



MINERALS COUNCIL OF AUSTRALIA
**SUBMISSION TO THE OPTIMISING STEM INDUSTRY-
SCHOOL PARTNERSHIPS: INSPIRING AUSTRALIA'S
NEXT GENERATION ISSUES PAPER**

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TABLE OF CONTENTS

1. EXECUTIVE SUMMARY	1
2. AUSTRALIA'S MINERALS INDUSTRY IS A WORLD-LEADING INNOVATOR	2
3. INDUSTRY INVESTMENT IN EDUCATION AND TRAINING	5
4. PREPARING THE FUTURE MINERALS WORKFORCE.....	9

1. EXECUTIVE SUMMARY

The Minerals Council of Australia (MCA) welcomes the opportunity to contribute to the [Optimising STEM Industry-School Partnerships: Inspiring Australia's Next Generation](#) issues paper.

The MCA is the peak industry organisation representing Australia's exploration, mining and minerals processing industry, nationally and internationally, in its contribution to sustainable development and society. The MCA's strategic objective is to advocate public policy and operational practice for a world-class industry that is safe, profitable, innovative, environmentally and socially responsible and attuned to its communities' needs and expectations.

The minerals industry is a fundamental source of Australia's comparative advantage in the global economy and a major contributor to the nation's innovation effort. Mining is Australia's second largest industry and Australia's largest export earner by a very wide margin.

Innovation is central to maintaining Australia's comparative advantage in minerals and energy by supporting more competitive, safer and more environmentally sustainable operations. The minerals sector invests nearly \$3 billion a year on research and development (R&D) and is an exemplar of collaboration with research bodies.

Critically, the minerals industry's contribution to Australian innovation and ongoing economic prosperity depends upon high-value, high-wage jobs in a diversity of professions, including engineers, environmental scientists, geologists, geophysicists, mathematicians and financial officers. Mining generates more gross value added per employee than any other industry (double the finance sector) and pays Australia's highest wages. Mining also accounts for the largest industry share of micro start-up businesses and is one of the largest contributors to job creation by these businesses.

The MCA has invested over \$50 million into minerals higher education since 2000, and in partnership with universities across the country, developed a world-class minerals education sector delivering the skills needed in industry today. However, the mineral education sector must also equip future graduates with skills the minerals industry will need in the decades to come, including attracting the future pipeline of students through schools.

To support the mineral education sector to do this, the minerals industry also invests in established programs supporting attraction of young learners to science, technology, engineering and maths (STEM) pathways. Supported programs include teacher professional development, outreach initiatives and online resource development.

Participation in the future minerals workforce will require the development of new capabilities and skills from primary and secondary education through to tertiary and higher education. This is why the minerals industry supports the Productivity Commission's recommendations for reform across the Australian education system to meet future workforce requirements for the industry and Australia.¹ These reforms support skill formation linked to an open, high quality education system able to prepare people with the right skills for technology adoption, use and diffusion.

¹ Productivity Commission, [Shifting the Dial: 5 Year Productivity Review](#), Report No. 84, Canberra, 3 August 2017, p. 83-84.

2. AUSTRALIA'S MINERALS INDUSTRY IS A WORLD-LEADING INNOVATOR

- 6,539 Australian mining inventions were filed for patent between 1994 and 2011 by minerals industry operators, suppliers and research institutions supporting the sector.
- The mining industry has the largest share of micro-start businesses of any sector with these businesses a significant source of new job creation.
- Various technologies reshaping Australia's workforce are already driving innovation across the minerals industry.

Innovation underpins Australia's comparative advantage in minerals

Mining is a leading industry in the Australian economy. It is Australia's largest source of export revenue, a key employer in regional areas and a world leader in innovation. According to the Australian Bureau of Statistics (ABS), mining accounted for 6 per cent of GDP in 2016-17 making it the fourth largest contributor to the Australian economy. When the broader economic contribution of the mining equipment, technology and services (METS) sector is included, this share of the Australian economy increases to over 15 per cent.

The mining industry continues to be a significant employer in the production phase of the boom. According to ABS, the industry's workforce was approximately 218,000 throughout 2016-17 with many of these jobs located in regional areas.² When the broader METS supply chain is considered, this workforce exceeds 1.1 million people and accounts for 10 per cent of jobs in Australia.³

Average weekly earnings (full-time adult) in the resources sector are \$2,659 per week, more than 66 per cent higher than the national average of \$1,606 per week.⁴ A large proportion of the workforce is highly skilled; 63 per cent hold a Certificate III level qualification or higher, above the national average. Five per cent of the workforce is currently apprentices and trainees.⁵ One in five workers also hold a bachelor degree or higher.⁶ The level of education within the workforce reflects the importance and value of trade and professional occupations to the mining industry.

Australia's comparative advantage in minerals is maintained and enhanced through continual innovation. Official data suggest that the mining sector invests nearly \$3 billion on R&D annually, or nearly \$1 in \$6 of all business R&D spending in Australia.⁷

The mining sector is a prolific inventor and developer of specialised technologies, with a total of 6539 Australian mining inventions filed for patent between 1994 and 2011 by operating miners, the METS sector, and publicly funded entities like CSIRO.⁸ Australian mining technology is exported globally, with patent filings overseas showing major markets include the United States, Canada, China, Japan, Europe, Russia, Brazil and Mexico.⁹

Government analysis shows mining accounts for the largest industry share of micro start-up businesses and has been one of the largest contributors to job creation by these businesses over the past decade or so (chart 1).¹⁰

² Australian Bureau of Statistics, [Labour Force, Australia, Detailed, Quarterly, Nov 2017](#), ABS cat no. 6291.055.003

³ Deloitte Access Economics, [Mining and METS: engines of economic growth and prosperity for Australians](#), 29 March 2017.

⁴ Australian Bureau of Statistics, [Labour Force, Australia, Detailed, Quarterly, Nov 2017](#), ABS cat. no. 6291.0.55.003, released on 21 December 2017. [Average Weekly Earnings, Australia, May 2017](#), ABS cat. no. 6302.0, released on 17 August 2017.

⁵ Minerals Council of Australia, [Miners at Work](#), Canberra, 2016.

⁶ Department of Education, [Industry Outlook: Mining](#), Canberra, 2014.

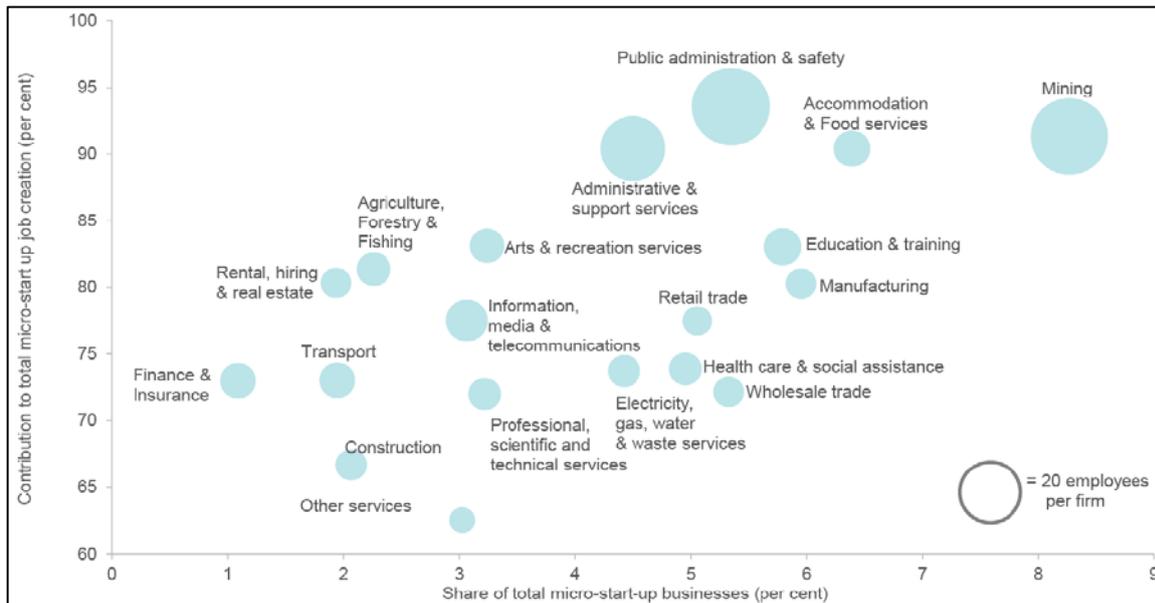
⁷ Australian Bureau of Statistics, [Research and Experimental Development, Businesses, Australia, 2013-14](#), catalogue number 8104.0, ABS, released on 4 September 2015.

⁸ CSIRO, [Unlocking Australia's resource potential](#), 2015, p.4.

⁹ Emma Francis, [The Australian Mining Industry: More than Just Shovels and Being the Lucky Country](#), IP Australia, 2 June 2015, pp. 6, 22, 30.

¹⁰ Luke Hendrickson, Innovation Research, Department of Industry, Innovation and Science, [Where does employment growth come from?](#) Presentation to the Industry Innovation Workshop 2015, 15 September 2015, p. 8.

Chart 1: High-growth start-ups: industry shares and contributions to job creation



Source: Department of Industry, Innovation and Science

A high level of innovation in the sector has traditionally been the means by which the mining industry has sought to overcome so-called ‘depletion effects’. These effects include the natural depletion of resource deposits, increased effort required to process saleable ores from extracted material, the adoption of more complex methods of extraction in expanded mines and the extraction of deposits that are further away or deeper in the ground. Innovation is also needed to maintain the Australian mining industry’s comparative advantage internationally.

Technological innovation will continue to change the nature of work in mining and therefore skills requirements. In some parts of the industry, increasing automation of mining and logistics is moving workers from mine sites to remote operational centres requiring skills and knowledge enhancement.

Deloitte research indicates that globally 69 per cent of mining companies are looking at introducing remote operations and monitoring centres, 29 per cent robotics and 27 per cent unmanned drones. These technologies are enabling work to be moved to locations which can support a more diverse and inclusive workforce, including primary carers and people with physical disabilities.¹¹

Deloitte further concludes that shared services centres and centres of expertise will employ a mix of on-shore, off-shore and robotic workforce, with increased human-machine interaction and new and different skills with both work and equipment being redesigned. A diverse, distributed and connected workforce will consider problems and opportunities in new and unique ways, using creativity and diversity of thinking to deliver innovative solutions.¹²

The Australian minerals industry’s latest advertisement in its *Making the Future Possible* campaign promotes its use of innovation.¹³ The advertisement showcases the role of drones as used by Rio Tinto and how these are being utilised to contribute to the minerals sector’s environmental, social safety and productivity performance including:

- conducting site environmental surveys and monitoring impacts on wildlife such as turtle nesting sites
- improving road safety by monitoring traffic, road conditions and hazards and inspecting overhead cranes, towers and roofs of tall buildings to avoid working at height

¹¹ Deloitte. [The digital revolution – Mining starts to reinvent the future](#), February 2017.

¹² *ibid.*

¹³ Minerals Council of Australia, [Making the Future Possible](#), Canberra, 12 January 2018.

- making it faster to gather more information about mine sites, saving millions of dollars when compared with using planes for survey work
- mapping and digitally recording areas of Indigenous cultural heritage.

Looking ahead, the industry's future prosperity will continue to depend on a professional and semi-professional class of highly skilled and technology-literate technical experts, including operators, engineers, environmental scientists, geologists, geophysicists, mathematicians and financial officers. Various technologies reshaping Australia's workforce (e.g. cloud, software and analytics) are already being used by the industry.

The future minerals workforce depends on young learners being both attracted to the industry and actively engaged in STEM subjects.

3. INDUSTRY INVESTMENT IN EDUCATION AND TRAINING

- Australia's minerals industry spends more on training per employee than most sectors and is the third largest user of accredited training and fourth largest user of non-accredited training.
- Through the Minerals Tertiary Education Council, MCA members have invested more than \$50 million of unencumbered funds over the past decades to collaborative initiatives at 17 universities across Australia, benefitting 4,500 graduates.
- Individual companies and the MCA also directly to initiatives designed to encourage students to participate in and pursue a STEM education.

Leveraging investment in higher education and training

Australia's minerals industry invests more on training per employee than most industry sectors (5.5 per cent of payroll).¹⁴ The industry is also a strong user of the vocational education and training system. In 2017, 30 per cent of mining employers used accredited training (the third largest user) and 60.5 per cent of mining employers used non-accredited training (the fourth largest).¹⁵

In 2017 mining employers reported a 70.3 per cent satisfaction rating that accredited training was meeting their skills needs with a 97 per cent satisfaction rating for non-accredited. This shows a significant discrepancy in industry confidence that accredited training is responsive and industry-led to provide its skilling needs.

In addition, the minerals industry makes a significant financial contribution to Australia's higher education sector to ensure a high quality supply of Australian graduates. Through the Minerals Tertiary Education Council (MTEC), the MCA supports collaborative initiatives at 17 universities across Australia.

Through MTEC, MCA members have invested more than \$50 million of unencumbered funds over the past decade in these programs, benefitting more than 4,500 graduates. Companies also provide paid vacation work and structured practical experience for undergraduate students, and award professorial chairs to leaders in industry-relevant research. A survey of just four MCA members found that in 2013-14 \$16.1 million was directly invested in supporting universities in addition to their contributions through MTEC.

However the minerals industry is concerned about the marked decline in participation in STEM subjects in schools over the past decade. In response, the industry engages in programs to increase awareness of the industry as well as support student learning (discussed below). The future minerals workforce depends on young Australians participating and pursuing education in STEM.

The Productivity Commission rightly identifies skills formation as a Government priority because technology adoption, use and diffusion (the long-run drivers of productivity) require people with the right skills.¹⁶

There is additional value in improving skills formation from foundational to advanced as it supports better job security, income and job satisfaction. These benefits are not well measured in official statistics, but have major implications for prosperity and quality of life more broadly. Further, the Productivity Commission confirms that

...the current skills system has fractures that put at risk its capacity to deal with the future labour market changes. There are deteriorating results among school students. The VET system is in a mess, and is struggling to deliver relevant competency-based qualifications sought by industry. Leading segments of the university sector are more focused on producing research than improving student outcomes through higher-quality teaching.

¹⁴ NCVER, [Training and education activity in the minerals sector](#), 20 March 2013.

¹⁵ NCVER, [Employers' Use and Views of the Vocational Education and Training \(VET\) System](#), 26 October 2017.

¹⁶ Productivity Commission, [Shifting the Dial: 5 Year Productivity Review](#), Report No. 84, Canberra, 3 August 2017, p. 83-84.

For many future jobs, new skills and knowledge will be needed as part of the core competencies. While some persist in characterising it as a curriculum-based problem — the emphasis being on increasing the number of students studying science, technology, engineering and maths (STEM) — at a fundamental level all workers will need the skills to interact with digital technology, regardless of whether they study physics to year 12 or not. A range of 'soft' skills (such as communication, empathy, creativity and adaptability) complement other 'harder' skills and are useful to navigate changes in job requirements. In short, while an innovative economy requires the development and use of skills in many disciplines and at a variety of levels, there is no skills-related silver bullet.

In that context, Australia needs a skills formation system that ensures people are work ready for the jobs on offer, and that the education and training system not only develops the required skills efficiently and cost-effectively, but has a system of qualifications that are meaningful to employers when people seek work.¹⁷

The minerals industry is actively considering the future minerals workforce, including opportunities and skills requirements associated with the increasing role of automation, data analytics robotics and artificial intelligence that will see Australian mining continue to be at the forefront of innovation. Central to this work is development of a sector capability framework identifying priority areas for skilling and upskilling related to technological advances to prepare the current and future workforce for these opportunities.

Accordingly, the industry supports the recommendations of the Productivity Commission for reform across the Australian education system to meet future workforce requirements for the industry and Australia. These reforms support skills formation linked to an open, high quality education system to prepare people with the right skills for technology adoption, use and diffusion.¹⁸

Minerals industry supports STEM promotion through outreach initiatives

The industry has developed and supported a number of initiatives to increase awareness of an interest in careers in the industry. Aside from more than \$50 million of direct investment in higher education through MTEC, the industry supports established programs including peer-to-peer outreach programs, online resources for teachers and teacher professional development.

Companies also make individual investments in STEM. For example, MCA member BHP has established the BHP Billiton Foundation is investing \$55 million over five years in STEM-related activities.¹⁹ In Western Australia, MCA member Rio Tinto committed \$2 million to pioneer a new curriculum in vocational education and training required for the mining industry's jobs of the future.²⁰

Some of the industry supported initiatives are described below.

Teacher Earth Science Education Programme (TESEP)

The MCA is a platinum sponsor of the Teacher Earth Science Education Programme (TESEP), which is endorsed by the Australian Science Teachers Association.²¹ TESEP is a national program established in 2008 to assist development of science teachers through nine professional development modules as well online resources and minerals kits provided at no-cost.

The acclaimed professional development workshops, entitled *The Challenging Earth*, reflect topical issues and teacher's needs and are designed to weave with existing curriculum requirements in all States and Territories. Nine topics are offered as webinars or as interactive session and are available in every State and Territory:

- PD1: Round and Round with Rocks (the rock cycle, ore bodies and crustal geology)
- PD2: Riding the Climate Roller Coaster (climate change)

¹⁷ Ibid.

¹⁸ Productivity Commission, [Shifting the Dial: 5 Year Productivity Review](#), Report No. 84, Canberra, 3 August 2017, p. 82.

¹⁹ BHP, [BHP Billiton Foundation](#), March 2016

²⁰ Rio Tinto, [Rio Tinto, TAFE and the WA State Government join forces for mining jobs of the future](#), 20 October 2017

²¹ See <http://www.tesep.org.au/> for more information

- PD3: Greening coal (carbon sequestration)
- PD4: Fossil sunlight (the hydrocarbon story)
- PD5: Wet rocks (ground water)
- PD6: Hot rocks (geothermal energy)
- PD7: Our Place in Space (Astronomy for the curriculum)
- PD8: Powerful stuff (the energy debate)
- PD9: Plate Tectonics (the reason for the Challenging Earth)

OresomeResources

Fully funded and managed by industry, OresomeResources provides free online educational resources and teacher professional development to assist the teaching and learning of minerals and energy.²² Over 400 curriculum-related items have been developed for OresomeResources by teachers for teachers utilising industry and educational expertise to support key learning areas of science, mathematics, technology and social science.

Oresome Resources was established in 2008 and proudly supported by the Queensland Resources Council, Chamber of Minerals and Energy of Western Australia, MCA, MCA Victoria Division, MCA Northern Territory Division, NSW Minerals Council, South Australian Chamber of Mines and Energy and the Tasmanian Minerals and Energy Council.

The Aspiration Initiative (TAI) High School Program

The MCA long supported the Aurora Education Foundation to inspire the academic and career aspirations and achievements of Aboriginal and Torres Strait Islander people.²³ It's The Aspiration Initiative (TAI) high school program works with cohorts of 30 students for six years from year 8 to the first year out of high school. TAI's success in terms of high school completion, ATAR achievement and transition to university from students of the program are well above the national Indigenous average.

TAI's approach is not about the student as an individual. Rather, TAI engages with families and schools, working together to help their children and students along their education pathways. As well as supporting academic excellence, TAI focuses on strengthening cultural identity and creating a cohort of students who will support each other through school and further education and into their careers.

MCA's ongoing support of the initiative will see the program grow to support 150 students finishing year 12 annually with most achieving high enough ATARs to progress to university.

Robogals Asia Pacific

The MCA and Robogals Asia Pacific share a commitment to building a diverse and inclusive workforce, and have worked together for many years to inspire girls about career pathways in engineering.

Robogals aims to inspire, engage and empower young women into engineering and related fields.²⁴ To fulfil this mission, an extensive global network of Robogals volunteers, typically university students, deliver interactive workshops with primary school students. This approach means that Robogals is in a unique position to empower girls and young women from an early age. Since its establishment in 2008, Robogals has reached more than 69,000 girls around the world. The organisation's efforts are now showing rewards – workshop participants inspired by Robogals workshops are now selecting

²² See <http://www.oresomeresources.com/> for more information

²³ See <http://auroraproject.com.au/about-aurora> for more information

²⁴ See <https://robogals.org/> for more information

engineering studies at university and in-turn, are becoming Robogals volunteers so that they too can give back to the community and inspire more school students.

MCA is Robogals Platinum Partner in 2018, with lead sponsorship for Robogals Rural Trips program. The program will see Robogal volunteers from across the country conduct 5 three-day drips to 5 regional cities. MCA members will assist in hosting volunteers for field trips in mining-regions and also to connect the volunteers with local schools to showcase to young learners the exciting opportunities in engineering and the minerals industry.

4. PREPARING THE FUTURE MINERALS WORKFORCE

The pace of technological change within Australia's minerals industry is already apparent. Technologies such as automation and big data are presently being used across the value chain to increase productivity and reduce risk. These technologies are changing how companies mine, and the skills needed to work in this new environment. The industry also recognises that the pace of innovation within the industry is changing workforce needs at speed, and this presents opportunities and challenges for the minerals education sector.

An education system requiring reforms that support skills formation linked to an open, high quality education system to prepare people with the right skills for technology adoption, use and diffusion is required for Australians to meaningfully acquire capabilities and skills in the future minerals industry.

The minerals industry has a role to play in supporting established programs including peer-to-peer outreach programs, online resources for teachers and teacher professional development that assist in showcasing the importance of following a STEM pathway at an early age to participate in this exciting industry.