Can Mining Ever be Sustainable? Environmental Impacts & Solutions

By CRUX Investor

Can mining ever be sustainable? It's a crucial question if we are to use our planet's finite resources more sustainably. The argument that mining provides the natural resources needed for the green revolution (Lithium, Nickel and other battery metals) is convincing, yet the wider question of how this will be managed in the long term is still up for debate.

Mineral extraction is by definition the extraction of a non-renewable resource, so finding ways to make this sustainable for future generations is complex and multi-faceted.

Let's take a broad look at the issues…

Environmental Impacts of Mining

If we are to make mining more sustainable, we need to know its areas of greatest impact so we can ameliorate and mitigate them at their source. According to the NGO "Alaskans for Responsible Mining" talking in the Western Mining Action Network (WMAN), mining activities can damage soil, pollute air and drinking water as well as impacting wildlife, habitats, and can permanently scar ecosystems.

There is still much to do on the ground to make the mining life cycle safer and more sustainable. Let's take a look at the main impact areas currently:

Carbon output

With mining being heavily dependent on fossil fuels to power its activities, carbon emissions are a big issue for the sector to address. To tackle these emissions, some nations have enacted regulations that require the use of emission credits. Yet, many countries still do not have codes that address carbon output. In places like China and Russia environmental standards are minimal and sometimes non-existent, which is a big problem as China continues to ramp up its mining activities.

The mining industry generates between 1.9 and 5.1 gigatons of CO2 equivalent (CO2e) of GHG emissions annually, according to a report by McKinsey consultants. The majority of emissions are from underground operations. Carbon emissions from mining, like emissions from any other industry are the main causes of climate change.

The emissions can cause respiratory health problems to local communities as was seen at. The majority of carbon emissions in mining come from coal bed methane. Not only that, a UN study states that extraction and primary processing of metals and other minerals are responsible for 20% of the health impacts of air pollution and 26% of total global carbon emissions.

Molycorp - Cutting carbon emissions in US mining

Molycorp is a great example of a company that took over a mine and adapted its activities to more sustainable operational standards, what MIT calls simply "environmentally sensitive mining".

Mountain Pass is a mine in the Clark Mountain Range in California, United States. Owned at the time by Chevron, it was shut down in 2002 for various reasons, including competition from China. Previously it had produced most of the global supply of rare-earth metals. In

2008 it was taken over by Molycorp. The firm implemented changes including new tailings storage methods to reduce volatility and water recycling, as well as using waste heat from operations for steam and power helping cut carbon emissions on site.

Dust particles

Mining usually involves the breaking up of materials to obtain ores or other metals. This creates dust which can have several human health impacts, especially from coal mining. Dust from Riebeckite, a mineral dust similar to asbestos can be absorbed by human lungs and animals causing pneumoconiosis and silicosis, which are better known as “Black Lung”. Dust can also be generated by mine flues.

When mining for Fluorine, flue output can contain fluorine dust (8.5 kg of fluorine per ton of flue dust), which are also damaging to human health if consumed in high concentrations, being linked to the condition skeletal fluorosis.

Chemical leaching and acid mine drainage

When mining for radioactive minerals such as Uranium there is the potential for these radioactive chemicals to be leached into the environment. These chemicals are called radionuclides and can contaminate waterways near these mines.

While some studies of rivers in Portugal (a Uranium rich region) suggest that concentrations of these chemicals sit within acceptable ranges there are incidences when leaching becomes very dangerous. For example, acid and metal runoff from the Zortman Landusky mine in Montana harmed biological life in a dozen streams in the Little Rocky Mountains. The mine has experienced over a dozen cyanide spills, including one spill that released 50,000 gallons of cyanide solution and contaminated a community drinking water supply.

What is acid mine drainage?

At metal mines, the ore being extracted (such as gold, silver, copper, etc) is often rich in sulfide minerals. The mining process exposes these sulfides to water and air, and together they react to form sulfuric acid. Acid mine drainage can be released from mines anywhere where sulfides are exposed to air and water.

This includes waste rock piles, open pits tailings, leach pads and underground tunnels. This has a big impact on fish, animals and plants. Many impacted streams can have a pH of 4 or lower - that’s the same pH as battery acid.

Robinson dam in Randfontein, South Africa contaminated and highly radioactive with uranium and iron pyrite from years of acid mine drainage.

Cyanide leaching impacts

To extract metals from oxidized ores Cyanide is often used. Yet the Cyanide in leach ponds has been known to cause wildlife mortality. In California for instance, between 1980 and 1989 7,613 animals died from exposure to Cyanide from leaching ponds in the state and Nevada and Arizona.

All these problems are not just from currently active mines either, abandoned mines can leave a legacy of significant environmental damage that can last decades and even centuries. Acid mine drainage is especially harmful because it can go on indefinitely.

This can be from Cyanide and Mercury release into water streams for instance, or simply the bifurcation of natural wildlife corridors. This is a huge issue when it comes to Gold mining in particular. For instance, the Lihir gold mine in Papua New Guinea dumps more than 5 million tons of toxic waste into the Pacific Ocean every year. This destroys corals and other ocean life and contaminates waterways both local and further downstream.

Mining can affect human health too. The leaking of toxic chemicals into local food chains can lead to health problems and even cancer in some instances. Coal dust still affects many people through black lung disease and other materials mining can cause a multitude of other health issues for mine workers and those living nearby.

There are thousands of fatalities due to mining accidents and health problems every year. Of course, the mining industry has made a concerted effort in the last decade to address these issues but there remains much to be done.

Strip mining

The worst effects on environmental and human health come from strip mining (also called open-cast mining), which still accounts for 80% of mining in Australia and 40% globally. Strip mining erodes topsoil due to water run-off (leading to chemical leakage into waterways) and can decimate local forests, habitats and landscapes. Its effects on human health are also considerable such as dust-related respiratory problems and water contamination and shortages in vulnerable communities.

Underground mining

Underground mining makes up the majority of mining activity globally. It may cause less environmental problems on the surface, yet the indirect effects are also large. Underground mining displaces huge amounts of earth to the surface, which requires a huge amount of energy to excavate, which of course adds to energy-related carbon emissions. It can also lead to subsidence above which can be a risk to buildings and people above.

The volume of waste brought to the surface can also contain a cocktail of toxic waste which can harm the health of nearby populations through drinking water or air-based pollution and contamination. Excavation can also lower local and even national water tables due to the large volumes of water required to sift through the material to obtain metals and other mined resources. This pressure on water capital is called “Water Stress”, with water scarcity one of the biggest sustainability issues in metals and mining, says Fitch Ratings.

Coal mine methane

Methane gas released from underground coal mining is another issue to contend with. Methane is twenty times more powerful than carbon dioxide as a greenhouse gas. While much of this is currently captured for use in power generation there are many instances such as in China where methane has been accidentally released in large quantities due to unsustainable mining practices. While methane can be used as a power source, its effects on climate change are considerable, if it isn’t captured. This has indirect effects on human health too from respiratory conditions brought on by higher greenhouse gas emissions.

Coal fires

If all that wasn't enough there is also the issue of underground coal fires which can burn for centuries, adding carbon monoxide filled smoke. This smoke can also contain carbon dioxide, methane, sulphur dioxide and nitrous oxides as well as fly ash. All these add to climate change emissions which affect environmental resilience in the poorest communities as well as causing health problems.

The International Journal of Coal Geology states that proximity to the source of coal fire pollution and smouldering combustion increases the risk of local communities to exposure to high concentrations of known toxins such as aerosolized particles. The Journal states that coal mine fire smoke also likely has "short-term adverse respiratory impacts, adverse cardiovascular outcomes" and leads to increased mortality.

Aerial view of an open-cast coal mine Belchatow, Poland.

Erosion of endangered species habitats

Mining causes damage to landscapes, and it's not just damaging to the immediate mining site either. As discussed in the Chemical Leaching section above, mining's poor environmental legacy can last indefinitely including the addition to greenhouse gasses, the death of flora and fauna, and erosion of land and habitat. According to the Centre for

Biological Diversity The main vessel for negative impacts from mining on habitats and wildlife come from impacts on the water which can kill plants and animals, as well as climate changes impact on vulnerable species that cannot adapt to changes in climatic conditions.

Is Mining Currently Sustainable?

With a recent United Nations' (UN) study finding that 26% of the world's carbon emissions stem from the extraction and early processing of metals and other minerals, the sustainability of the industry is coming under increasing scrutiny. Add to that the Taskforce on Climate-related Financial Disclosures (TCFD) and the Taskforce on Nature Related Disclosures (TNFD) and you have an industry suffering from an identity crisis.

So, is mining currently sustainable and where is it winning and losing?

For a very scientific answer to this question, we can turn to Saleem H.Ali, Director of the Centre for Social Responsibility in Mining (CSRM) at the University of Queensland Australia. He observes that when assessing the sustainability of mineral extraction we must be looking at the level of entropy (disorder) or renewability, that mineral extraction produces. He states that metallic minerals can be retrieved and recycled which produces low environmental disorder, whereas coal for instance is converted to a high level of entropy (to Carbon Dioxide) which is non-renewable. In Ali's view then it is the material extracted and its use, rather than how it is extracted that is key if we want to label a mining project sustainable.

Mining operations are still crucial however to minings sustainable impact, especially on the communities and habitats they operate within. In terms of operations much has already been achieved. Here are three recent innovations:-

Contamination reduction technology

The use of zero liquid discharge technology is gathering pace. Zero liquid discharge (ZLD) is an innovative technology that intercepts contamination from wastewater. It allows up to 95-98% of wastewater to be reused as high-purity distilled water in industrial mining processes. Raw mining wastewater is acidic and highly saline, often containing a large proportion of sediment. Methods to remove contaminants include sedimentation, dissolved air flotation (DAF), biological treatment, media filtration, activated carbon filtration, ultrafiltration, and reverse osmosis. Using these technologies helps the bottom line while helping mining companies improve their reputation among stakeholders.

Dust control technology

The use of dust control measures has helped human and wildlife health immensely in recent years. Traditionally pre-wetting raw materials with water can help reduce dust clouds but other things are becoming more common too. Stabilising road surfaces can reduce dust generated from vehicles on site. Fog cannons which use a strategically dispersed water fog to capture fine sediment in the air are increasingly useful. This along with high-pressure dust suppression mist systems can reduce airborne PM10 dust by over 80%. Lower pressure watering systems don't actively subdue PM10 dust particles that are already airborne. PM10 particles are respirable sized dust particles which are less than 10 microns (PM10 dust). Dust control measures that use high pressure also help cut water usage and prevent excessive water pooling.

Operational Energy Efficiency

The continued drive for material and energy efficiency are also slowly improving mining from an operational standpoint. Though the trend has been for bigger comminution equipment in mines (equipment for grinding down raw materials). Alan Boylston, director, process engineering development, sales at Metso, says that breaking down grinding into three stages rather than two creates a more energy-efficient circuit. Fuel consumption can be reduced by using in-pit crushing and conveying (IPCC). Then on top of these changes, powering all operations with renewables on-site can make a net-zero mine a reality.

Social Sustainability - Progress and pitfalls

Mining Sustainability also includes social sustainability and in terms of mining, this has been put in sharp focus by the COVID-19 pandemic. In June, MiningWatch Canada condemned the industry for not taking COVID-19 seriously enough amid contagious hot-spots at mining sites. There is still a huge opportunity for the industry to continue to improve on social sustainability by actively listening to detractors and constructive critics.

Mining's impact on communities, especially in developing countries can still be significant and not always for the good. Take the Brumadinho disaster in Brazil's Minas Gerais region for example. In January, at least 248 people died when a dam containing tailings (waste) had collapsed. The disaster has had long term consequences for local communities.

Forests were destroyed and rivers polluted, leaving a "lunar landscape" that can no longer absorb rain in the rainy season and perpetuating floods and running livelihood sustainability in the process. Unfortunately, this is not the only disaster in recent years and the industry has been condemned by NGOs such as Mining Watch Canada for its role in perpetuating numerous environmental and social problems around the world.

Tackling the UN Sustainable Development Goals (SDGs)

The United Nations asked a similarly provocative question recently, about whether mining can help tackle the UN Sustainable Goals. A report by MiningWatch Canada stated that companies should do the following:

- Extract responsibly
- Produce with less waste
- Use safer processes
- Incorporate new sustainable technologies.
- Promote the improved wellbeing of local communities

- Curb emissions
- Improve environmental stewardship.

A tall order it seems but one that the mining industry must deliver on if it wants to truly address its sustainability impact. The report states that mining can tackle all 17 SDGs but it identified SDG 6, 7, 8, 9,13 and 15 as goals the industry can tackle directly.

These are:

6 - Clean water and Sanitation- Mining requires access to land and water. Excessive water use and water body contamination are adverse impacts on human and ecological health.

7 - Affordable and Clean Energy- Mining can use a lot of energy, both for extraction and for processing materials and metals. There are many opportunities for greater efficiency as well as expanding the use and purchase of renewable energy which can also help make clean energy affordable to stakeholders.

8 - Decent work and economic growth- There are many new economic opportunities for local communities and workers to access better training and more stable employment by making mines sustainable for the long term. By investing in clean-tech and clean jobs the industry can future proof the sector and workers livelihoods.

9 - Innovation and infrastructure-Sustainable mining activities can spur economic development and diversification through direct and indirect economic benefits. It can also play an active role in constructing new infrastructure for transport, communications, water and energy.

10 - Reducing inequality- Mining companies can support local decision-making processes regarding the mining operations, the equitable allocation of benefits and the resolution of grievances. Engaging communities helps companies identify and expand opportunities to strengthen the voice and influence of marginalized groups, including women.

13 - Climate Action-Mining can lead the way on creating clean energy infrastructure that local communities can help build and access. It can also lead to creating circular resource models to help curb emissions and tackle climate change.

15 - Life on Land:- Making mines more sensitive to local habitats and other ecological considerations are crucial if the industry is committed to helping preserve natural capital.

So, it may be better to ask not whether mining is sustainable per se, but whether it can be made more sustainable. Afterall resource use is not going to stop overnight, even amid a COVID-19 pandemic. The above recommendations show that many areas can be improved.

What does mitigation look like in mining?

The potential for harmful environmental, social and economic consequences is ever-present in the mining industry, especially if it is left unregulated. To mitigate that risk, as mentioned in the previous section several technologies and strategies can help mining operations be more sustainable and cause less harm.

Operational safeguards such as those set out by the proposed Strategic Minerals Association (SMA) could help mitigate social harm and human rights violations if implemented. An SMA, as proposed by the Massachusetts Institute of Technology (MIT) would be a UN agency tasked with policing mineral extraction and mining activities. It would encourage the development of new technologies in the strategic mineral industry as well as providing loans for the implementation of new sustainable resource extraction technologies.

Glencore and WEF - partnering for change

Glencore is a huge player in the mining industry and it is also leading the way in making its operations more sustainable, transparent and accountable. To do this, in 2019 Glencore and six other mining companies began a partnership with the World Economic Forum (WEF) to share ideas to help better mitigate sustainability risks and ensure responsible sourcing.

The partners use blockchain to share data so that efficiency improvements can be made and shared for maximum positive impact. The data is also helping improve carbon reduction reporting, enabling better emissions mitigation measures to be adopted. These partnerships could offer real insight into the future of mining. You can read more at the WEFs mining and metals page.

Mining Sustainably - Mitigating Risk

Thankfully, the global community of political and business leaders are making solid progress in creating more sustainable societies. Despite the challenges, there is also a lot of optimism amongst nations and CEOs such as Tesla's Elon Musk about our ability to achieve the UN 2030 Agenda and the Sustainable Development Goals (SDGs). Mining and its associated environmental and social impacts are increasingly coming to the fore, especially with the wide-scale adoption of the TCFD and TNFD reporting guidelines (a set of reporting guidelines to help companies formulate responses to climate and nature-related risks).

Mitigation of ESG risk is now becoming expected as the new normal for most industries. ESG stands for Environmental, Social and Governance and is increasingly used by companies to understand sustainability risks and manage and improve impact. This new and increasingly ubiquitous approach to risk management presents the mining sector with perhaps its greatest challenge and its biggest opportunity to improve its impact. Not only that, but it can also help reputationally, attracting and retaining shareholders and stakeholders.

According to the Environmental Evidence Journal, mitigating risk in mining includes implementing measures to "avoid, eliminate, reduce, control or compensate for negative impacts and ameliorate impacted systems". This is done at the site and strategic level through Environmental Impact Assessments (EIAs) and Social Impact Assessments (SIAs).

Arctic mining - Unusual sustainability risks

The Arctic contains substantial mineral resources, and this has meant it has attracted mining activities for several 100 years, and this is still increasing. Yet, this puts pressure on the local Sami people who are having to fight for land rights as extraction sites grow and proliferate. The Sami practice of reindeer herding relies on these land rights.

In a report by The Sustainable Development Working Group (SDWG) of the Arctic Council 2011, mitigation measures recommended include stakeholder engagement and local consultations. Yet given the size of the issue true social mitigation solutions seemed sparse in the lengthy report. The report does however deal comprehensively with environmental risk. Including many of the new technologies and practices included in this article.

Aerial view of Agnico Eagle's Meadowbank Mine, an open-pit gold mine located in the Kivalliq region of Nunavut

UK sustainability reporting - Mining industry must keep up or fail

As early as 2014, industry experts spoke of the industry's shift from a technical risk focus (ie on safety and cost metrics), to more of an ESG and stakeholder-led focus on reducing social and environmental risks. This ESG trend is here to stay, says mining consultancy Hill Dickinson and that if mining companies fail to prepare they must prepare to fail. This is backed up by UK's Financial Reporting Council's (FRC) new 12 principle Stewardship Code 2020. The code is clear that ESG and climate change are now material issues for investors and wider stakeholders.

Despite the growing calls for more sustainable mining, significant challenges are remaining: over the last two decades, mining output has shifted from developed economies such as Europe to underdeveloped economies such as Chile, the Congo and South Africa among others. The stringent environmental and social standards in developed nations are not yet met by these emerging economies presenting a problem of accountability for the sector to address if it is to become more sustainable.

United States - Barrick Gold leads on ESG

Barrick Gold is a great example of how industry players can get to grips with ESG and sustainable mining issues. Barrick takes a simple risk vs. impact matrix as its starting point to identify the most material issues. To do this it uses early dialogue with stakeholders to identify issues ahead of time, helping minimise wasted capital expenditure, social harm and needless environmental degradation.

Barrick's Sustainability Executive Grant Beringer stated in a press release in April that the firm is committed to transparently measuring and reporting performance by developing "a sustainability scorecardto rate our ESG performance".

Barrick Gold mitigation hierarchy applied to biodiversity.

Sweden identifies 6 key sustainability focus areas

Mining stands at the forefront of ensuring we can power society and provide resources that will enable a clean energy revolution. Much of minings output will still be needed well into the future, even with a cleantech revolution. This means there is an enormous opportunity to do good and also a large possibility of getting it very wrong. Thankfully a recent project in

Sweden run jointly by the Stockholm Environment Institute (SEI) and Svemin (the Swedish mining and minerals association) between 2018 and 2019 could provide some answers.

Its question: how could the mining and minerals sector contribute the materials needed for sustainable development while also transforming its own operations to more sustainable ones?

The project identified 6 key areas for the industry to focus on. There are respectively:

1. Make mining a hub for circular-materials use- This can be achieved by enabling circular supply chains with buyers and partners

2. Work with communities to define sustainable mining locally- By engaging local communities potential problems and environmentally sensitive data can be assessed ahead of operational projects.

3. Develop more robust permitting processes- This will require pressure from within the industry to align its activities and create an assured process that is transparent, much like those being developed in forestry through initiatives like the Rainforest Alliance.

4. Encourage transparency and traceability- Tougher human rights standards and accountability is needed to remove the potential for modern slavery and other worker abuses that hinder social sustainability.

5. Strengthen both national and local engagement-Through lobbying and working with governments and other official bodies to find targeted and tailored solutions in each jurisdiction and ensure supply chain assurance is joined up across borders.

6. A more collaborative approach to sustainable raw material supply- By working with local communities and also consumers, the industry can help make sustainable materials the norm (for example in construction projects). This could be developing standards and trademarks that say how sustainable a product is in relation to the mining of its raw materials

The project emphasised the need for better management of human rights impacts from mining by addressing land-use conflicts more holistically. It also called on the industry to build out ideas of “zero-impact mining” into reality by addressing the surface impacts of mining activity.

Seven important sector trends say WEF

These ambitions were echoed by the World Economic Forum (WEF) that identified seven trends for the sector to utilise as part of the industry's role in achieving the Global 2030 Agenda for a sustainable future.

These include transitioning to a low carbon economy by providing less carbon-intensive materials and by using renewable energy to power mining operations at the site level. It also emphasised the potential of targeting mining using AI so that only areas known or likely to be rich in metals and minerals are exploited, thereby reducing the needless environmental impacts of unproductive mines. The WEF calls for more adoption of in-situ leaching. This is where minerals such as copper and uranium are captured using boreholes, which are less disruptive than strip mining for instance. Then there is a renewed focus on bio-mining that extracts metals from ores and other solid materials by using prokaryotes or fungi.

The Future of Sustainable Mining

A future sustainable mining industry can only be created, says the WEF, if it is financed sustainably. It encourages alternative financing solutions such as royalty and metal stream agreements which can reduce the burden on the balance sheets of mining companies' indirectly helping to finance the changes needed toward cleaner technologies. It also called for a social contract for mining which addresses geopolitical issues that can exacerbate environmental harm. It also sees the use of big data as vital to hold mining operations to account on environmental and social breaches and to create a modern and safe mining workforce.

It is also worth considering the potential of wider market forces to enact change more quickly. For example, if the markets for EVs do take off in the next decade, it may spark a wider call from consumers for even safer, more sustainable supply chains, putting mining once again in the spotlight as EV owners, for instance, demand environmental best practice. It is important then, that the mining industry gets started now so that it can position itself as a problem solver rather than a problem generator, as public and private scrutiny inevitably increase exponentially up to 2030 and beyond. This is already happening according to Andrew Winston at the Harvard Business Review (HBR), who states that the mining industry is starting to adopt a 'beyond regulatory compliance' approach which Winston says "is becoming critical" for the mining sector if it is to address both the risks and opportunities being ushered in by "environmental and social pressures."

Chilean copper - A microcosm of a megatrend

Chile is a huge player in the Copper mining business. The country produces around 25% of the copper output with China its largest buyer, using 45% of the world's copper. There are risks on the horizon though, with ore grade richness down from 4% a century ago to just 1% today. In other words, more earth must be dug up to find the same amount of copper. This has meant total energy use for the copper sector has increased by 46% between 2006 and 2016.

Thankfully Chile's recent signing of the Paris Climate Accord is turning energy use in the other direction. It's enhanced climate plan includes a commitment to reduce harmful emissions by 30% by 2030. Chile's mining industry has therefore stepped up its use of renewables such as Solar to power its mining operations, given its sunny climate. With ore grade richness still decreasing, however, there are still questions to be asked about the ultimate sustainability of mining copper at all.

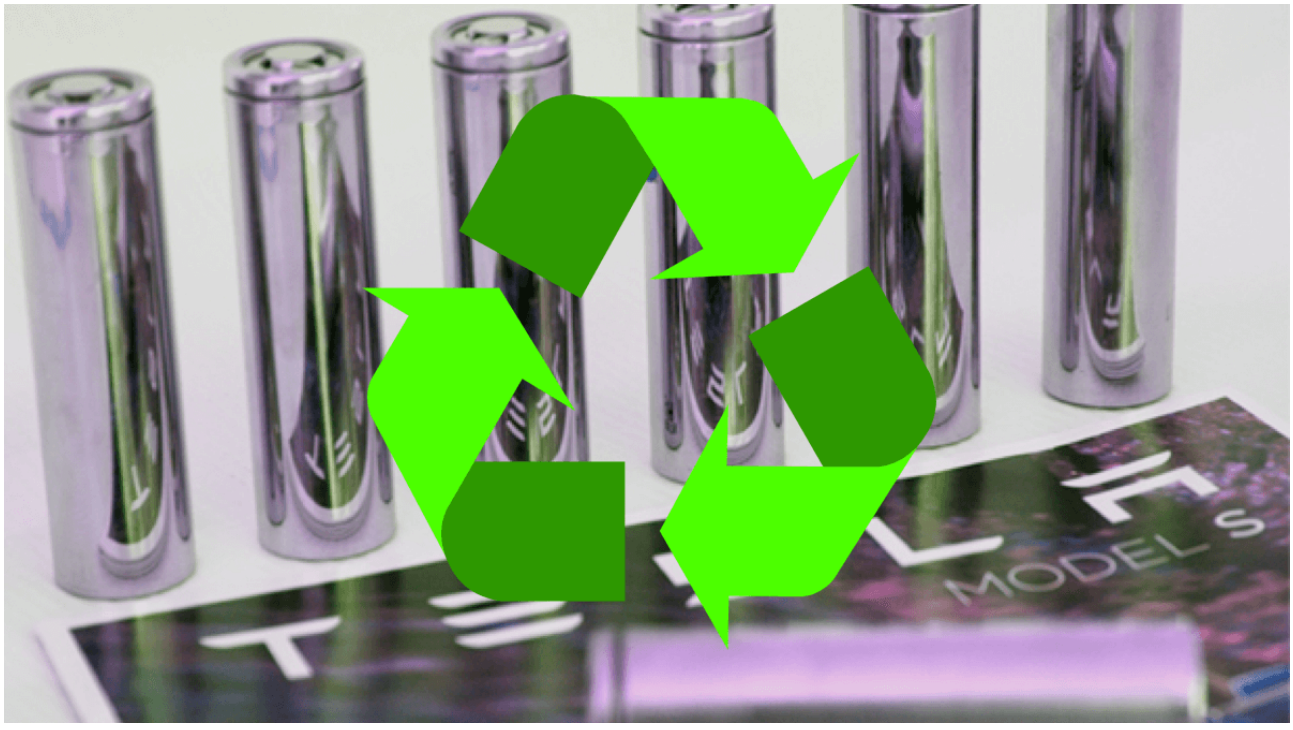
Abengoa's solar thermal plant - South America's largest power plant

Neometals are leading the way in battery recycling

Neometals is one company that seems to be enabling a more sustainable mining future by seeing “the upside” of sustainable mining as Andrew Winston puts it in a recent CRUX Investor interview. The young firm along with many others seem poised and ready for an explosion in the EV market by positioning themselves as experts in the battery metals recycling space.

In our interview with Neometals CEO Chris Reed & general manager Jeremy McManus, Reed stated that the mining company would “recycle every Tesla battery for free, forever” in a call to Elon Musk that they are ready to help move the dial on the EV battery supply chain. It’s also an excellent example of mining industry players making real efforts to capture some of the potentials of a circular economy approach that is crucial for the industry’s long term sustainability.

Neometals has also entered into a binding deal with German metallurgical equipment supplier and plant construction company, SMS Group GmbH, to establish a joint venture to recycle lithium-ion batteries. This is just one private sector-led example of a shift we are seeing in the mining space. Other broader initiatives are also leading the way on improving ESG performance in the industry such as the Responsible Cobalt Initiative, with Panasonic signing up (Tesla’s principle battery supplier). Elon Musk stated that Tesla would eventually eliminate cobalt from its batteries.



The way forward

It is clear from the examples given in this article that there are many potential ways to make mining more sustainable. It is also good to see some commonalities in the suggestions of different stakeholders and the practical possibilities that have been suggested to mitigate environmental and social risks.

Perhaps this growing consensus reflects a broader trend in the sector as a whole to better grasp the opportunities that sustainable mining practices will undoubtedly create. These trends are also increasingly being reinforced by political and regulatory pressure such as the Responsible Cobalt Initiative.

It is probable, therefore, that the industry will start to find ways of building in more prescriptive accountability for mining firms and their stakeholders to engage with. In the meantime, there is much to be done, and companies like Neometals and Barrick Gold are leading the way proactively. Other mining players and investors should take note.