroup		●	●		
SDV Longwall Support					
Sinclair Knight Merz		●		●	●

INTRODUCTION
INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
COMPANIES AND CAPABILITIES
FURTHER INFORMATION

The following table lists some examples of companies and their capabilities.

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SMEC International Pty Ltd	●					
Specialised Vehicle Solutions Pty Ltd						
SRK Consulting						
SRO Group Pty Ltd	●					
Strata Safety Products					●	
Swick Mining Services				●		
The Mancala Group	●	●	●	●	●	
University of Newcastle						
University of NSW - School of Mining Engineering						
University of Western Australia						
VLI Pty Ltd					●	●
Wilco Technologies Pty Ltd				●		
Wilshaw	●	●		●	●	●

INTRODUCTION
INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
› COMPANIES AND CAPABILITIES
FURTHER INFORMATION

Company name	**Underground mobile equipment** - man transporters, LHDs	**Management systems** Planning and support systems - mine planning tools and advisory services, mine operations support	**Safety systems and equipment** - emergency response systems / equipment, gas detection	**Environmental Services** - rehabilitation services, water management services, treatment of discharge water	**Underground mining research** - organisations and institutes
SMEC International Pty Ltd		●			
Specialised Vehicle Solutions Pty Ltd	●				
SRK Consulting		●		●	●
SRO Group Pty Ltd					
Strata Safety Products			●		
Swick Mining Services					
The Mancala Group	●	●			
University of Newcastle					●
University of NSW - School of Mining Engineering					●
University of Western Australia					●
VLI Pty Ltd	●				
Wilco Technologies Pty Ltd					
Wilshaw	●	●	●	●	

INTRODUCTION
INDUSTRY OVERVIEW
INDUSTRY STRENGTHS
COMPANIES AND CAPABILITIES

FURTHER INFORMATION

The following are some of the government and industry bodies involved in the Australian mining industry.

Contact your local Austrade representative about connecting and partnering with the Australian mining industry.

austrade.gov.au

The Department of Industry provides advice and policy support to the Australian Government regarding Australia's resources sector. **innovation.gov.au**

The Mining and Energy Services Council of Australia (MESCA) is an industry body that represents and promotes a diverse range of skilled, innovative providers which include:

- capital equipment
- contractor and consultancy resources
- OEM (Original Equipment Manufacturers) project management
- engineering
- MRO (Maintenance Repair and Operational) suppliers to the energy and mineral resource industries across Australia. **mesca.com.au**

The Minerals Council of Australia (MCA) represents Australia's exploration, mining and minerals processing industry, nationally and internationally, in its contribution to sustainable development and society. **minerals.org.au**

Austmine is an industry body representing the Australian mining equipment, technology and services (METS) sector. **austmine.com.au**

AusIMM (the Minerals Institute) provides services to professionals engaged in all facets of the global minerals sector. **ausimm.com.au**

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The Australian Trade Commission – Austrade – is the Australian Government's trade, investment and education promotion agency.

Through a global network of offices, Austrade assists Australian companies to grow their international business, attracts productive foreign direct investment into Australia and promotes Australia's education sector internationally.

Austrade helps companies around the world to source Australian goods and services. We can help you reduce the time, risk and cost involved in sourcing suppliers by:

- helping you identify and contact Australian suppliers
- providing insight on Australian capabilities
- alerting you to the latest products and services out of Australia to help you grow your business.

Austrade partners the strengths of Australian businesses with the needs of international markets. We can open the door to a world of opportunities for your business.

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