

# Mining and Metals Dynamic Briefing

Generated 27 January 2020 for Marco Antonio Gonzalez





# Executive summary

The mining and metals industry is recovering from one of its most difficult periods in decades. Market volatility and a downturn in commodity prices have created a new normal where cost cuts, automation, and operational efficiency are a must. Meanwhile industry-specific issues related to regulation, geopolitical risk, legal limits on natural resource use, shareholder activism, and public scrutiny have created additional challenges.

This briefing is based on the views of a wide range of experts from the World Economic Forum's Expert Network and is curated in partnership with Perrine Toledano, Head of Extractive Industries, and Nicolas Maennling, Senior Economics and Policy Researcher, at the Columbia Center on Sustainable Investment - a joint center of Columbia Law School and the Earth Institute at Columbia University.

---

## 1. A Social Contract for Mining

Creating real benefits for communities near mine sites will be key for successful new projects.

## 2. Big Data and Mining

The collection and transparent use of data could aid the mining industry's relations with stakeholders.

## 3. Modern Mining Workforces

Maintaining open dialogue will be key as mining companies try to revamp their employee base.

## 4. The Geopolitics of Mining

Mining companies must navigate rising geopolitical risk and economic protectionism.

## 5. Transition to a Low-Carbon Economy

Low-emission energy and transportation are more mineral intensive than fossil fuel-based systems.

## 6. Access to Resources

Mining companies are using new technologies and techniques to tap high-grade, hard-to-reach deposits.

## 7. New Ways to Finance Mining

As mining companies try to limit risk, novel financing and production models will become more common.

# A Social Contract for Mining

---

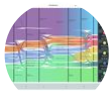
## Creating real benefits for communities near mine sites will be key for successful new projects

Obtaining full license to operate from local communities has been a challenge for the mining industry. Many proposed projects have been rejected, and operations have been disrupted by protests. A greater global awareness about the impacts on people living near mine sites has resulted from advances in communication technologies, a mobilization of indigenous populations, and broader shared experience through international organizing. New operating models have to be developed to counterbalance negative trends only likely to get worse for the industry: using taxpayer money for remediating (cleaning up) the record number of mine sites now nearing the end of their life will further increase resentment; new mining projects meant to satisfy rising global demand for resources will aggravate the impact of mining on the environment; new projects will likely provide fewer local jobs and procurement opportunities due to the automation of the sector (which may in turn collide with the implementation of local regulations and requirements); and global warming, related water stress and extreme weather events may lead to more of the environmental accidents that are a primary concern of communities near mine sites.

In addition, the profit shifting and transfer pricing practices (where a company uses loopholes to lighten its tax burden) that minimize the tax revenue the mining sector provides to governments in countries that are home to mines are increasingly causing reputational damage. Mining companies with a good track record as far as paying their taxes, community engagement, and environmental practices will generally have a competitive advantage when it comes to developing new projects. More specifically, business models that lead to lasting benefits at the local level will be key, as will finding synergies with other sectors that are big employers in any given region. In many mining regions, for example, agriculture is vital - and shared water infrastructure solutions that not only benefit a mine, but also serve surrounding communities and farmers, have brighter prospects (co-ownership models where communities benefit from mining operations in other ways are also being explored). Other means to help ensure the sustainability of a region following a mine closure could include installing renewable power projects on remediated land, or continued biomining (using microbes to extract metals from mine waste).

---

Related insight areas: [Emerging Multinationals](#), [Digital Communications](#), [Workforce and Employment](#), [International Trade and Investment](#), [Sustainable Development](#), [Climate Change](#), [Biotechnology](#), [Civic Participation](#), [Values, Justice and Law](#), [Corporate Governance](#), [Artificial Intelligence and Robotics](#), [Public Finance and Social Protection](#), [Environment and Natural Resource Security](#), [Agriculture, Food and Beverage](#), [Advanced Manufacturing and Production](#)



**World Economic Forum**  
**The world needs a circular economy. Help us make it happen**  
 22 January 2020

Business-as-usual is no longer a viable option; our sustainable future depends on transitioning to a circular economy. Here's what we are doing to make that happen, and how you can help.



**Frontiers**  
**Comparison of Visual Functions of Two Amazonian Populations: Possible Consequences of Different Mercury Exposure**  
 21 January 2020

The present study investigated the visual perimetry and color vision of two Amazonian populations differently exposed to mercury. Ten riverines environmentally exposed to mercury by fish eating and 34 gold-miners occupationally exposed to mercury vapor. The visual perimetry was estimated using the Förster perimeter and the color vision was evaluated using a computerized version of Farnsworth–Munsell test. Riverine and gold-miners' hair mercury concentrations were quantified. Mercury hair concentration of the riverines was significantly higher than that from gold-miners. Riverines had lower perimetric area than the gold-miners. The errors in the hue ordering test of both Amazonian populations were larger than the controls (non-exposed subjects), but there was no difference between themselves.



**Yale Environment 360**  
**Shuttering of U.S. Coal Plants Saved More than 26,000 Lives Over the Past Decade, Study Finds**  
 06 January 2020

The shutdown of hundreds of coal-fired power plants in the United States over the past decade has saved an estimated 26,610 lives, according to a new study published in the journal *Nature Sustainability*. This closure of coal plants also has reduced carbon dioxide emissions and lowered air pollution and ozone levels, and has even increased nearby crop yields, the study found. More than 330 coal-fired power plants stopped operating in the U.S. between 2005 and 2016, thanks in part due to aging facilities and a glut of cheap natural gas. The new research, led by environmental scientist Jennifer Burney at the University of California, San Diego, found that the wave of closures prevented more than 300 million tons of carbon dioxide from being emitted into the atmosphere.



**Asian Development Bank**  
**Options for Urban Mining and Integration with a Potential Green Circular Economy in the People's Republic of China**  
 19 December 2019

This brief discusses how the People's Republic of China can apply the green circular economy concept to address urban mining challenges toward achieving zero waste.



**Center for International Forestry Research**  
**Towards zero-deforestation commodities in Ghana's Atiwa forest**  
 24 November 2019

Testing a jurisdictional approach to landscape governance.



**Brookings Institution**  
**The natural resource governance discussion needs to move beyond transparency to analysis**  
 18 November 2019

Don Hubert argues that natural resource governance discussion needs to move beyond transparency to analysis.



**Max Planck Society**  
**"The metal industry is about to undergo one of the greatest upheavals in history".**  
 10 November 2019

Dierk Raabe, Director at the Max Planck Institute for Iron Research in Düsseldorf, explains the opportunities that industrial companies already have today to achieve the goal of a sustainable metal industry. - Metallic materials are the backbone of modern economies. However, large quantities of CO<sub>2</sub> are produced during their production and processing. The metal industry must therefore use more climate-friendly processes in the future. The CO<sub>2</sub> balance of alloys and their components must also be improved over their entire service life. Dierk Raabe, Director at the Max-Planck-Institut für Eisenforschung in Düsseldorf, explains the possibilities that industrial companies already have in this respect as well as the tasks that metallurgists must take on in order to achieve the goal of a sustainable metal industry.

# Big Data and Mining

---

## The collection and transparent use of data could aid the mining industry's relations with stakeholders

Collecting and processing massive amounts of data will be essential for mining companies as they digitalize and automate operations. Increasingly, governments in countries where mining companies are publicly traded are approving regulations that require these firms to publish project-by-project data on payments they make to governments in the countries where they operate - in order to reduce corruption, properly disclose taxable subsidiaries, and increase transparency regarding the handling of particularly problematic minerals. Host-country governments have meanwhile adopted data-driven frameworks to bolster their evidence-based policy-making. Mineral buyers including the technology and transportation sectors and jewellers are also making use of big data, to gain insight into the provenance of minerals and to try to ensure compliance with their environmental, social, and governance standards. Investors are using the proliferation of non-financial data (like potential water scarcity in mine locations) in order to better assess the risks tied to their mining-related portfolios.

Mining companies have been pressed to go beyond the global standard established by the Extractive Industries Transparency Initiative (which is funded by governments and corporations) when it comes to transparency on contracts and environmental impact assessments; local communities affected by mining are particularly interested in accessing data on issues including water quality readings, for example, though current corporate reporting only focuses on water intake. While the data revolution provides mining companies with an opportunity to better address reputational risk and attract investors, it will be essential for them to work together with other stakeholders in order to understand exactly which data should be made available, and the appropriate format for data disclosure - in order to ensure standardization and impact (blockchain technology and geographic information systems can be particularly useful in this regard). If data transparency requirements are not standardized, the amount of time and resources required for mining companies to provide the important information they are required to disclose may increase, to no one's benefit. Other risk associated with the increased collection and reliance on data include cyber security breaches, and the misuse of vital information.

---

Related insight areas: [Corruption](#), [Fourth Industrial Revolution](#), [Sustainable Development](#), [Innovation](#), [Global Risks](#), [Justice and Law](#), [Public Finance and Social Protection](#), [Digital Economy and Society](#), [Cybersecurity](#), [Artificial Intelligence and Robotics](#)





**World Economic Forum**  
**Forging a Sustainable Path Towards a Common Future | DAVOS 2020**  
 21 January 2020

Carbon emissions from fossil fuels hit a record high in 2019 – yet another sign that we are betraying future generations who will increasingly need to adapt.



**Center for International Forestry Research**  
**Management of intact forestlands by Indigenous Peoples key to protecting climate**  
 14 January 2020

Rights recognition crucial to fend off global warming and catastrophic climate change.



**SpringerNature**  
**Pollution potential and causative hydrogeochemical processes in unconfined aquifer systems in a typical urban setting: emphasis on recharge and discharge areas**  
 06 January 2020

The inhabitants of Akure Metropolis, south-western Nigeria, depend solely on groundwater for their domestic, industrial and irrigation purposes. There is a need to delineate recharge and discharge areas for assessment and management of groundwater in these areas. One hundred and ninety (190) dug wells were selected for this assessment. Elevation and water table data aided accurate delineation of recharge, discharge and groundwater divide areas. Thirty-six wells representative of recharge and discharge areas were subjected to pollution assessment [DRASTIC, water quality index (WQI) and runoff potential]. The results revealed that the recharge areas have higher pollution potential and runoff amount than the discharge areas.



**World Resources Institute**  
**CO2 Emissions Climb to an All-Time High (Again) in 2019: 6 Takeaways from the Latest Climate Data**  
 04 December 2019

Global carbon dioxide emissions from fossil fuels are on track to climb to yet another record high this year, according to a new report from the Global Carbon Project, putting the world at risk of catastrophic climate change due to these heat-trapping gases.



**Stockholm International Peace Research Institute**  
**The socio-economic impact of anti-vehicle mines in Angola**  
 22 November 2019

The humanitarian and developmental impact of anti-vehicle mines (AVMs) is particularly relevant in immediate post-conflict reconstruction efforts. However, the comprehensive analysis of how AVMs hamper the socio-economic and sustainable development outlook of communities in the medium and long term has often been overlooked.



**World Economic Forum**  
**The world's economy is only 9% circular. We must be bolder about saving resources**  
 11 November 2019

Simple household recycling isn't enough – only systematically decoupling the economy from resource use can save the planet.



**UNRISD**  
**Valueworks: Effects of Financialization along the Copper Value Chain**  
 07 November 2019

The Research Issue in Context Commodity chains are crucial for understanding global economic and societal connections. They emerge from and reproduce unequal roles in the global division of labour—an inequality increased by higher price volatility, greater international competition for investment, and increasing financialization of trade. Financialization—the growing influence of financial markets and institutions on national and international economies—has deeply affected commodity markets. Since the early 2000s, new derivative instruments, higher market volatility and automated trading have critically changed the role of finance in commodity trading. Financial instruments today play an important role in determining commodity prices at all points in the value chain.

# Modern Mining Workforces

---

## Maintaining open dialogue will be key as mining companies try to revamp their employee base

Constantly evolving technologies and business models will require mining company employees to develop new skills. Mining companies in general will have to help frontline employees become “protean” workers who embrace self-directed careers and developing new abilities, according to a report published by Deloitte in 2017; management will have to prepare employees for work that is not repetitive, but instead involves more complex tasks like remotely operating machinery, or monitoring efficiency metrics. In addition, as it seeks to attract top talent to drive digitalization and automation initiatives, the mining sector will have to increasingly compete with fast-growing technology firms. Entire fleets of self-driving trucks can already be operated remotely by a single person, and further technology-aided efficiency is on the horizon, according to a report published by the International Institute for Sustainable Development and the Columbia Center on Sustainable Investment in 2016. Governments and companies will have to work together to help workers who can no longer find their place in a more automated mining sector, by providing retraining programs.

The speed at which mining companies are able to roll out new technologies at their mine sites will be closely linked to the willingness of local governments and labour unions to accept the fact that these technologies may lead to reduced employment and procurement opportunities. Local policy-makers and unions must therefore be included in the decision-making on transitioning to new technologies and strategies, and should develop policies that support workers who are negatively affected. Many regulatory frameworks will also have to be adapted in order to better encourage the private sector to implement only those innovative models that provide for social wellbeing - and impose penalties on those that unleash negative consequences. In addition, contracts will have to be adapted in order to reflect mining's new, technology-focused value proposition. Governments themselves will also need technical assistance, as they seek to maintain political and legal stability in mining areas.

---

Related insight areas: [Agile Governance](#), [Supply Chain and Transport](#), [Education and Skills](#), [Migration](#), [Artificial Intelligence and Robotics](#), [Civic Participation](#), [Workforce and Employment](#), [Ageing](#), [Innovation](#), [Future of Economic Progress](#), [Gender Parity](#)





World Economic Forum

### Cobalt mining is a global scandal. We must build an ethical battery

10 January 2020

The connection between the battery driven green economy and the exploitative conditions under which its essential commodity – cobalt – is mined is well known. Here's what needs to change in mining for ethical batteries.



SpringerOpen

### The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan

08 January 2020

Developing countries are facing the problem of environmental degradation. Environmental degradation is caused by the use of non-renewable energy consumptions for economic growth but the consequences of environ...



Circle of Blue

### Dams, Sand Mining Threaten to Wreck Mekong Delta

20 December 2019

More than sea-level rise, unsustainable development on the Mekong Delta is the biggest risk to the delta's economy and ecology. The post Dams, Sand Mining Threaten to Wreck Mekong Delta appeared first on Circle of Blue .



GreenBiz

### The coal industry is shrinking — here's what miners need for a just transition

05 December 2019

Programs should be nurtured to have lasting effects, rather than serving as short-term band-aids.



Brookings Institution

### The role of civil society in Malawi's natural resource industry

18 November 2019

Elvin Nkhonjera shares how the civil society in Malawi has been able to inform natural resource management policies there.



VoxEU

### Does the inflow of precious metals from the New World really explain the 'Great Inflation' in renaissance Europe?

10 November 2019

Economists mostly argue that the Great Inflation in renaissance Europe was caused by an inflow of silver. Historians counter that it was caused by population growth. The column uses long-run economic data to argue that the historians' position is credible for England's economy. On this evidence, both contributed equally to inflation during this period.



Rocky Mountain Institute

### We Are Living in a Materials World

05 November 2019

It's as true today as it was when Madonna first sang it more than three decades ago: we are living in a material(s) world. Besides cluttering our lives, the objects around us are produced via a multistage process called a... Read More The post We Are Living in a Materials World appeared first on Rocky Mountain Institute .

# The Geopolitics of Mining

---

## Mining companies must navigate rising geopolitical risk and economic protectionism

A growing popular resistance to globalization and free trade is altering politics, and directly affecting the mining and metals sector. For example, policy-makers in the places where mines operate are increasingly trying to enact local content laws and regulations, which require minerals to be processed (and therefore gain in value) before they are exported. Meanwhile import restrictions on semi-finished products such as steel and aluminium have triggered recent trade disputes; full-blown trade wars and increased protectionism would likely lead to lower global commodity demand, and disrupt mining and metals companies, while an increase in local content regulations could increase production costs for individual mining projects. On the flip side, increased protectionism could actually provide opportunities for domestic mining companies, and for those that are vertically integrated (or, in control of multiple stages of a supply chain), as they can provide solutions that go beyond the simple extraction of minerals. Best practices for navigating these and other geopolitical risks include maintaining good relationships with domestic joint venture partners where mines are located, and securing access to countries with high consumer demand.

When it comes to minerals that are essential for promising renewable-energy technologies, geopolitical risk has been further complicated by market consolidation. China, for example, has secured its own supply of critical minerals such as lithium, cobalt, and rare earths, while developing a dominant market position by acquiring mining projects, forging resource-for-infrastructure deals with mineral producing countries (one example is an arrangement with the Democratic Republic of Congo to provide billions of dollars worth of infrastructure in exchange for access to copper mining), promoting domestic production, and gaining control of key components of the mineral and technology value chain. Countries that must rely on imports and are wary of supply disruptions have examined ways to hinder Chinese-backed takeovers, and to avoid having to rely on Chinese companies. Further consolidation, geopolitical manoeuvring, and muscle flexing could create challenges for companies that have so far prospered under a system of relatively free trade - while creating opportunities for domestic projects that might not be economically viable without government intervention.

---

Related insight areas: [International Trade and Investment](#), [China](#), [Geopolitics](#), [Justice and Law](#), [International Security](#), [Geo-economics](#), [Global Risks](#), [Africa](#), [Public Finance and Social Protection](#)



**World Economic Forum**  
**Davos 2020 - Averting a Climate Apocalypse**

21 January 2020

Averting a Climate Apocalypse Global emissions of carbon dioxide remain on course to rise above 1.5°C despite clear and present risks.



**YiCai Global**  
**China Will Open Oil, Gas Exploration and Mining to Non-SOEs, Ministry Says**

09 January 2020

China plans to open up its oil and gas exploration and mining markets, which are currently only open to state-owned enterprises, to more capital resources in order to stimulate vitality in the sector, according to the Ministry of Natural Resources.



**Bruegel**  
**Lessons from the China-US trade truce**

19 December 2019

The tentatively agreed deal between China and the United States temporarily stops a dangerous dynamic, yet it falls far short of the negotiating objectives of both sides. US trade policy has become a dominion of the executive branch guided principally by the President's electoral interests. Meanwhile, China demonstrates its capacity to resist pressure: it will enact structural reforms at its own pace in line with its interests. Sadly, the deal confirms that the United States no longer feels obligated to follow WTO rules, and can induce others to do the same.



**Project Syndicate**  
**A Green Industrialization Strategy for Africa**

14 November 2019

African countries cannot abandon “brown” industries – those that depend on oil, gas, and minerals – and create a green economy overnight. But they can use them as a tool to achieve a clean, sustainable economy.



**VoxEU**  
**How the iPhone widens the US trade deficit with China**

11 November 2019

In order to pursue ‘fair trade’, the Trump administration has imposed a punitive 25% tariff on \$250 billion’s worth of Chinese goods. However, conventional trade statistics greatly exaggerate the US trade deficit with China. This column uses the iPhone as an example to demonstrate how the trade deficit is inflated and why value-added should be used to assess the bilateral trade balance. If multinational enterprises, including Apple, shift part of their value chains out of China, China may no longer play a central role in global value chains targeting the US market. Depreciation of the yuan will be insufficient to counter the effect.

# Transition to a Low-Carbon Economy

---

## Low-emission energy and transportation are more mineral intensive than fossil fuel-based systems

While fossil fuels like coal have helped to improve living standards around the world since the 18th century, associated greenhouse gas emissions have led to devastating global warming. In order to avoid reaching temperatures that would have catastrophic consequences for the planet, countries must decarbonize their energy systems by the middle of this century. Companies with coal mines and reserves therefore face a significant risk of stranded assets. However, for minerals considered critical for the green transition - those needed for renewable power plants, energy storage solutions, efficient housing and infrastructure, or related technology and transportation systems - increased demand is likely. With this opportunity comes a series of risks. For example, as final products based on these in-demand minerals become more modular, they will potentially become easier to recycle if the right incentives are in place. While vertically-integrated mining companies (active along the entire "value chain" from mining minerals to selling finished products) in the steel and aluminium sectors are already an important part of recycling systems, a thriving recycling sector might ultimately dampen any demand for minerals generated by the clean energy transition.

Transitioning to a low carbon economy will require the mining sector to reduce its environmental footprint. This is especially true now, because energy and water demand related to mining are expected to increase due to declining ore grades (as more energy is needed to produce the minerals that are in demand). Mining, processing, smelting, and transportation are energy intensive, and largely fossil fuel based. Mining companies are increasingly sourcing renewable energy in order to decarbonize; electrifying their operations and investing in alternative fuels to power their equipment will be key for them. Ultimately, companies with low-emission and recycling operations can market themselves at a premium to consumers and corporations increasingly conscious of greenhouse gas emissions. Public procurement programs in OECD countries that promote greener purchasing are evidence of this, as are commitments from companies to rely solely on recycled metals and minerals. Apple, for example, outlined plans in a 2017 report to help reduce the need to mine metals from the earth by only making use of renewable resources or recycled material. The company cited related developments including an ability to melt down iPhone 6 aluminium enclosures to make Mac mini computers for use in its factories.

---

Related insight areas: [Sustainable Development](#), [Climate Change](#), [Fourth Industrial Revolution](#), [Oil and Gas](#), [Batteries](#), [Electricity](#), [Future of Economic Progress](#), [Values](#), [Water](#), [Future of Energy](#), [Supply Chain and Transport](#), [Circular Economy](#)



**World Economic Forum**  
**Achieving net-zero emissions by 2050 will rest on these 3 pillars**  
 17 January 2020

Scaling up technology, policy support and stimulating demand: we will need to focus on all three if we are to realise a net-zero emissions world within the next three decades.



**Scientific American**  
**Natural Gas Use Is Rising. Is that Good News or Bad News for the Climate?**  
 09 January 2020

It's a little of both for now, but in the long run it's bad.



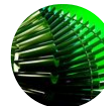
**VoxEU**  
**Market discipline and environmentally and socially sustainable corporate policies**  
 24 December 2019

There is growing consensus that as well as maximising shareholder value, listed companies should also take into account their shareholders' environmental and social concerns. This column aims to shed light on whether market discipline can influence corporate behaviour. The findings indicate that through their sales and purchases, investors and customers can effectively impose their social preferences on firms, suggesting that market discipline indeed works.



**Science Daily**  
**Detours may make batteries better: Scientists show point defects in cathode crystals may speed lithium absorption**  
 09 December 2019

Adding atom-scale defects to battery materials may help them charge faster, theoretical models show.



**Ecole Polytechnique Fédérale de Lausanne**  
**Eliminating cracks in 3D-printed metal components**  
 21 November 2019

21.11.19 - Researchers at EPFL have developed a new laser 3D-printing technique to manufacture metal components with unprecedented resistance to high temperature, damage and corrosion. The method has applications in fields ranging from aerospace to power-generating turbines. 3D printing, also known as additive manufacturing, has revolutionized the way components are made, setting new standards in terms of production speed when geometric complexity is high. Manufacturers use a technique known as selective laser melting (SLM) to 3D-print metal components. With SLM, a powerful laser melts and fuses metallic powders together, gradually building a 3D component layer by layer. Any remaining powder is removed at the end of the process.



**SpringerNature**  
**Risk assessment due to intake of trace metals through the ingestion of groundwater around proposed uranium mining areas of Nalgonda district, Telangana, India**  
 15 November 2019

Abstract In the context of proposed uranium mining area, it is very important to evaluate the presence of certain trace metals in groundwater around a proposed uranium mining area at Peddagattu and Seripally areas of Nalgonda district, Telangana (India). The concentrations of certain metals (Cu, Zn, Ni, Pb, Fe, Mn, Cd, Co, Sr, Ba, Cr, Cs and As) were measured in 37 groundwater locations and 10 surface water locations for seven times during 2 years around proposed uranium mining areas. The risk of the chemical toxicant [may be characterized using a hazard quotient (HQ)] is calculated by the results obtained during the study. The HQs of both groundwater (37) and surface water (10) all the considered trace metals were well below the threshold value of 1 as suggested by USEPA.

# Access to Resources

---

## Mining companies are using new technologies and techniques to tap high-grade, hard-to-reach deposits

As world-class mineral resources in low-risk areas are exhausted, mining companies must either master new technologies for extraction and processing - or venture into frontier areas where it has not previously been economically viable to extract. As a result, mining companies are increasingly automating processes in order to improve safety, increase productivity, and lower costs. In addition, better exploration technologies and geographic information system tools are enabling more targeted mining of higher-grade ore. As extraction becomes more efficient, it could become easier to re-process resources like tailings dams (used to store mining by-products). Recently, block caving - which enables access to deeper resources at a cost similar to that of open pit mining - has received increased attention as many open pit mines cease operations. Some technologies being tested could fundamentally alter mining; in-situ leaching, for example, dissolves minerals and extracts them through boreholes drilled into a deposit, while biomining uses microbes to extract metals from rock ores or mine waste. In addition, methods of deep sea mining and asteroid mining are being actively explored by governments and companies.

As these technologies and techniques open up new possibilities for mining companies to optimize the valorization of existing resources, or enable access to new resources, they are moving the industry into uncharted territory in terms of business models, processes, and social and environmental consequences. As technologies mature, and the impacts of alternative mining models become clearer, new rules and regulations will have to be developed to address them. It is also essential to better recognize the early-stage companies around the world that are designing and deploying potentially helpful new technologies, as they will likely have significant impact both on the industry and on society as a whole; greater collaboration between traditional mining companies and startups has the potential to benefit local communities, clients, and investors by ensuring a safer and more sustainable industry. AngelList, a US-based website designed to help young companies attract funding, listed more than 90 “minerals” startups as of late 2018, including a company that develops a blockchain protocol for the more responsible tracking and sourcing of minerals, and another that develops 3D Printing applications for mining.

---

Related insight areas: [Blockchain](#), [Infrastructure](#), [Arctic](#), [3D Printing](#), [Artificial Intelligence and Robotics](#), [Biotechnology](#), [Future of Economic Progress](#), [Oceans](#)





Frontiers

### Rare Earth Elements in Andaman Island Surface Seawater: Geochemical Tracers for the Monsoon?

09 January 2020

The Asian summer monsoon affects the lives of billions of people. With the aim of identifying geochemical tracers for the monsoon-related freshwater input from the major rivers draining into the Bay of Bengal (BoB) and the Andaman Sea (AnS), we have analyzed the yttrium and rare earth element (YREE) concentration of surface seawater samples from various locations spanning the Andaman Islands in 2011 to 2013. In some locations, samples have been taken in March, July, and November 2011, thus spanning the seasonal cycle and including different monsoon phases. Generally, the YREE patterns are similar to those reported for offshore samples from the BoB and AnS in January 1997, with seawater-normalized patterns of most samples characterized by middle REE enrichments.



Peterson Institute for International Economics

### Phase One China Deal: Steep Tariffs Are the New Normal

19 December 2019

Nearly two years after President Donald Trump fired the opening shot in his trade war with China, the smoke is clearing on what seems to be the new normal in the troubled US-China economic relationship. Some previously threatened tariffs poised to hurt American shoppers are not taking effect. Some...



The New York Times

### Is Blockchain the New Ethical Gold Rush? Maybe

06 December 2019

Advocates say tracing gold from mine to jewelry customer could help guarantee provenance, improve the lives of miners and reduce carbon emissions.

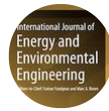


National University of Singapore

### NUS researchers create new metallic material for flexible soft robots

25 November 2019

A team from NUS has created a material that is half as light as paper and highly flexible but also shows enhanced characteristics for electrical conductivity, heat generation, fire-resistance, strain-sensing and is inherently capable of wireless communications.



SpringerOpen

### Energy-saving behaviour as a demand-side management strategy in the developing world: the case of Bangladesh

07 November 2019

Abstract Although demand-side management (DSM) needs to be more customer centred, either with or without smart technologies (e.g. smart grid), less attention has been paid to the developing world in relation to DSM strategy development. The main reasons have been lack of appropriate technology and capital costs. Importantly, there are alternative DSM strategies that require minimum or no cost to implement and provide immediate results, of which energy-saving behaviour of the occupants at residences is one. This study explores the potentiality of this energy-saving behaviour as a DSM strategy for the least developed economies, focusing particularly on Bangladesh. The literature suggests that energy-saving behaviour could reduce energy demand by a maximum of 21.9%.



SpringerOpen

### Identification, partial characterization, and use of grey mullet ( Mugil cephalus ) vitellogenins for the development of ELISA and biosensor immunoassays

07 November 2019

Abstract Vitellogenin (Vtg) has proven to be a sensitive and simple biomarker in determining sex, sexual maturity, and xenoestrogenic effects in fish. Thus, our investigation has been focused on identification, partial characterization, and quantification of grey mullet ( Mugil cephalus ) Vtg through the use of a variety of biochemical and immunological analytical techniques. Mullet is considered both a promising aquaculture candidate and an important species for improving sediment quality in polyculture systems. In the first part of this work, grey mullet Vtg was purified from plasma of 17 $\beta$ -estradiol (E2)-induced male fish by a one-step chromatographic protocol, and partially characterized.

# New Ways to Finance Mining

---

## As mining companies try to limit risk, novel financing and production models will become more common

After the commodity boom in the first decade of the 21st century - a phenomenon triggered by demand from China and other emerging economies often dubbed the “super cycle” - prices collapsed. Mining companies were forced to focus on reducing debt ratios, and generally improving their balance sheets. Meanwhile traditional equity and debt markets relied upon to fund the industry dried up, so companies have had to seek out new means to restoring financial health. One avenue has been to improve productivity through greater automation and digitalization. Another is the adoption of “lean” and “design” thinking approaches, which involve developing a lean startup culture, maintaining budget flexibility, and pursuing multiple opportunities that vary in terms of time horizon, risk, and value but are strategically aligned. Companies can also devise alternative financing solutions. These could include bulking up on both royalty and metal streaming agreements; the first involves providing cash for a project in return for a regular royalty payment (calculated as a percentage of sales) once the project starts producing or making returns, while the second has investors receive minerals purchased at a pre-agreed price generally below market rate.

These novel financing methods create the benefit of not burdening a mining company’s balance sheet, while transferring both risk and reward to investors interested in gaining more exposure to the minerals market. Even as mineral prices rise, it is likely that these solutions will nevertheless persist - because they can be attractive options for relatively high-risk, capital-intensive mining projects that require significant amounts of time to provide a return. For traders, the metal streaming approach can be a particularly attractive option for securing metal supplies. Mining companies may also increasingly seek to develop joint ventures similar to those favoured by the oil and gas sector, which can reduce exposure to individual projects and jurisdictions. To further limit their exposure, mining companies may even develop service agreements, where governments in countries where they operate, or other third-party investors, own and finance a project while the mining company itself only provides services for a pre-agreed fee.

---

Related insight areas: [Financial and Monetary Systems](#), [Private Investors](#), [Oil and Gas](#), [Institutional Investors](#), [Banking and Capital Markets](#), [Agile Governance](#), [International Trade and Investment](#)



**Rocky Mountain Institute**  
**Sunshine for Mines: A Brighter Vision for Sustainable Resources**

15 January 2020

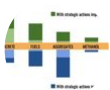
In both life and work, it's important to reflect on your past accomplishments and how they inform your future journey. When RMI started its mining initiative five years ago, carbon reduction wasn't on the radar for mining companies, and the... Read More The post Sunshine for Mines: A Brighter Vision for Sustainable Resources appeared first on Rocky Mountain Institute .



**SpringerOpen**  
**Does abnormal lending behavior increase bank riskiness? Evidence from Turkey**

30 October 2019

This study empirically analyzes whether the rapid growth of loans and risk-taking behavior during the expansion of loans affected non-performing loans (NPLs) and the solvency of financial institutions in the T...



**World Economic Forum**  
**Using CO2 as an industrial feedstock could change the world. Here's how**

09 January 2020

Billions of tons of CO2 can be removed from the atmosphere every year and used to make products such as building materials and fuels. What are we waiting for?.



**SpringerOpen**  
**Industrial policy, structural transformation and economic growth: evidence from China**

05 December 2019

Industrial policy is an important means for governments to promote industrial development and accelerate economic growth. This paper mainly uses the Chinese Law and Regulation Database as the source of the rel...



**Harvard Business School Working Knowledge**  
**Pathways to Materiality: How Sustainability Issues Become Financially Material to Corporations and Their Investors**

04 December 2019

This paper provides a framework for understanding and predicting how environmental, social, and governance (ESG) issues become financially material.



**Center for Global Development**  
**A Smoother Trade Transition for Graduating LDCs**

01 November 2019

For nearly 50 years, the world's "least developed countries" have received extra financial support and preferential trade treatment to help them grow and develop. In the first three decades after the United Nations (UN) created the LDC category in 1971, only one country –diamond-rich Botswana–outgrew that status.

# References

---

## 1. A Social Contract for Mining

- The world needs a circular economy. Help us make it happen, World Economic Forum, [www.weforum.org](http://www.weforum.org)
- Comparison of Visual Functions of Two Amazonian Populations: Possible Consequences of Different Mercury Exposure, Frontiers, [www.frontiersin.org](http://www.frontiersin.org)
- Shuttering of U.S. Coal Plants Saved More than 26,000 Lives Over the Past Decade, Study Finds, Yale Environment 360, [e360.yale.edu](http://e360.yale.edu)
- Options for Urban Mining and Integration with a Potential Green Circular Economy in the People's Republic of China, Asian Development Bank, [www.adb.org](http://www.adb.org)
- Towards zero-deforestation commodities in Ghana's Atiwa forest, Center for International Forestry Research, [forestsnews.cifor.org](http://forestsnews.cifor.org)
- The natural resource governance discussion needs to move beyond transparency to analysis, Brookings Institution, [www.youtube.com](http://www.youtube.com)
- "The metal industry is about to undergo one of the greatest upheavals in history"., Max Planck Society, [www.mpg.de](http://www.mpg.de)

## 2. Big Data and Mining

- Forging a Sustainable Path Towards a Common Future | DAVOS 2020, World Economic Forum, [www.youtube.com](http://www.youtube.com)
- Management of intact forestlands by Indigenous Peoples key to protecting climate, Center for International Forestry Research, [forestsnews.cifor.org](http://forestsnews.cifor.org)
- Pollution potential and causative hydrogeochemical processes in unconfined aquifer systems in a typical urban setting: emphasis on recharge and discharge areas, SpringerNature, [link.springer.com](http://link.springer.com)
- CO2 Emissions Climb to an All-Time High (Again) in 2019: 6 Takeaways from the Latest Climate Data, World Resources Institute, [www.wri.org](http://www.wri.org)
- The socio-economic impact of anti-vehicle mines in Angola, Stockholm International Peace Research Institute, [www.sipri.org](http://www.sipri.org)
- The world's economy is only 9% circular. We must be bolder about saving resources, World Economic Forum, [www.weforum.org](http://www.weforum.org)
- Valueworks: Effects of Financialization along the Copper Value Chain, UNRISD, [www.unrisd.org](http://www.unrisd.org)

## 3. Modern Mining Workforces

- Cobalt mining is a global scandal. We must build an ethical battery, World Economic Forum, [www.weforum.org](http://www.weforum.org)
- The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan, SpringerOpen, [jfin-swufe.springeropen.com](http://jfin-swufe.springeropen.com)
- Dams, Sand Mining Threaten to Wreck Mekong Delta, Circle of Blue, [www.circleofblue.org](http://www.circleofblue.org)
- The coal industry is shrinking — here's what miners need for a just transition, GreenBiz, [www.greenbiz.com](http://www.greenbiz.com)
- The role of civil society in Malawi's natural resource industry, Brookings Institution, [www.youtube.com](http://www.youtube.com)
- Does the inflow of precious metals from the New World really explain the 'Great Inflation' in renaissance Europe?, VoxEU, [voxeu.org](http://voxeu.org)
- We Are Living in a Materials World, Rocky Mountain Institute, [rmi.org](http://rmi.org)

## 4. The Geopolitics of Mining

- Davos 2020 - Averting a Climate Apocalypse, World Economic Forum, [www.youtube.com](http://www.youtube.com)
- China Will Open Oil, Gas Exploration and Mining to Non-SOEs, Ministry Says, YiCai Global, [www.yicai.com](http://www.yicai.com)
- Lessons from the China-US trade truce, Bruegel, [bruegel.org](http://bruegel.org)
- A Green Industrialization Strategy for Africa, Project Syndicate, [www.project-syndicate.org](http://www.project-syndicate.org)
- How the iPhone widens the US trade deficit with China, VoxEU, [voxeu.org](http://voxeu.org)

## 5. Transition to a Low-Carbon Economy

- Achieving net-zero emissions by 2050 will rest on these 3 pillars, World Economic Forum, [www.weforum.org](http://www.weforum.org)
- Natural Gas Use Is Rising. Is that Good News or Bad News for the Climate?, Scientific American, [blogs.scientificamerican.com](http://blogs.scientificamerican.com)
- Market discipline and environmentally and socially sustainable corporate policies, VoxEU, [voxeu.org](http://voxeu.org)
- Detours may make batteries better: Scientists show point defects in cathode crystals may speed lithium absorption, Science Daily, [www.sciencedaily.com](http://www.sciencedaily.com)
- Eliminating cracks in 3D-printed metal components, Ecole Polytechnique Fédérale de Lausanne, [actu.epfl.ch](http://actu.epfl.ch)
- Risk assessment due to intake of trace metals through the ingestion of groundwater around proposed uranium mining areas of Nalgonda district, Telangana, India, SpringerNature, [link.springer.com](http://link.springer.com)

## 6. Access to Resources

- Rare Earth Elements in Andaman Island Surface Seawater: Geochemical Tracers for the Monsoon?, Frontiers, [www.frontiersin.org](http://www.frontiersin.org)
- Phase One China Deal: Steep Tariffs Are the New Normal, Peterson Institute for International Economics, [www.piie.com](http://www.piie.com)
- Is Blockchain the New Ethical Gold Rush? Maybe, The New York Times, [www.nytimes.com](http://www.nytimes.com)
- NUS researchers create new metallic material for flexible soft robots, National University of Singapore, [news.nus.edu.sg](http://news.nus.edu.sg)
- Energy-saving behaviour as a demand-side management strategy in the developing world: the case of Bangladesh, SpringerOpen, [link.springer.com](http://link.springer.com)
- Identification, partial characterization, and use of grey mullet ( Mugil cephalus ) vitellogenins for the development of ELISA and biosensor immunoassays, SpringerOpen, [link.springer.com](http://link.springer.com)

## 7. New Ways to Finance Mining

- Sunshine for Mines: A Brighter Vision for Sustainable Resources, Rocky Mountain Institute, [rmi.org](http://rmi.org)
- Using CO2 as an industrial feedstock could change the world. Here's how, World Economic Forum, [www.weforum.org](http://www.weforum.org)
- Industrial policy, structural transformation and economic growth: evidence from China, SpringerOpen, [fbr.springeropen.com](http://fbr.springeropen.com)
- Pathways to Materiality: How Sustainability Issues Become Financially Material to Corporations and Their Investors, Harvard Business School Working Knowledge, [hbswk.hbs.edu](http://hbswk.hbs.edu)
- A Smoother Trade Transition for Graduating LDCs, Center for Global Development, [www.cgdev.org](http://www.cgdev.org)
- Does abnormal lending behavior increase bank riskiness? Evidence from Turkey, SpringerOpen, [jfin-swufe.springeropen.com](http://jfin-swufe.springeropen.com)

# Continue the experience online

## Explore the collective intelligence of the World Economic Forum

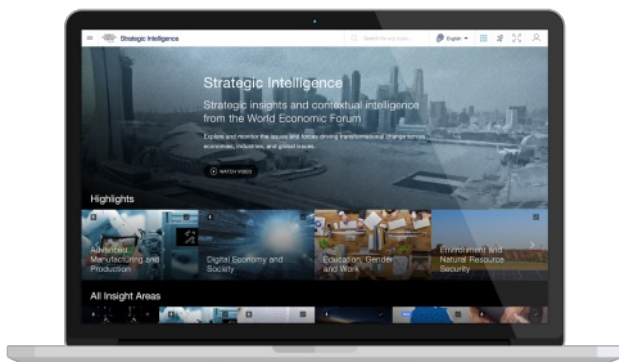
In today's world, individuals and organizations can find it difficult to keep up with the latest trends or to make sense of the countless transformations taking place around them.

How can you decipher the potential impact of rapidly unfolding changes when you're flooded with information—some of it misleading or unreliable? How do you continuously adapt your vision and strategy within a fast-evolving global context?

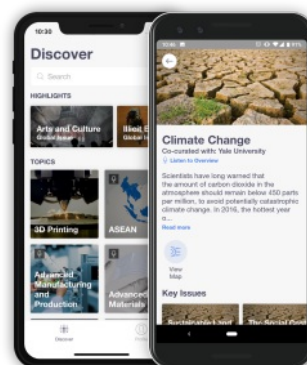
Leaders require new tools to make better strategic decisions in an increasingly complex and uncertain environment. The World Economic Forum developed Strategic Intelligence to help you understand the global forces at play and make more informed decisions.

## Connect to Strategic Intelligence

Visit [Strategic Intelligence](https://intelligence.weforum.org) on the web or download the [Strategic IQ](https://wef.ch/si) app on your mobile device to learn more.



[intelligence.weforum.org](https://intelligence.weforum.org)



[wef.ch/si](https://wef.ch/si)





---

COMMITTED TO  
IMPROVING THE STATE  
OF THE WORLD

---

The World Economic Forum, committed to improving the state of the world, is the International Organization for Public-Private Cooperation.

The Forum engages the foremost political, business and other leaders of society to shape global, regional and industry agendas.

---

World Economic Forum  
91-93 route de la Capite  
CH-1223 Cologny/Geneva  
Switzerland  
Tel.: +41 (0) 22 869 1212  
Fax: +41 (0) 22 786 2744  
contact@weforum.org  
[www.weforum.org](http://www.weforum.org)