

An aerial photograph of a large-scale mining operation. A long conveyor belt system, supported by a complex network of orange and yellow metal structures, runs diagonally across the frame. Below the conveyor, a train of several empty, rectangular ore cars is visible. The surrounding landscape is dark and rugged, with visible tire tracks and piles of material. The overall scene depicts a modern, industrial mining environment.

# **BDO'S ENERGY 2020 VISION:** THE NEAR FUTURE OF MINING



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# EXECUTIVE SUMMARY



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“We expect renewables to account for one-quarter of the world’s electricity generation by 2020.”

Driverless technology, deep-sea excavations and mining expeditions on the moon were once just the ideas of sci-fi movies.

Today, they’re realities or just around the corner. And by 2020, we expect (most of) them to be the norm.

As low commodity prices persist, mining companies are under pressure to reimagine their business models. Those that have incorporated technology into their operations have seen their revenue streams live on, while those that haven’t have fallen short.

Mining is in the early stages of the Fourth Industrial Revolution, or Industry 4.0, and further digitisation is on the horizon. The value of harnessing technology is obvious. Driverless technology increases mining output by 15 to 20 percent while cutting fuel and maintenance costs by 10 to 15 percent and 8 percent, respectively. It also improves mining safety exponentially. At the same time though, these Internet-connected technologies open the mining industry up to new cyberattack vectors that they must hedge against through proper

internal controls. If not, they risk seeing their entire operation crippled by a single attack.

Decreased coal consumption in China—the world’s largest coal consumer—meanwhile, is slowing global demand for the commodity. As dependence on coal wanes, we expect renewables to account for one-quarter of the world’s electricity generation by 2020.

Reflecting on this period of transition, BDO’s Global Natural Resources team is looking towards the future to help mining companies anticipate and plan for the challenges and opportunities ahead. We believe that to prepare for success in 2020 and beyond, mining companies must strive to become “Lean, Green, Digital” machines.

The global predictions presented in this report are based on research and collective input from BDO’s Natural Resources and Mining leaders. In addition, the practice leaders from five countries (Australia, Canada, South Africa, the United Kingdom, and the United States) have provided predictions for the industry in their local markets.

## SUMMARISING BDO'S ENERGY 2020 VISION FOR MINING:

### 1. ROBOTS:

By 2020, robots will replace more than 50 percent of miners, and mining accidents will be cut by 75 percent. Half of the miners will themselves be retrained to run the technology controlling the robots.

### 2. EU CONFLICT MINERALS:

Supply chain transparency will take the compliance spotlight for 2020 as companies gear up for the European Union’s Conflict Minerals Rule, effective in 2021.

### 3. CYBERSECURITY:

By 2020, activist hackers will launch at least five cyberattacks on mines around the world in Permanent Denial of Service (PDOS) attacks aimed at eliminating the environmental and social threats they pose. They’ll use workers’ connected devices to initiate the attacks.

### 4. RENEWABLES:

By 2020, renewables will account for one-quarter of the world’s electricity generation as dependence on coal wanes.

### 5. IoT IN MINING:

Global mining companies leveraging Internet-connected sensors and automated drillers in mines will decrease their per ton digging costs by more than 30 percent.

Agree or disagree with our predictions? We want to know—reach out to us [here](#).

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# BDO'S ENERGY 2020 VISION: THE NEAR FUTURE OF MINING GLOBAL PREDICTIONS





# WHEN ROBOTS RUN THE MINES

## PREDICTION 1

### ROBOTS

**BY 2020, ROBOTS WILL REPLACE MORE THAN 50 PERCENT OF MINERS, AND MINING ACCIDENTS WILL BE CUT BY 75 PERCENT. HALF OF THE MINERS WILL THEMSELVES BE RETRAINED TO RUN THE TECHNOLOGY CONTROLLING THE ROBOTS.**

Robots will be at the forefront of most mineral extraction by 2020, reducing safety risks for miners, maximising output, and streamlining costs. By 2020, we predict robots will replace most miners. Most in the workforce will be retained, but advances in technology and remote mining equipment will transform what that workforce looks like.

The global mining industry is already well-acquainted with autonomous technology. Self-driving trucks and autonomous drillers and muckers are employed onsite at almost every large multinational company's mines. "[Snake robots](#)"—named for their agility—are equipped with Internet-connected sensors and used to navigate narrow mine shafts and collect data. Drones are also beginning to play a role in mapping the topography of a mine and capturing aerial images of inaccessible areas of the mine to identify possible vulnerabilities and areas of tension. Remote vein miners (RVMs) are being developed to eliminate the need to drill and blast to excavate rock—potentially reducing rock stress that can lead to seismic events.

The rise of the robot is not a death knell for the mining workforce but will inevitably lead to a demand for reskilling. Traditional operational positions—drilling, blasting, and driving—will be downsized, but replaced by demand for remote operators and maintenance personnel to create the new version of the miner. Emerging digital mining jobs—engineers, software developers, and data processing and data analytics specialists—are more likely to attract the technologically savvy millennial workforce. By 2020, mining automation and data analytics will be key components of the curriculum for mining engineers.

Digitisation also promises to reduce safety risks for miners. Not only will robots assume the most dangerous tasks, but they'll also be key to minimising damage if disaster strikes. Snake robots and the smart sensors they're equipped with will be further optimised to capture real-time data to predict or quickly identify equipment malfunctions and closely track miners' exact locations and vitals. With the aid of robots and new technology, the number of mining fatalities will be cut in half by 2020.

Mining is in the early stages of the Fourth Industrial Revolution, or Industry 4.0, and further digitisation is just around the corner.



# TRANSPARENCY COMBATS CONFLICT

## PREDICTION 2

### EU CONFLICT MINERALS RULE

#### **SUPPLY CHAIN TRANSPARENCY WILL TAKE THE COMPLIANCE SPOTLIGHT FOR 2020 AS COMPANIES GEAR UP FOR THE EUROPEAN UNION'S (EU) CONFLICT MINERALS RULE, EFFECTIVE IN 2021.**

The EU's efforts to stem trade in minerals that finance armed conflicts and terror groups will turn a spotlight on global mining companies' supply chains by 2020.

The EU's Conflict Minerals Regulation, effective in 2021, establishes supply chain due diligence for imports of tin, tantalum, tungsten, and gold (3TG)—used to produce phones, cars, and jewellery. The rule aims to ensure European industries use responsibly-sourced minerals, stemming proceeds that finance armed conflict in high-risk areas.

What the rule means for the mining industry:

- EU-based 3TG importers and their international supply chain partners—smelters and refiners—will need to update their supply chain due diligence
- Additionally, 3TG importers in the EU will need to identify the smelters and refiners in their supply chains, confirm their due diligence practices comply, and report insufficient supply chain due diligence

- The Organisation for Economic Co-Operation and Development (OECD) laid out a five-step framework for the due diligence requirements:

- Create strong company management systems
- Identify and assess supply chain risk
- Implement a program to respond to such risks
- Conduct an independent third-party audit of supply chain due diligence
- Submit annual reports on supply chain due diligence.

All upstream companies are subject to the due diligence requirements when they import—the riskiest area of the supply chain—as are downstream companies that import metal-stage products. This regulation will likely create a lowest common denominator effect across the global mining industry—for EU-based 3TG importers and their international supply chain partners—requiring the entire industry to put supply chain due diligence at the forefront.





# HACKTIVISTS TARGET MINES

## PREDICTION 3

### CYBERSECURITY

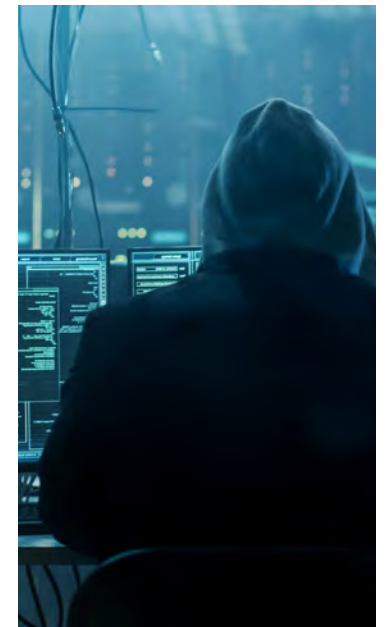
**BY 2020, ACTIVIST HACKERS WILL LAUNCH AT LEAST FIVE CYBERATTACKS ON MINES AROUND THE WORLD IN PERMANENT DENIAL OF SERVICE (PDOS) ATTACKS AIMED AT ELIMINATING THE ENVIRONMENTAL AND SOCIAL THREATS THEY POSE. THEY'LL USE WORKERS' CONNECTED DEVICES TO LAUNCH THE ATTACKS.**

The mining industry is no stranger to [environmental scrutiny](#). Advances in technology have introduced more sustainable mining methods, including the emerging practice of bioleaching, in which companies extract minerals by using biological assets instead of harmful chemicals. Despite those advancements, environmental concerns persist, including water and soil contamination, carbon emissions, and impact on animal life. Pressure from environmentalists is set to increase by 2020. In fact, an emerging type of environmentalist—activist hackers (hacktivists)—will soon have their targets locked on the mining industry. By 2020, there will be at least five Permanent Denial of Service (PDOS) cyberattacks on mines around the world, motivated by eliminating the environmental and social threats they pose.

PDOS attacks are the next generation of Distributed Denial of Service (DDoS) attacks—which temporarily disable operations—and aim for permanent destruction. In a PDOS attack, hackers' goals include destroying physical equipment and structures, disabling services, and/or wiping out data. For global mining companies in the early stages of harnessing big data, losing seismic and reserves data would be damaging to their ongoing operations.

While the rapid acceleration and adoption of new technology will be instrumental in bolstering mining's future, it will also be the sector's Achilles heel when it comes to cybersecurity. The industrial control system, the central hub controlling a mine's automated operations, could serve as the hacker's point of entry into the mine's remote

operating controllers and connected devices. Damage and disruption to automated equipment could also jeopardise the safety of workers in the mines—as many of the systems in place are designed to monitor and detect dangerous conditions.





# COAL STRIPPED OF SOME POWER

## PREDICTION 4

### RENEWABLES

#### **BY 2020, RENEWABLES WILL ACCOUNT FOR ONE-QUARTER OF THE WORLD'S ELECTRICITY GENERATION AS DEPENDENCE ON COAL WANES.**

Decreased coal consumption in China—the world's largest coal consumer—is slowing global demand for the commodity. According to the International Energy Agency, global coal consumption decreased about 2 percent last year. In confluence with the rapid growth of renewables, the world's energy mix is set for a [shakeup](#). By 2020, we predict that renewables will grow to account for one-quarter of the world's electricity generation as dependence on coal wanes.

Mining plays an integral behind-the-scenes role in developing renewable energy. Electric vehicles, wind turbines, and solar panels rely on minerals like aluminium, copper, lithium, and various emerging, rare metals. Powered by new technology, deep-sea mining is allowing mining companies to tap into previously inaccessible reserves of copper, nickel, and cobalt, among others, beneath the ocean floor to fuel increased demand for these minerals.

In 2019, Nautilus Minerals, a Canadian mining firm, is set to launch one of the first large deep-sea mining ventures in the Bismarck Sea with the aid of remote-controlled robots. The excursion is forecast to produce more than [72,500 metric tons of copper](#) and more than 4.5 metric tons of gold. The International Seabed Authority, a United Nations regulatory body, has granted 25 contracts to nations including China, India, Japan, and Brazil to embark on similar deep-sea mining projects.

By 2020, further advancements will be made to overcome one of renewables' largest hurdles: energy storage. The world's largest lithium ion battery—built by Elon Musk in November 2017—is a 100-milliwatt (MW) battery storage farm located in Australia. Come 2020, the capacity of energy storage is likely to evolve well beyond 100MW, solidifying renewables' role in the world's energy mix.





# AN ARSENAL OF AUTOMATION BOOSTS PROFITABILITY

## PREDICTION 5

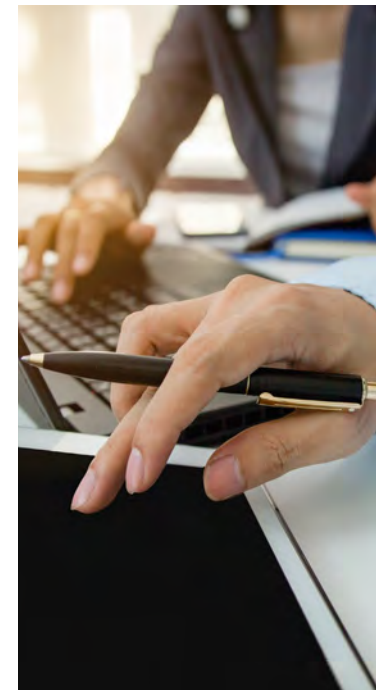
### IOT IN MINING

**GLOBAL MINING COMPANIES LEVERAGING INTERNET-CONNECTED SENSORS AND AUTOMATED DRILLERS IN MINES WILL DECREASE THEIR PER TON DIGGING COSTS BY MORE THAN 30 PERCENT.**

In an environment of subdued commodity prices, the value of harnessing technology is clear. Mining companies' end consumers closely monitor the price of commodities and are sensitive to the slightest uptick. For automakers, for example, steel is a significant expense on their books. When multiplied by a few thousand metric tons, a variance of a few cents on steel price could incentivise automakers to find a new supplier. Global demand is not expected to wane. In fact, steel and mining company ArcelorMittal [forecasts](#) a 36 percent increase to automakers' global demand for steel by 2020. However, which global mining companies win that business is up for debate.

Tapping into [new technology](#) is key to streamlining operations, reducing expenditure, and enabling companies to keep their prices competitive. The [International Institute for Sustainable Development](#) estimates driverless technology, for instance, increases mining output by 15 to 20 percent, while decreasing fuel and maintenance costs by 10 to 15 percent and 8 percent, respectively. Self-driving trucks are just the tip of the iceberg. Global mining companies that digitise nearly all their drilling—relying on a combination of automated drillers and Internet-connected sensors—will recognise far more significant savings. By 2020, we predict global mining companies' per ton digging costs will decrease by more than 30 percent because of automation.

These savings factor in reduced labour costs, increased output, a decrease in the number of safety incidents, and companies' ability to enhance decision-making capabilities leveraging the vast amount of data collected by smart mines.





# BDO'S ENERGY 2020 VISION: THE NEAR FUTURE OF MINING IN AUSTRALIA





# ARTIFICIAL INTELLIGENCE AND PRICE NEGOTIATION

## PREDICTION 1

### ARTIFICIAL INTELLIGENCE

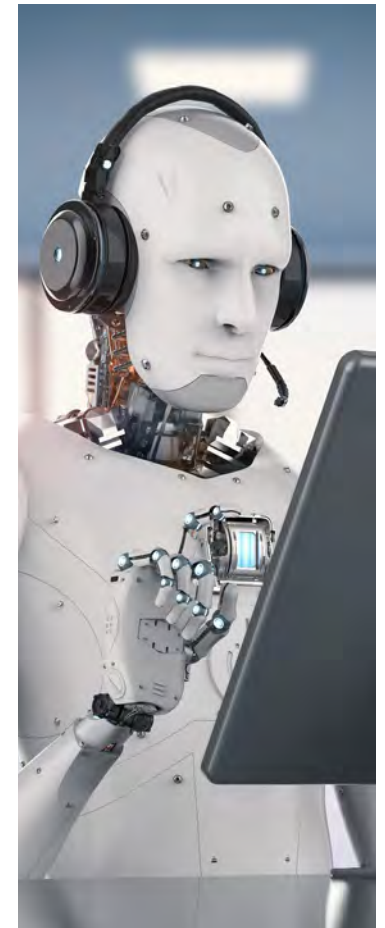
**BY 2020, ARTIFICIAL INTELLIGENCE (AI) WILL CHANGE THE WAY WE NEGOTIATE AND PRICE CONTRACTS, AND HUMANS WILL NO LONGER CONTROL DEALS IN MARKETS.**

If you want to know where the mining industry is headed, look to AI.

With the rapid advancement in technology, AI systems are becoming the way of the future for most industries—and mining is no different. As mining companies embrace technologies that have significantly improved efficiencies and processes at all stages of the mining lifecycle, we expect that commodity supply negotiations will no longer require human interaction.

AI technology will drive computerised negotiation, providing benefits of reduced time, cost, and cognitive effort in negotiating win-win deals. The Extractive Industries Transparency Initiative (EITI) is a global standard to promote the open and accountable management of oil, gas, and mineral resources. Such initiatives have been fuelling the need for greater transparency in the natural resources sector, with an end goal of creating deals that are managed effectively for increased development impact.

AI-based negotiations will enable higher quality agreements that are economically and socially beneficial, driving economic growth and social development. Human interaction will play a greatly reduced role in the negotiation process, ultimately changing the way contracts are priced. These negotiations will rely on key information including licencing, ownership, legal and financial arrangements, production levels, and allocation of revenue to determine efficient and ethical negotiation outcomes for all parties. This is particularly relevant in the Asian region where a number of marketing hubs are located. In addition, a number of miners in the region operate projects with commodities that have opaque pricing.





# MINERS OF THE FUTURE

## PREDICTION 2

### TECH INNOVATIONS

#### **BY 2020, TECH COMPANIES WILL BECOME THE MINERS OF THE FUTURE.**

Could Apple or Tesla be the mining companies of the future?

Just as AI will replace today's price negotiation process, technology companies will revolutionise the miners of the future. Technology companies have been "mining" more and more over the last few years—but in respect to data and Bitcoin. By 2020, however, they may well become traditional miners.

Technology companies have become some of the world's largest by market capitalisation, and their rapid growth is likely to continue. Two crucial factors may present some challenges and impede the rate at which these companies expand. The first is anti-trust or competition, potentially limiting their ability to expand horizontally into their existing markets. Secondly, technology innovators are heavily reliant on the security of resources, and we will see them seek to secure the supply of rare materials. Because of these two factors, we are likely to see technology companies undertake meaningful ownership stakes in mining companies—or even buy the mines themselves.

Competition will put pressure on cash-rich companies that find it relatively easy to raise funds, making it difficult for them to make acquisitions in their existing markets. These companies will most likely look to other markets for vertical integration, rather than returning that cash to shareholders.

Technology companies rely on commodities to manufacture their high-tech products, particularly high-demand ones such as battery minerals (lithium, cobalt, graphite, etc.) or those in short supply (rare earths, tungsten, etc.). With a considerable stake in the game, technology companies will likely step in to maintain a strong mineral supply. Projects that are likely to be acquisition targets will be located in jurisdictions such as Australia where there are well-established legal frameworks to provide security of tenure.





# CROWD FUNDED PREDICTION 3

## EQUITY

### THE PATH TO GROWTH IS CHANGING.

For decades, most Australian mining companies have followed a well-worn growth path. The journey has historically started with an exploration area privately funded by friends and family. Following additional rounds of raising capital at the exploration stage, successful companies will require larger amounts to allow for necessary feasibility studies to be undertaken, enabling the large-scale funding required to build the mine. To get the funding, they typically progress to an early small-scale Initial Public Offering (IPO) on the Australian Securities Exchange (ASX).

This initial public funding has allowed them to raise a few million dollars—enabling exploration to continue. As a result, many small exploration companies are subject to the same reporting and disclosure requirements as all other ASX-listed companies, presenting a significant burden on small-listed explorers compared to large-listed companies.

Crowd Sourced Equity Funding (CSEF) legislation was passed by the Australian Government in 2017 and CSEF platforms will be live in 2018. While the media focus on CSEF has been on technology start-ups, the new method of financing in Australia has the potential to transform the growth path of small-to-medium mining companies as well. CSEF will likely replace the first rungs of the ASX ladder for exploration companies.

By 2020, rather than planning for the obligatory IPO on the ASX, the managing director of an exploration company will plan for a crowdfunding offer on a CSEF platform. The company will raise the funds it needs without the burdens of being an ASX-listed company, and with reduced compliance requirements. This will allow for a greater focus of efforts and resources into exploration and value-add activities.

If the company experiences exploration success with the funds raised, it will be better placed to seek an ASX listing—and better able to cope with the associated burdens. By 2020, we see CSEF forming a key part of the growth journey for exploration companies, with early ASX listing becoming a strategy of the past.

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