

MORE TO MINING

CAREERS GUIDE

Open your mind to an exciting future!



THE BEST PART OF MY JOB IS...



“What other industry allows you to travel to far-flung locations, fly drones, help impoverished communities or drive trucks the size of a house? The world is your oyster, and mining could be the pearl that illuminates it.”

**FRISKA WIRYA,
NEWCREST**

“

IT'S
PRETTY
EXCITING
TO BE A
YOUNG
PERSON
WORKING
WITH
MASSIVE
MACHINERY
– BIG BITS
OF KIT.”

**SAMANTHA WATSON,
ANGLO AMERICAN**



“I often go to NASA and deliver lectures. Space used to be something mining engineers couldn't even dream about... But not anymore.”

**SERKAN SAYDAM,
UNSW**



“

IT'S A VERY DYNAMIC INDUSTRY; THERE ARE A LOT OF CHALLENGES. IF YOU APPLY YOURSELF, YOU CAN REALLY GO FAR. EVERY DAY IS DIFFERENT.”

**AMY LOWE,
ST BARBARA**



WELCOME TO THE MORE TO MINING CAREERS GUIDE

04 A lot more to mining

06 Choose your own adventure

07 Tomorrow's world

08 Mining myths busted

10 Day in the life

11 Study hard, shine bright

12 Modern life goes better with mining

14 Green energy begins here

15 Leave it as you found it: mine site rehabilitation

16 Mining from the city office block

17 Drones and space mining

18 Creative destruction

19 Go to Weipa, see the world

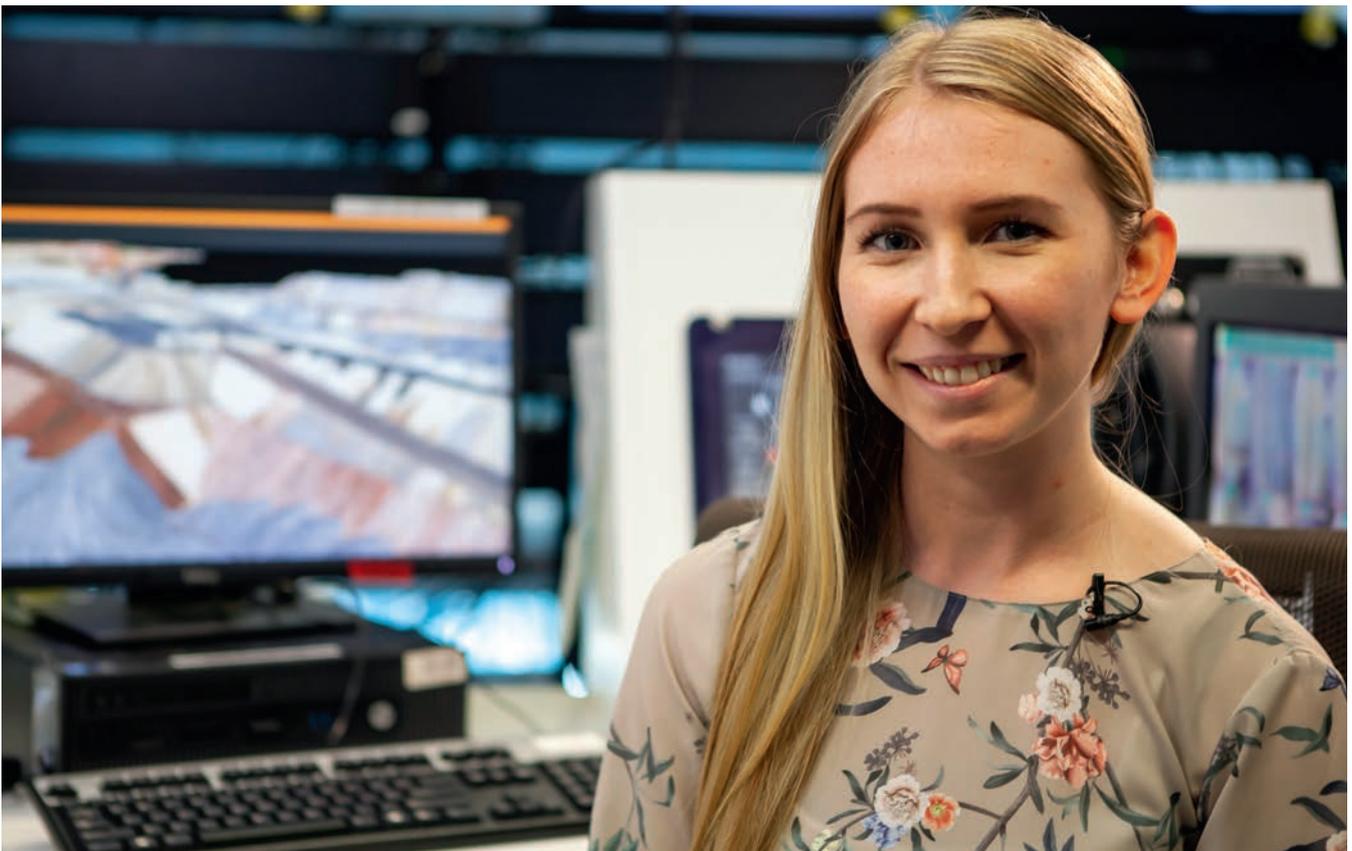
20 Modern-day explorers

22 Innovation and design

24 Building your career in mining: VET and trades

26 Building your career in mining: university

THERE'S A LOT MORE TO MODERN MINING THAN YOU THINK



The modern mining industry is much more than big machines, hard hats and high vis.

We interviewed workers, students, industry experts and researchers from across Australia for this magazine – to share their mining career stories with you.

They all have two things in common: they love their job and are proud of their industry.

This Career Guide is designed to take you beyond some of the stereotypes and into the *real* world of mining.

Choosing a career can be a daunting experience made easier with access to good information and first-hand experiences.

This is your chance to find out why there is so much *more to mining*.

1. MORE OPPORTUNITIES

Many of the people you will meet here are just like you. They didn't know what to expect from mining and couldn't imagine the opportunities that came their way for world and local travel, new discoveries, lifelong friendships and challenges.

→ You could be sent to the United Nations (page 19), become an inventor (page 22), design an outdoor laboratory (page 15) or search for the sustainable energy of the future (page 21).

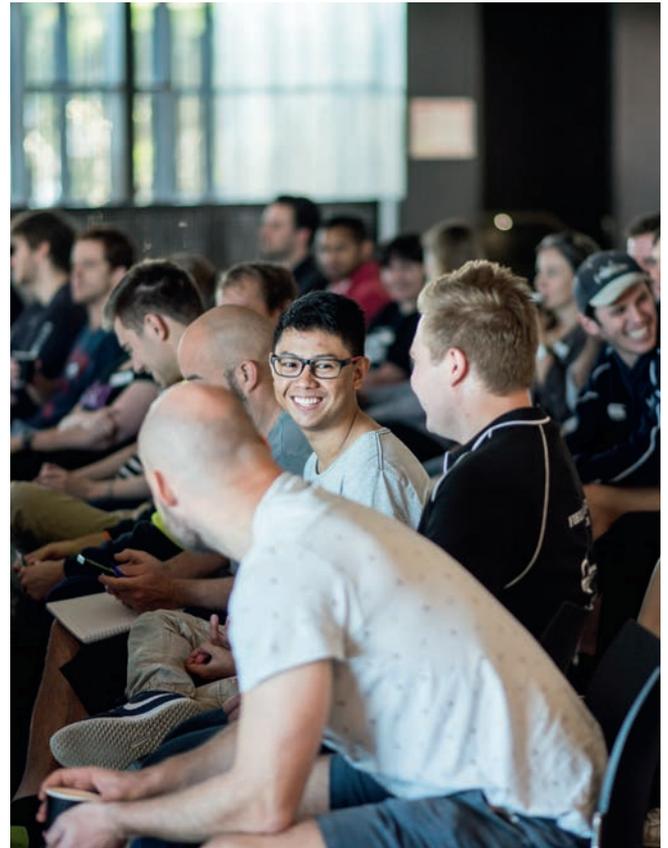


2. MORE TECHNOLOGY

Research, development and innovation are the bedrock of Australian mining. You will find cool tech and some of the brightest minds on the planet making life better.

You could build remote operational gear, as the team at Australian Droid + Robot does, or work with telepresence technology, which allows underground mine operators to remotely inspect hazardous areas without putting their people at risk.

→ You can read more about these sorts of exciting technology jobs on pages 16 and 17.



3. MORE TO LEARN

The University of Queensland is ranked first in the world for Mining and Mineral Engineering. It is one of 10 Australian universities offering mining-related degrees. Two of those unis offer Associate Degrees; a fast and flexible alternative for students, or those already working in the sector.

→ Check out your options for tertiary study on pages 26 and 27.

CHOOSE YOUR OWN ADVENTURE

From pit operators to PhD students, mining opportunities are incredibly varied.



WORKING THE NUMBERS

Name: Lara Garth

Job: Financial Controller, Idemitsu Australia Resources

Work site: Brisbane, QLD

Qualifications: Chartered Accountant, Graduate Diploma (Chartered Accountants Australia and New Zealand), Bachelor of Commerce/Bachelor of International Business (Griffith University)

Career: “I started my career as an auditor at a professional services firm. Mining sparked my interest due to its tangible nature – and the big yellow trucks! I joined Idemitsu Australia Resources in 2005, holding senior leadership roles across finance, planning, governance and risk.”

THE MINING ENGINEER

Name: Jelena Ceranic

Job: Mining Graduate Engineer, BHP

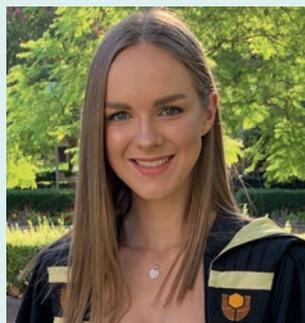
Work site: Mt Whaleback Mine, WA

Qualifications: Bachelor of Civil and Construction Engineering (Hons), Curtin University

Favourite part of the job: “The practical side. We get to be a truck driver, be part of the blast crew and see how things happen in the field. And you feel really accomplished doing 12-hour days, even though it is hard and long. You learn how to stay focused for a long time.”

“Also, the time off is awesome – I work hard, then get to really switch off and recharge.”

Ambition: “I want to be in a leadership position one day, influencing and inspiring people and making people’s lives happier.”



A CHANGE MAKER

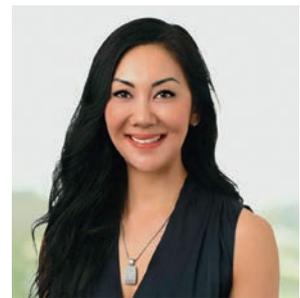
Name: Friska Wirya

Job: Head of Change, Newcrest Mining

Work site: Melbourne, VIC

Qualifications: MBA (Curtin University of Technology), Bachelor of Commerce (Curtin University), Post-Grad Cert in Business, Post-Grad Dip in Business, Prosci Change Management Certification, Design Thinking course

Career: “I develop and execute initiatives to unite



people through a strong performance culture. You can have all the processes and systems in place, but the extent of mindset and behavioural change determines how fast, how well, and how safely you progress towards your vision.”



Qualifications: BSc Geology (Federation University)

Career: “Working as a geologist in the mining industry has given me the opportunity to experience a variety of geology-based roles in different mines across Australia. Each mine has had unique living conditions, from residential to fly-in fly-out and even drive-in drive-out. My career has been spent looking for gold in places such as Mount Isa, Kalgoorlie, Leinster and now at Woods Point in Victoria’s High Country. I really enjoy utilising and expanding on the science skills I learned at university.”

GEOLOGY ABOVE AND BELOW

Name: Zac Marshall

Job: Geologist, Centennial Mining

Work site: A1 Gold Mine, Woods Point, VIC

TOMORROW'S WORLD TODAY

Mining is one of the most technologically advanced industries in Australia. Read on to find out more.

Drone operator. Virtual reality researcher. Robotics technician. Artificial intelligence developer. These are all jobs in Australia's mining industry in 2019. And they're also the jobs of tomorrow.

Within five years, 77% of jobs in Australian mining will be different thanks to technology – and the people who make the most of it.

Across the mining process – from exploration through to operations, processing, transport and trading – technology is transforming the way we mine.

In some industries, that would mean losing jobs to robots and automation. In mining, technology means safer and more productive jobs.

Most jobs in mining will be enhanced by technological innovation.

Surveyors, field geologists and drill operators will still be in demand, but these jobs will be revolutionised by artificial intelligence, drones, driverless vehicles and remote-controlled systems.

This means that if you're interested in robotics and automation, mining could be for you!



EXISTING

Drill operator

Truck driver

Drill and blast engineer
(working underground)

Diesel-powered
machines

Underground workers

Exploratory drilling

Standard drill
and blast

EMERGING

Data modeller and systems engineer (working remotely to make decisions about data collected by an autonomous drill rig)

Autonomous fleet operator (managing the human-to-machine interface with driverless vehicles)

Geotechnical engineers, technology and systems support (working remotely on autonomous underground machinery)

Electric- and renewable energy-powered machines

Remote workers

Use of historical and predictive data, real-time data analysis, 3D and virtual reality visualisation software

Adapting to drilling conditions using artificial intelligence (AI) and robotics, and predicting blast results with 3D simulation and AI

MINING MYTHS BUSTED

MYTH ONE: THE MINING BOOM IS OVER

Reports claiming the mining boom is over have misled some Australians about what is really happening in the industry.

The mining industry has undergone a period of significant expansion in the past decade. A period of massive investment supported many construction jobs in the industry as new mines, processing plants and infrastructure were built.

Now that these projects have been built, Australia is producing new record volumes of iron ore, coal, bauxite, gold and lithium.

This production phase of the boom will last for a much longer period because mines typically take a few years to build but can run for considerably more than 20 years.

These operating mines are offering many new positions in the industry. More than 17,000 new jobs in the resources sector have been created since 2016.

Most of the things we use in daily life are made from mined materials. With global population growth and rapidly escalating demand for energy and infrastructure, we are using more minerals and metals than ever.

So you can expect the appetite for our world-class Australian resources to remain strong.



MYTH TWO: MINING IS DANGEROUS

No one is more aware of risk than the people who own and run mines.

Australia is an international leader in mine safety research and technologies, virtual training facilities and mining software. Safety and health are prioritised in all operations.

Ventilation, high-tech monitoring, protective clothing, training, certificates of competency, supervision

and daily safety briefings are all integral to daily mining operations.

There has been a big drop in the number of injuries recorded during the past decade.

This improvement is partly due to better precautions and training but also because, in a modern mine, fewer employees spend most of their time underground.

MYTH THREE: ALL MINING JOBS ARE REMOTE

Many workers choose the lifestyle advantages of working remotely through fly-in fly-out (FIFO) or drive-in drive-out (DIDO), in order to get up to nine consecutive days off back home with family and friends.

Conditions are also good on the job. FIFO workers have all their food and accommodation taken care of on-site, along with

recreational facilities such as swimming pools and gyms and social activities to create a community atmosphere.

If FIFO isn't for you, the increase in "digital mining" methods – such as real-time data capture, autonomous vehicles and automation – means that more mine workers can work closer to their home towns.



**MYTH FOUR:
MINING IS
BAD FOR THE
ENVIRONMENT**

Australia sets the standards for social responsibility, environmental management and governance in mining.

Environmental officers, social scientists, anthropologists, accountants, lawyers, safety experts, statisticians, community liaison officers, plant scientists and more help companies meet community expectations and adhere to tight regulations.

Land rehabilitation is fundamental to responsible mining. The industry's approach has improved significantly during recent decades.

**MYTH FIVE:
MINING COMPANIES ARE DOING
NOTHING ABOUT CLIMATE CHANGE**

The Australian mining industry supports participation in global agreements such as the Paris Agreement, which would hold the increase in the global average temperature to below 2°C above pre-industrial levels.

This includes reducing emissions from minerals extraction and processing and increasing the use of renewable energy in operations.

**MYTH SIX: MINING COMPANIES DON'T
CARE ABOUT LOCAL COMMUNITIES**

"Mining companies are an important part of the communities in which they operate and they take that responsibility seriously. We hold regular meetings with the local community to share exploration plans, what we are doing in the community, and employment opportunities," says Felicia Binks, Environment and Community Manager at Kirkland Lake Gold's Fosterville Mine.

"We provide land holders with a guide created by the Minerals Council of Australia and the Victorian Farmers Federation to fully explain their rights."

Mining companies often work on local community partnerships such as employment programs or the sponsorship of local sporting teams and events.

**MYTH SEVEN:
MINING IS A
MAN'S WORLD**

While women currently make up just 16.1% of the mining workforce, that is changing fast as the industry works hard to diversify its workforce.

For example, BHP is aiming for gender equality across its global workforce by 2025 and has started at the top. Five of its 11 senior executive roles are held by women.

Gold producer St Barbara is also working towards gender equality by 2030. It has closed the pay gap and is providing flexible work conditions to recruit and retain female staff.

There are a lot more women working across all fields than in the past, when certain roles might have been off limits. Now there are no barriers – if you want to do it, you can.

A DAY IN THE LIFE OF A COAL MINER

Joining a shift 300 metres under Queensland “there’s no dark or small spaces.”



Graduate mining engineer Sarah Coughlan (above) loves working underground all day as a coalminer.

“I was never going to work in the city, so the idea of living in the country but still using my brain was great,” she says. “And I want to get out in the field and be dirty!”

She first had an inkling mining might be the life for her at her hometown school, Nanango State High, in country Queensland, when she “really got the wow factor.”

Just after graduating she spent a little time in an office, which made her wonder if she’d made the right choice.

“Then I got into operations and it’s so hands-on, making day-to-day decisions about what’s happening. I thought ‘This is where it’s going on!’”

Joining Anglo American’s graduate program for prospective mine managers was a perfect fit for Sarah.

“When I found out about that, I thought it was incredible.”

LIVING THE LIFE

“ I do two days, three nights in one roster, then five days off. And then I do five day shifts straight and get four days off, then four nights on and four days off. It’s complicated but having 50% of my time to myself is great – I bought a cane farm with my partner and so I’m a farmer on my days off.”



WORKING UNDERGROUND

4AM:

“We work a 5am-to-5pm day shift, so I get up early. I go to a deputy pre-start meeting, where they brief all the supervisors on what’s happening that day.”

5AM:

“We have the big crew pre-start briefing. And then we all get in a Driftrunner, like a troop carrier, and drive down a steep ramp and then are underground for nearly an hour.”

5:55AM:

“We have our smaller crew pre-start. The deputy of that panel gets his instructions and explains what’s going on – how much air’s coming on, how much gas we’ve got, the road conditions. Then we go up the face and start cutting coal.”

6AM:

“We extract coal in panels about 4 km long and 4.4 m high. You’re always standing under one of 150 solid steel roof supports (*roof chocks*). In front of those roof chocks is the shearer that travels across our 300 m section of face,

cutting a metre of coal in each pass. As the coal falls, it lands on a chain conveyor that takes it out of the panel. Once the shearer’s gone from chock one to chock 150, all the chocks are automated to walk forward. It’s just incredible watching this whole thing basically run itself.”

MIDDAY:

“We go to the crib room, which is just part of the roadway where we put a couple of bench tables. They have attachments so they can be picked up by a machine and moved along with us. There are Eskys, and that’s where we go for lunch. All the roads underground are 3.5 m high by 5.5 m wide, and they’re lit up like a Christmas tree with LED strips.”

4PM:

“Down tools and back out of the mine for 5pm knock-off! When I’m a deputy I’ll have to inspect different districts of the mine and write reports and spend time at the face, making sure everything complies with the regulations controlling underground coalmining.”

STUDY HARD, SHINE BRIGHT

From the study hall to the underground mine, academia's brightest sparks show us the way.

A scholarly life of the mind might not seem to have much in common with mining. Yet, Australia's graduate students are reinventing mining from the (under) ground up.

For instance, Bradley Cave's PhD at the University of Adelaide is about how mineral deposits form.



"I'm looking at the chemistry of sphalerite, galena and chalcopyrite, which are the main lead, zinc and copper-bearing minerals, and what conditions the deposit formed in," Brad says.

"If you know how the deposit forms, then you can try to back-calculate the conditions you need to form a deposit. If you're exploring, you know you want A, B and C conditions. So you look at a place where A, B and C have taken place."

His work won him an Australian minerals industry research scholarship, which he's doing in partnership with Glencore.

"It's easier for me to solve a problem knowing it means something at the end of the day," he says.

University of Tasmania PhD student Javier Merrill (pictured) is also inspired by mining's application to the real world.

"My PhD is about combining geology, metallurgy, and mining engineering to get predictive modelling of ore behaviour in metallurgical processes," he explains. "When you can predict, let's say, the water or energy consumption that a specific kind of rock will require to process, you can make better decisions about how much water to add to the system, or how long the rock has to spend in the mill. So that impacts energy and water consumption."

Javier also won an Australian minerals industry research scholarship this year and confesses, "I'm more a fan of applied science than academia."

WORDS OF WISDOM

JAVIER'S ADVICE:

"The world lacks people who can look at the big picture and start connecting the dots. So there's a big opportunity if you can develop multidisciplinary skills with team management – the ability to combine people's skills to solve the challenges of the industry."

BRAD'S ADVICE:

"The mining industry is great, you're very well looked after. Obviously people like the idea of big money, but I think most people find if you chase the money instead of what you love, you end up a bit sad. You have to love what you do to do it well."

LOOKING TO THE FUTURE

JAVIER'S PLANS:

"I see myself more like an inventor than a scientist. My main idea is the development of solutions linked to new technologies. After finishing my PhD, I'd like to maybe work part-time in a university and also have my own company that develops multidisciplinary solutions for different industries."

BRAD'S PLANS:

"I like the idea of exploration. But I also like the idea of being a geologist at a mine, or running my own little company – I like the idea of consistently being challenged and trying to solve problems while creating new knowledge. It would be great to work in a place that is open to new ideas and changing our current perspectives."

MODERN LIFE GOES BETTER WITH MINING

Australia already has the most diverse and abundant mineral reserves in the world – and there is still so much of the country to explore.

And growing populations, new technologies and economic and social development mean the world just can't get enough of our minerals and metals.

From the gold in your iPad to the iron, chromium and nickel in your stainless steel fridge, from the bauxite that made the aluminium in the plane that takes you on holidays to the lithium that powers your phone and electric car, mining provides many of the things in modern life.



SOME STUDENTS THINK WE MINE GOLD JUST FOR JEWELLERY. I ASK 'DO YOU HAVE AN IPAD OR PHONE WITH YOU? YOU HAVE GOLD ON YOU RIGHT NOW!'"

**FELICIA BINKS,
ENVIRONMENT AND
COMMUNITY MANAGER,
FOSTERVILLE GOLD MINE,
KIRKLAND LAKE GOLD**

ASIA WILL SOON BE RESPONSIBLE FOR MORE THAN HALF OF THE WORLD'S ECONOMIC OUTPUT. IT ALREADY USES

40%

OF THE WORLD'S ENERGY AND IS HOME TO A MIDDLE CLASS OF ALMOST 3.5 BILLION PEOPLE.

AUSTRALIA IS WELL-PLACED TO SUPPLY OUR NEIGHBOURS WITH THE HIGH-QUALITY MINERALS, EDUCATION AND EXPERTISE THEY NEED TO BUILD BETTER LIVES.



\$140K

Average annual salary 2017-18



THRIVING ECONOMY

Mining has not only driven Australia's long and steady growth – it has protected our economy in times of financial crisis.

The industry provides highly skilled, highly paid jobs while the taxes and royalties it pays support public services.

The resources sector accounts for 8% of Australia's economy, with exports worth \$248 billion in 2018.

MINING MINDS



Some of the world's best science and engineering minds are working in mining through world-renowned institutions such as Geoscience Australia and the CSIRO.



MINED MATERIALS MAKE UP MORE THAN

70%

OF AUSTRALIA'S GOODS EXPORTS.

3

Li

AUSTRALIA IS THE WORLD'S LARGEST LITHIUM PRODUCER WITH NEARLY 18% OF KNOWN GLOBAL RESOURCES.

JOB FOR AUSTRALIANS

240,000

Mining gives 240,000 Australians a job. And when you take into account the Mining Equipment, Technology and Services sector, which provides vital support to mining and minerals processing, the industry provides jobs for about 1.1 million people.

"I think we need a better understanding of the role of minerals in society. Mining is a fundamental activity, just like agriculture, that we all depend on."

ROBIN EVANS, SUSTAINABLE MINERALS INSTITUTE

GREEN ENERGY STARTS HERE



Australian minerals such as lithium, cobalt, copper and nickel are supporting the growth of renewable energy across the globe.

Solar panels, wind turbines, lithium-ion batteries and electric vehicles are already everyday items, or under development along with other new clean green technologies.

Renewable energy is making an increasing contribution to supplying power needs as global electricity demand grows by 3% every year.

This sustainable energy is only possible with a reliable and plentiful supply of copper, silicon, aluminium, lithium, cobalt, rare earths and silver, all of which are used for generation, storage and distribution.

RENEWABLES RACING AHEAD AT HOME

During 2018, renewable energy created 13,233 jobs, \$24.5 billion in investment and 14,841 MW of power. Investment in large-scale renewable energy projects was \$20 billion in 2018, double the year before.

Six solar panels were installed every minute of 2018 and by the end of 2019, one in five Australian households will have rooftop solar.

NEW MINERALS, LESS CARBON

Reducing global temperatures by 2°C is predicted to require 20 million tonnes more copper and 10 times more lithium than is currently mined to supply demand for batteries, without including electric vehicles.

RENEWABLES FOR MINING

Mine sites across Australia are already embracing renewable energy including solar power and solar/diesel hybrid systems.



Aussie innovations such as the portable, pre-fabricated SunSHIFT solar PV blocks (pictured) can provide short-term and affordable solar energy.

Case studies suggest a significant cost saving for off-grid sites when compared with buying diesel.

“ THE MINING INDUSTRY WORKS IN PARTNERSHIP WITH LANDOWNERS, BE THEY FARMERS OR INDIGENOUS PEOPLE OR EVEN A LOCAL TOWN OR WATER CATCHMENT AUTHORITY, TO GET THE BEST OUTCOME.”

**FELICIA BINKS,
ENVIRONMENT AND
COMMUNITY MANAGER,
FOSTERVILLE GOLD MINE,
KIRKLAND LAKE GOLD**



LEAVE IT AS YOU FOUND IT...

...OR BETTER THAN BEFORE

Todd Erickson loves science, research and plants. Yet he never imagined these passions would lead him to the Pilbara in remote Western Australia and the world of iron ore extraction. Now he is helping to return the ecosystems that existed before mines were opened.

“You can’t just sprinkle some seeds on the ground and hope for the best. The key is to crack the tricky secrets of native plant seed behaviour,” Todd says.

And that’s what he does in his outdoor lab – an enormous shelter (pictured below) near an iron ore mine.

There he runs experiments in collaboration with a team of scientists to get a better understanding of seeds, soil, climate, weather, microbes and mine waste.

It all began when Todd followed up a Bachelor of Applied Science with a PhD in plant science, studying seed dormancy and germination in the Pilbara. Then, with Perth’s Kings Park Botanic Garden, the University of Western Australia and BHP, Todd helped produce the Pilbara Seed Atlas and Field Guide.

“This sort of impact is what I had always hoped I could achieve through a career in science.”

Rio Tinto, Greening Australia, and three USA universities soon took notice and joined up, with project funding from the Australian Government’s Global Innovation Linkages program. The work is being shared globally, helping mining companies ensure the big investment they make in mine rehabilitation takes root – literally.

New Hope Group likes to leave its mine sites as it found them, or in even better condition. The company is a leader in Australia when it comes to rehabilitating open-cut coalmines.

When the New Oakleigh West coalmine in the Bremer Valley west of Brisbane closed in 2014, 223 hectares of mined land, including a 90m deep pit, was restored to grazing land during three years (see the before and after photos below).

When researchers compared the weights of cattle that grazed on the pre-mine pastures to those recorded after the site had been restored, they found no negative impact. In some cases, the cattle living on rehabilitated sites were the heaviest!



BEFORE: NOVEMBER 2012



AFTER: MARCH 2017

MINING FROM THE CITY OFFICE BLOCK



“ You never build a robot and it works straight away.”

Today, miners can be found in our city office blocks, regional towns and in the middle of the outback.

As robots multiply, we aren't far away from artificial intelligence systems playing a greater role complementing human ingenuity.

Professor Salah Sukkarieh, Director of Research and Innovation at Sydney University's Australian Centre for Field Robotics (pictured), says that requires an awful lot of moving parts.

“It's exciting bringing computing, mechanics, electronics and software all together and making things work,” he says.

Salah has been helping Rio Tinto realise its vision of tomorrow's mine, finding ways to automate machinery and allow robots to talk to one another.

“Data is coming from sensors on the robots, and we use machine learning to analyse it and pull out interesting pieces of information, such as changes in rock surfaces,” he says.

“You never build a robot and it works straight away. You have to go through the process of trial and error, and a lot of that comes back to opening your mind and being able to learn from that.”



EYE IN THE SKY



“Drones offer an opportunity to enhance safety and minimise risks to a person.”

Every day drones are hard at work in the skies above Australian mines, monitoring blasts, surveying mine sites and even rehabilitating old sites by spraying seeds to begin the process of revegetation.

“On a daily basis if we’re doing a blast, we put a drone up for an eye-in-the-sky view and survey all the stuff going on,” says Don Cameron, Glencore’s Project Manager for Remotely Piloted Aerial Systems (RPAS).

The number of drones used by Glencore has increased markedly since the first one flew in 2014. There are now about 60 RPAS operated by 158 pilots across the business.

The next step is to put drones to use in rescue operations underground, where GPS satellite and radio signals can’t reach.

“Mining environments can be hazardous, given we blow up rocks and operate in remote areas,” Don says.



OUT OF THIS WORLD



“In the future, either astronauts will have mining skills or mining engineers will have astronaut skills.”

Space mining might sound like far-fetched sci-fi but, according to the experts, will be a reality in coming decades.

“I totally believe that in the next 10–20 years, space mining will happen,” says Professor Serkan Saydam, the off-Earth mining specialist at the University of New South Wales in Sydney.

Serkan is backed by NASA and has 12 PhD students modelling resource use on the Moon and Mars, running environmental impact assessments in space and getting on top of the geophysics of asteroids.

“Water will be the first thing mined,” he says.

“It has hydrogen and oxygen, which can be used as rocket propellant.” It will also help support life in any colony on the Moon or Mars.

Next up might be asteroids, where the haul would be gold, platinum, rare earth minerals and diamonds.

Space mining also represents a big jobs opportunity. The world’s space agencies, including NASA, have virtually no people with mining skills.

“They are realising that they can’t produce anything in space without mining skills,” Serkan says. “In the future, either astronauts will have mining skills or mining engineers will have astronaut skills.”



CREATIVE DESTRUCTION

Sometimes you have to
break rocks to save them.



“ You can do this kind of job and you can enjoy it and be passionate about it.”

Painting giant blocks of granite and throwing them off cliffs in northern Italy might sound like an unlikely route into the mining industry for Anna Giacomini (pictured above right and far right).

The creative destruction that occupied her during her civil engineering Master’s degree gave her insights about how rocks fall and break, which is essential for underground mine safety.

The specialty is called Rock Mechanics, and it saves lives by preventing deadly rockfalls.

It wasn’t Anna’s first choice though: “Absolutely not. I wanted to be an architect.”

So it was a bitter blow when she failed the entrance exam leaving her wondering what she should do with her life.

“I enrolled in engineering and it was the best choice of my professional life.”

She would like to see more women in science and engineering jobs – not least to take advantage of the huge variety of career

opportunities including senior roles, travel and immense job satisfaction.

Anna helped create the HunterWISE STEM mentorship program to promote STEM education and careers and to support women already working in those fields.

She regularly visits schools to tell students about her work on mine sites as an academic and as a leader in her field, with the message: “You can do this kind of job and you can enjoy it and be passionate about it.”

“There will always be opportunities for STEM graduates because they are trained to have a problem-solving, innovative mindset,” she says.

“Today’s high school and university students should see themselves in the future of mining because there are always new ideas, new challenges and better ways to do things.”

Associate Professor ANNA GIACOMINI is based at the School of Engineering at the University of Newcastle. Anna is the Co-Director of the University’s Priority Research Centre for Geotechnical Science and Engineering.

GO TO WEIPA, SEE THE WORLD

Leaving Melbourne for big trucks
and the Big Apple.



“ I look forward to building pathways here for Aboriginal and Torres Strait Islander people within STEM and the workforce to develop our knowledge and skills and to contribute.”

In between gigs advocating for women and Indigenous people before the United Nations in New York, you can find Florence Drummond (above) driving a 25-metre, 195-tonne truck as a mine operator at Rio Tinto’s bauxite mine in Weipa, Western Cape York.

She left her office worker life in Melbourne behind four years ago to get back to nature and closer to her family home in the Torres Strait Islands.

The pay, lifestyle and community atmosphere were strong incentives, but she didn’t know how many other benefits there would be.

There’s the “lifestyle roster” that means she gets up to five days off in a row when she can get home to see the family, or take off on a camping trip.

But there is also the support from Rio Tinto, which has nurtured

her natural leadership skills and her drive to help more women and Indigenous people get into the industry.

That led recently to Florence joining the Australian delegation at the 63rd session of the UN Commission on the Status of Women.

Now she is working to get more women and Aboriginal and Torres Strait Islander people in strategic and management roles in the mining industry.

Florence has seen many local kids start mining jobs through traineeships and entry level roles, even after dropping out of school.

Mining sets them on course for fulfilling careers and can break the cycle of long-term unemployment experienced in some regional areas.

FLORENCE DRUMMOND is the Co-Founder of Indigenous Women in Mining and Resources Australia (IWIMRA), supporting Aboriginal and Torres Strait Islander women working in mining and resources. In recognition of her work with IWIMRA, Florence was named Weipa’s Citizen of the Year in 2019, and was a Finalist in the Queensland Resources Council Resources Awards for Women.

MODERN-DAY EXPLORERS



SPACE MINING – THE NEXT FRONTIER

“ Travelling into space is very costly, and so creating areas where craft can refuel within space will enable greater exploration.”

Nima Sherpa (above) has her feet planted firmly on the ground as a superintendent at BHP’s Olympic Dam mine in South Australia.

But her head is in the stars as she researches the amazing possibilities of space resources, while working towards her PhD.

Space mining could be nearer than we think. “The first operations could extract water from Moon rocks to make hydrogen for rocket fuel,” Nima says.

“Travelling into space is very costly, and so creating areas where craft can refuel in space will enable greater exploration,” she explains.

Nima, 27, was raised in Colorado and came to Australia in 2014 in search of adventure.

As a young woman from another country, she says she has faced pre-conceived views about her abilities from time to time. But she silenced the critics in 2018 when she won the prestigious Exceptional Young Woman in Australian Resources Award.

“Mining and resource industries are becoming more innovative and diverse, and that will only strengthen them further,” she says.

READING THE LANDSCAPE

“ We need to understand our connection to our planet, as well as how it works.”

Understanding Earth’s geology, climate, water cycles and ecosystems is critical to making new mineral finds.

With the easier finds behind us, future discovery will require an even better understanding of vegetation and rock cover and the environments in which minerals might be found, says Geoscience Australia’s Canberra-based Chief Scientist, Dr Steven Hill.

He enjoys training students to “read” landscapes so they can look for clues about what lies beneath the surface.

“This includes taking samples of leaves, termite mounds, ant nests and even kangaroo poo, then performing chemical analyses to uncover signatures of otherwise buried rocks and mineral deposits,” Steve (pictured below) explains.

“This really shows how linked and integrated all things are in our landscapes – including human beings.”

Steve says he loves being a geologist because it is relevant to many aspects of our lives.





GOING FOR GOLD

“ I look forward to the excitement of the hunt.”

Finding gold today is a lot more high-tech than panning in rivers – not least because new deposits are often far underground.

The Gwalia Gold Mine near Leonora in Western Australia is “one of the deepest trucking mines in the world,” says Amy Lowe, Senior Exploration Geologist with mine owner St Barbara.

Amy (above) spends her time searching for new deposits up to 30 km away from the Gwalia site, often having to employ sophisticated

sleuthing methods as well as science.

Her team are even looking to incorporate machine learning based on artificial intelligence to help process the vast quantities of data they collect and help pinpoint potentially productive sites.

“I look forward to the excitement of the hunt. You work out the target and then you get excited when it looks promising,” she says. “Fingers crossed that you find enough gold to start mining soon.”

FEELING THE HEAT

“ Your targets are always blind.”

With many minerals, there are some clues on the surface that might help you detect where they are found underground.

Geoscience Australia National Drilling Initiative Coordinator, Dr Anthony Budd (pictured below), has often worked with two resources that offer no clues above ground whatsoever – geothermal energy and petroleum.

“Your targets are always blind. There’s virtually no indication of these things at surface – you’re relying solely on using geological models and geophysics,” he says.

“If you’re looking for high-temperature geothermal systems, you need about 150°C to produce electricity... and you won’t get that in Australia until you’re at 3 km depth.”

Anthony has explored deep granite rock sites around Australia as potential sources for geothermal energy. This requires water to be pumped deep underground and heated, so it can turn to steam and drive turbines at the surface.



SAFER THROUGH INVENTION

“Embrace the things that go wrong. You’ll learn so much more than when things go right.”

Leigh Sutton has always been an inventor; as a fourth-generation farmer from central Victoria, coming up with practical solutions to problems came naturally.

But it wasn’t until he joined Fosterville Gold Mine near Bendigo as a long hole driller that he saw a way to turn that into a business.



Innovators such as Leigh Sutton can change the world. It’s not the easiest job but it might be the most satisfying.

“I’m actually an A-Grade Automotive Engineer which is just a fairly fancy mechanic really,” he says.

At 48, Leigh raised some eyebrows in coming late to the mining game. But with two daughters off to university he needed more regular income than that provided by farming’s seasonal and price variability.

“So I started at the bottom again, but with my mechanical and farming background, that made me a reasonable employee to take on.”

Long hole drilling can be a dangerous game – especially when drilling vertically into the roof. Drills can break off and lodge in the hole, only to come loose and crash out 20 m or more at high speed; a fatal accident just waiting to happen.

When it happened to Leigh (pictured centre, at left), he fortunately wasn’t injured but it sparked a brainwave for a potentially industry-changing innovation.

“I was drilling a vertical hole and broke off some of the drill string in the hole,” he recalls. “And I was going to go what we call “fishing” for it.”

But before he could, he heard a terrible noise. Instinctively he dropped his gear and ran for his life.

“The drill string had got loose and came speeding out of the hole and smashed into the rig itself. I thought, “Wow, the power of this is enormous.”

In inventing, Leigh says there is no light bulb moment, “it’s more putting all the ingredients in a pot and letting it simmer slowly.” And all that simmering led to the idea of the Safety Spear.

Leigh describes the device as “a high impact absorbing plugging system.” In simple terms, he’s worked out a way to insert a plug in the drill hole so that it secures itself, stopping old drill rods from escaping and hitting anybody.

His employers – who had been looking for a solution to this problem – were supportive of Leigh testing the device.

So Leigh and his wife Sue funded development themselves through their company, RattleJack Innovations.

He acknowledges that the trip from idea to marketable product can be a long and difficult one, but says there is no more exciting thing in the world than when it comes off.

“And if I said anything to young people setting out, I’d say “embrace the things that go wrong”. You’ll learn so much more than when things go right – that just confirms what you already know.”

BETTER BY DESIGN

The more you think about a mine before operations start, the better the outcomes for everyone – especially the environment.



“ Mine design covers the whole life of mine.”

Mine planning and design is some of the most fascinating, complex and rewarding work a mining engineer can do.

And getting it right – which also means working out what goes on after the mine has closed – is the most important factor in whether a mine is a success or failure.

“Mine design is something that dictates the strategic direction of a mine all through its life,” says Peter Knights, a professor at University of Queensland’s School of Mechanical and Mining Engineering.

The checklist is daunting, however: you need to work out how much ore the mine is likely to hold, where reserves are located, the most efficient way to get to them, the best way to get them out, which reserves you tackle first and which to leave to last – all with the best equipment.

Further, if it’s an open-cut mine you need to look at trucking options and the shape and slope of the walls of the mine. If it’s

underground, there are tunnels to be dug and ventilation to keep the air clean. And how do you get workers to and from the mine – all while keeping them safe?

Maths provides lots of the solutions.

“You’re trying to optimise the economic performance of a mine within social and environmental and physical constraints over a long-term timeframe,” Peter says, explaining that mine life is anywhere between 20 and 80 years.

Now, more than ever, engineers are planning how to measure and mitigate the environmental impact of a mine.

“Mine design covers the whole life of mine, and that includes closure,” Peter says. “There is more and more work for mining engineers in looking at the sustainable closure of existing mining operations and cleaning up legacy ones.”

It is satisfying work. Any impact of a mine on the environment can be significantly reduced by good design and planning ahead.

“So when you design a mine, you’re also thinking about how you’re going to rehabilitate and close that mining operation,” Peter says.

BUILDING YOUR CAREER IN MINING: VET AND TRADES

Vocational education and training provides a number of pathways into the minerals industry, including apprenticeships and traineeships, skill sets, and Certificate I, II, III, IV and Diploma level training packages for Mining, Drilling and Civil Infrastructure.

Go to the Australian Government Department of Education and Training My Skills website to find out more.

→ myskills.gov.au

STRONG SKILLS FOR LIFE

Mine sites are a great place to kick off your career, with a range of apprenticeships and traineeships available to start straight out of school.

With a 36-48 month apprenticeship or 12-24 month traineeship you will get on-the-job experience and a nationally recognised qualification, all while getting paid.

Australian mining companies invest heavily in training and certification with frequent opportunities to upskill, on and off site. The industry has one of the youngest and most highly skilled workforces in Australia.

Oliver Cassim, 18, from PYBAR's Dargues Gold Mine in Majors Creek, NSW, was recently selected to take part in a one-week underground mine rescue course in Mudgee.

"The course was challenging but also fun," he says. "We were put into some pretty realistic underground emergency situations. Six months after finishing Year 12 I have already added so many new skills and qualifications to my résumé."

LIFELONG EXPERTS IN THE TRADE

Sarah Bellottie spent her childhood wandering along the beach at the remote salt-mining town of Useless Loop, WA (pop 139), looking at shells and rocks.

With a dad who worked in the mines, it was perhaps inevitable that she followed both in his footsteps and her own interest in rocks. She studied geology.

Now a geologist at Mining Area C, outside Newman in the Pilbara, Sarah is in her second year of BHP's two-year graduate program.

As well as pit work and being out on drill rigs, Sarah spends time in the office planning blasts and creating mine plans, as well as using a skill she's learned recently – coding. "Working these days, you do have to use a lot of computer-based skills. If you can code, it's amazing," she says.

Digital literacy is becoming more important, but mining still needs people with trade skills, such as Kristen Churnside.

Kristen was just a child when she started learning the skills she uses every day.

Her dad was a heavy duty fitter. "I used to watch him fix cars and trucks," she says. "I love building stuff, starting from scratch."

She went to TAFE, thanks to a Rio Tinto program supporting further study for Indigenous workers.

"I started my apprenticeship in Dampier [WA], on the port, working on the tug boats and in the wharf area. I finished it at Tom Price. Then I worked FIFO at Brockman and Hope Downs."

Needing even more of a challenge, Kristen then learnt to drive the longest, heaviest trains in the world, for BHP.

"You're in control of this 40,000 ton plus train."

SARAH'S SKILLS



"I use the basic geology knowledge I learned at uni. I use a lot of general problem-solving skills – and a lot of my job is communication and negotiation with other departments. I think where I want to head in my career might be using a skill I haven't even found yet."

KRISTEN'S SKILLS



"I'm naturally a mechanically minded person. I have my trade certificate in boilermaking and have worked as a qualified tradeswoman in different areas of fixed plant and mobile plant. I've now had my Certificate IV in train driving for nine years."

TOP FIVE IN-DEMAND TRADES

1. Electricians
2. Steelworkers
3. Mechanics
4. Plumbers
5. Construction workers

TOP FIVE PRACTICAL SKILLS MINING EMPLOYERS ASK FOR

1. Forklift Truck Operation
2. Work Safely at Heights
3. Construction Induction Card
4. Enter and Work in a Confined Space
5. Boom-type Elevating Work Platform



FOUR NEW SKILLS IN DEMAND

1. Data and digital literacy
2. Stakeholder analysis
3. Data analysis
4. Creativity

TOMORROW'S PATHWAYS

The MCA is working with industry and education and training providers to develop new and exciting pathways into mining, including micro-credentials, new units of competency and target experiential programs.

→ minerals.org.au/careers to find out more

HOW MINING IS CHANGING

The new skills needed in different areas of the mining industry

Exploration	Data analytics, design and modelling skills; collaboration skills
Mining operations	Data analytics and geological model design skills; data and digital literacy skills; operational and planning skills
Processing	Advanced data analytics skills; data and information management; business information systems; operations and analysis
Transport	Data and digital literacy skills in human-to-machine interface operations (from traditional operators to managing autonomous trains); advanced systems development skills to manage autonomous systems and shipping platforms
Trading	Change management skills to instil a customer-centric focus; market forecasting and modelling skills
Overall process	Systems thinking skills; change management and collaboration skills; enhanced decision-making support skills underpinned by data and digital literacy skills; technical modelling and advanced geological and geospatial capabilities; scenario planning, predictive modelling and options analysis skills; interpersonal skills

BUILDING YOUR CAREER IN MINING: UNIVERSITY

Today’s school and university students will be tomorrow’s mining leaders.

Technically literate graduates – trained to think, explore, analyse, create, experiment and improve – are among the people who will build our country’s future.

Universities are working with the Minerals Council of Australia to make sure the skills they teach are already in hot demand by the mining industry – future-proofed and ready to adapt to changing industry needs!

Australia’s universities are home to some of the world’s best minerals and mining schools.

MINERALS INDUSTRY NATIONAL ASSOCIATE DEGREES

Looking for a flexible and fast way to get started in a skilled mining role?

Minerals Industry National Associate Degrees offer a two-year university qualification as a stepping stone to work or higher degrees.

Offered through distance education, these degrees are ideal for those already working on regional mine sites or as a pathway for students who didn’t qualify for regular degree programs.

Professor Kevin McDougall, Head of School of Civil Engineering and Surveying, University of Southern Queensland, says that 70% of current Associate Degree students are already out working in industry.

“The majority of those students get time off to study and their fees are subsidised by their employer. Mining companies recognise the value of upskilling their workforce.”

THE NATIONAL EXPLORATION UNDERCOVER SCHOOL (NEXUS)

This is a prestigious annual summer school for the next generation of Australian exploration geologists.

It is a unique learning and networking opportunity for undergraduate and early career geoscientists.

The program combines classroom, laboratory and drill-core facility activities with two field-site placements, in the Adelaide Hills and the Yorke Peninsula.

Participants from the 2018 program said:

“NEXUS opened my world to all the careers I could possibly have.”

“The program has given me more drive and equipped me with more tools to do my little bit to build Australia’s future.”

→ nexus.org.au

GRADUATE DEMAND

In addition to Mining Engineering, other key graduate qualifications that the industry will need in the coming years include Mechanical Engineering, Electrical/Control Engineering, Geotechnical Engineering and Geomechanics, Data Science/ Data Analytics, Chemical/Process Engineering, Environment and Sustainability Science, Mechatronics Engineering, Computer Science and Cognitive Engineering.



WHERE YOU CAN STUDY A MINING DEGREE

University of New South Wales

NSW
School of Minerals and Energy Resources

Bachelor of Engineering (Honours) – 4 years

→ unsw.edu.au

University of Queensland

QLD
School of Mechanical and Mining Engineering

Bachelor of Engineering (Honours) – 4 years

→ uq.edu.au

Curtin University

WA
Western Australian School of Mines: Minerals, Energy and Chemical Engineering

Bachelor of Engineering (Honours) – 4 years

→ curtin.edu.au

University of Adelaide

SA
School of Civil, Environmental and Mining Engineering

Bachelor of Engineering (Honours) – 4 years

→ adelaide.edu.au

University of Wollongong

NSW
School of Civil, Mining and Environmental Engineering

Bachelor of Engineering (Honours) – 4 years

→ uow.edu.au



ROCK STAR

As a child, Samantha Watson (right) was always coming home with rocks that she found interesting. But she had her heart set on physiotherapy as a career – until work experience in Year 11.

“None of the local physios were taking students from my school so I ended up at Callide Coal Mine as a second choice, without any idea that I would enjoy it so much,” Samantha says.

“I absolutely fell in love with it.”

Fast forward to age 19 and the second year of a Bachelor of Geology.



Anglo American awarded Samantha a scholarship, including financial support and on-site placement throughout the rest of her undergraduate studies.

And then she was one of the first to be snapped up in an Anglo American graduate program that brings new workers in as a

group, providing support and friendship when everything is new and potentially daunting.

Six years later Samantha still works for the company.

She is part-way through a Postgraduate Diploma of Mine Geotechnical Engineering at UNSW and is given paid study time and financial support to build

her skills in underground tunnelling, rock mass characterisation and strata control.

With the mining industry facing a shortage of geotechnical engineers and mining geologists, companies such as Anglo American work hard to look after staff and retain people like Samantha.

Federation University

VIC

School of Science, Engineering and Information Technology

Bachelor of Engineering (Honours) – 4 years

→ federation.edu.au

Monash University

VIC

Department of Civil Engineering; Resources Engineering

Bachelor of Engineering (Honours) – 4 years

→ monash.edu

University of Western Australia

WA

Department of Civil, Environmental and Mining Engineering

Master of Professional Engineering – 5 years

→ uwa.edu.au

Central Queensland University

QLD

Associate Degrees in Engineering and Geoscience

→ cqu.edu.au

University of Southern Queensland

QLD

Associate Degree of Engineering

→ usq.edu.au



Australia's minerals industry is an exciting and dynamic sector with a diverse range of highly skilled, highly paid jobs.

Advances in technology are making mining safer, more competitive and more sustainable.

Technology is transforming today's jobs into tomorrow's new frontier.

The Australian mining industry will continue to evolve to meet the needs of a rapidly changing world.

We still attract the best people who want diverse and challenging careers to last a lifetime.

You can change roles as your career expands, and travel Australia and the world to work with great people in interesting locations.

minerals.org.au/careers

