

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 yellow 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

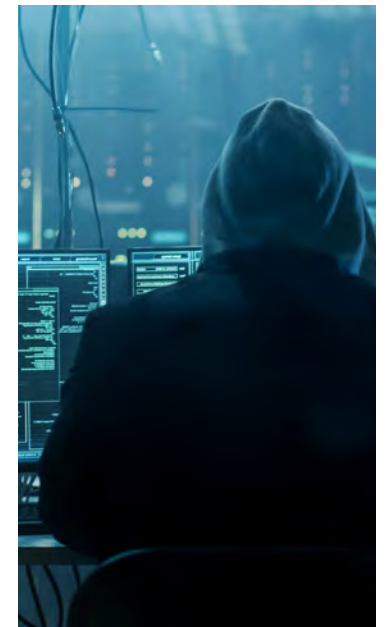
**BY 2020, ACTIVIST HACKERS WILL LAUNCH AT LEAST FIVE CYBERATTACKS ON MINES AROUND THE WORLD IN PERMANENT DENIAL OF SERVICE (PDOS) ATTACKS AIMED AT ELIMINATING THE ENVIRONMENTAL AND SOCIAL THREATS THEY POSE. THEY'LL USE WORKERS' CONNECTED DEVICES TO LAUNCH THE ATTACKS.**

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

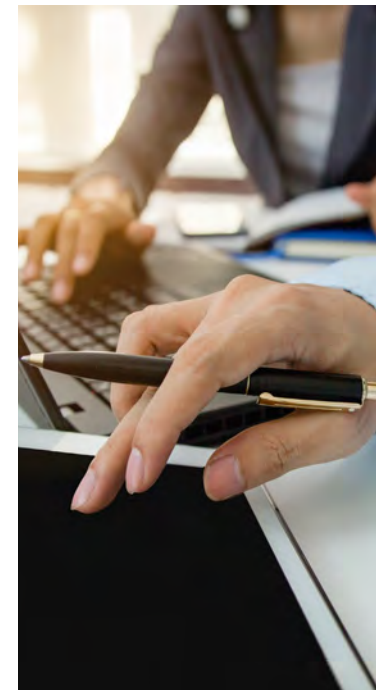
### IOT IN MINING

**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 THE UK







# DEMISE OF OFFSHORE HOLDING COMPANIES

## PREDICTION 1

### TAXATION

**BY 2020, WE WILL SEE THE DEMISE OF OFFSHORE HOLDING COMPANIES IN ZERO TAX JURISDICTIONS.**

Many mining businesses are international groups with operations and administrative functions located in several different countries. Over the last 20 years, the use of offshore holding companies has been a common approach to achieving tax-efficient group structures. However, the landscape is now rapidly changing and by 2020, mining groups will no longer be forming new zero tax offshore holding companies.

The last two years have seen the most significant development in international tax history. The pace of the changes, led by the Organisation for Economic Co-operation and Development (OECD) and G20, has been staggering. To date, more than 100 countries have signed up to a multilateral instrument aimed—amongst other actions—to combat treaty shopping (the practice of using low or zero-rated tax regimes to minimise or eliminate withholding taxes). Political pressure will be levied on those countries that have not yet signed up to encourage widespread use of these measures.

Base erosion and profit shifting—which are strategies that exploit gaps and mismatches in tax rules to artificially shift profits to low or no-tax locations—have been at the heart of these changes following high-profile cases of multinational companies. Governments are being encouraged to adopt various measures ensuring that profits are properly taxed in the jurisdictions in which the economic activities arise. As a result, we are seeing a significant reduction in tolerance to tax risk, while tax compliance and risk strategy is escalating up the board room agenda.

The OECD measures include the introduction of country-by-country reporting (the requirement for large companies to provide transfer pricing data to its tax authority for sharing with other tax authorities). We can expect to see more collaboration between tax authorities to combat secrecy and ensure profit shifting is addressed globally.

The UK tax authorities have already adopted several measures to make the country fiscally enticing as a holding company location for the mining sector. The UK government recognises the need to remain an attractive place for talented management and mining groups to ensure it capitalises on the shift away from offshore holding regimes.



# IPO RUSH

## PREDICTION 2

### FINANCE

#### LONDON MINING IPOs WILL INCREASE FOURFOLD BY 2020.



By the end of 2020, mining IPOs will make a dramatic return to the London stock exchanges. We're predicting there will be four times as many flotations as in the previous three years.

There was an increase in mining IPOs in 2017; however, they were relatively small in terms of value. Despite the slow growth of the world economy, there are strong indications that investor appetite for the right project is increasing. The relevant question is: What does the right project look like? Based on what we're seeing, a project should fulfil as many of the following criteria as possible:

- i. **Scale and quality:** Does it make economic sense as a standalone project?
- ii. **Management:** As always, you need the right blend of skills and experience to bring any project into production. Have the management team done it before, preferably with the same commodity and in the same country/region?

iii. **Cash flow and stage of development:** There is a strong preference for one-time-only fund raises to bring an asset into production. Exploration remains a challenge to fund via the public markets.

iv. **Choosing the right commodity:** Investors are looking to invest in commodities where they see near-term shortages in supply or long-term growth in demand. For example, there is high demand for commodities linked to the new technology-led economy of mobile communication and electric transportation.

v. **Political risk:** While it's never possible to eliminate political risk, some jurisdictions are going to be difficult regardless of the nature of the project.

A significant increase in new funding into the sector will drive the development of new mines to produce increasing volumes of metals needed in the next 10 years by the new low-carbon economies.





# BLOCKCHAIN PROVING VALUE

## PREDICTION 3

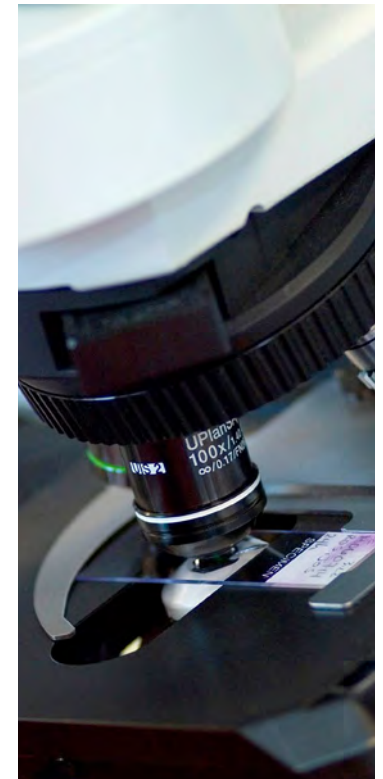
### TECHNOLOGY

**BLOCKCHAIN TECHNOLOGY WILL BE USED TO VERIFY THE PROVENANCE OF HIGH-VALUE MINERALS BY 2020.**

For many years, the verification of the provenance of high-value gemstones has been a significant concern for the buyers of those stones. The Kimberley Process was introduced 15 years ago to help address the problems of diamonds being used to finance conflicts. New rules such as the EU's Conflict Minerals Regulation, combined with pressure from the OECD, will place more responsibility on miners to provide verification of the high-value metals they produce.

Blockchain, a technology originally developed to assist verification and transactions of Bitcoin, will form a vital part of the process. It could revolutionise the verification of the provenance of high-value minerals, providing a unique list of records that is secure from tampering and forgery. As such, it is a technology ideally suited for the identification of products throughout the supply chain.

Major diamond producers are in the advanced stages of using blockchain technology to provide each diamond with a unique imprinted code that serves as a tamper-proof record of the stone's authenticity. Over the next three years, the mining industry will start to adapt this technology for similar authentication of other high-value minerals, ensuring the required supply chain transparency to manufacturers and end users.





# OUTSIDERS BECOME REGULARS

## PREDICTION 4

### NEW INVESTORS

#### **NON-MINERS WILL MAKE SIGNIFICANT INVESTMENTS IN THE SECTOR BY 2020.**



Our economies are experiencing a rapid and accelerating transition from carbon-based to renewables-powered, with a growing requirement for electrical storage and battery power in all aspects of our lives. This uptick in demand for batteries and their associated equipment will require similar increases in the production of a wide range of metals. Lithium has had the highest profile; however, modern battery technologies require other metals, including nickel, cobalt, cadmium, and magnesium.

The surge in demand for these metals will only be met by the discovery of new resources and the opening of new mines. In recent years, the big mining companies—damaged by poor financial performance and several high-profile failed projects—have been reluctant to invest in large-scale exploration. Smaller mining companies have been keen to progress new exploration projects

for these metals, but the institutional funds and private investors remain cautious about funding early-stage exploration projects, having incurred significant losses at the end of the last mining boom.

Non-mining investors are now beginning to fill this investment gap. Most commonly, these investors are trading and manufacturing organisations that need to meet the forecast production shortfall and are willing to take direct investments in mining companies to secure their future supply. They are willing to make significant, strategic investments that can form the cornerstone to funding new projects. The specialist knowledge players in other industries will introduce fresh thinking and innovation to the mining sector. Over the next three years, trading and manufacturing organisations will be the investors that have the most significant impact on the sector.







# 'ACCESS DENIED' BECOMES THE NORM

## PREDICTION 5

### REGULATORY

#### **MORE LICENCES WILL BE LOST DUE TO REGULATORY AND COMMUNITY INTERVENTION BY 2020.**

In recent years, there have been several high-profile examples of licence refusals or cancellations for failures to meet regulatory requirements and community concerns. Examples include the recent government mining bans in the Philippines and the long-stalled permitting process for the Rosia Montana gold project in Romania due to concerted community opposition.

Resource nationalism is not a new phenomenon, and over the last 20 years, it has led to many countries introducing new mining taxes and royalties. The positive outlook for many commodity prices and overall mining sector profitability in the next three years could spur increased government attention on securing a share of mining profits. It could also lead to scrutiny from other new directions.

Because of the growing demand for tax transparency, governments of countries with significant mineral resources will be equipped to more effectively claim what they consider to be a fair share of mining projects' profits. At the same time, continuing advances in social media and technology will enable local communities and interest groups to be more effective and forceful in communicating their concerns and requirements for new mining projects.

Over the next three years, the mining sector will need to address these stakeholders' increased scrutiny collaboratively and strategically. Failure to do so will be costly, putting many mining licences at risk.

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