Jayanta Bhattacharya
Hony. Chief Editor

MINE AND RETURN™

Why looking away from the circular economy in mining will be foolhardy for the industries

Background

The 'circular economy' ethos rejects the ephemeral approach of more traditional manufacturing (wherein goods or products are made, used and then disposed of) in favour of a more efficient, environmentally sound and sustainable way of thinking that focuses on the careful management of resources. In the circular economy, products are designed for high performance and durability (rather than inbuilt obsolescence) and the use of raw materials is optimised – including the intelligent re-use of any waste products created during the manufacturing process.

At the end of a product's life cycle, the resources used to create it are, where possible, recovered, recycled or re-purposed, creating a responsible, restorative and regenerative cycle that 'designs out' unnecessary waste. With the rapid rise of global recycling and shift to the circular economy, mining and metals companies are under increasing pressure. How can they safeguard their existing market share while competing with new players for a slice of the fast-growing recycling market? Rising downstream demand is creating risk as more innovative players capitalize on new opportunities to monetize circularity. Look at the opportunity side:

- 40% of steel produced is now made from scrap metal.
- 41 mobile phones can yield as much gold as one tonne of ore.
- $4.5 trillion of opportunity from eliminating waste through the circular economy.
- 78 million tonnes of global electronic waste is predicted to be produced by 2026 as electronic devices become more widespread, and demand for gadgets increases.

How it applies to mining

The cyclical approach to manufacturing and resource management is particularly well suited to the mining and metals industry. On the whole, metals are infinitely recyclable, while their inherent durability, strength and anti-corrosive properties help to enhance the longevity of products in which they're used. The high value of many metals and minerals also incentivises the recovery of such materials at the end of a product's life cycle, and hence there are many methods in place to facilitate their re-use and recycling.

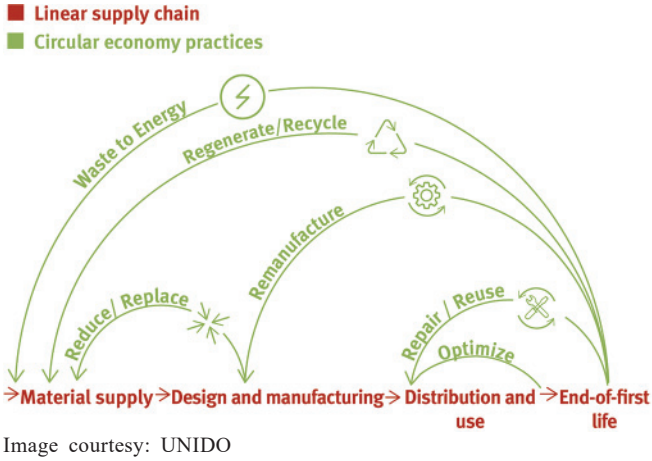

Image courtesy: UNIDO

The sites of mining operations also have much scope to adopt a circular approach to business. As well as considering the environmental and societal impact of their operations, mining companies can, and do, take steps to minimise negative effects, share best practice and reduce waste. For mining and metals companies, the issue is twofold: first, they're not always well positioned to monetize the new recycling flow; and second, increased circularity will likely impact primary demand as waste and material losses are reduced. Changing supply chains and new business models are raising questions about the future-readiness of incumbents. And, as the global recycling market matures, they must adapt fast. The challenge for mining and metals companies is to work out where best to target their efforts to take advantage of the circular economy.

Rising to the recycling challenge

Mining as an industry creates much in the way of waste – from rock and emissions to water treatment sludge and mine

water – and this too can be reused, either within the production chain or re-purposed elsewhere. Waste rock, for example, is often used as backfill, as landscaping material or as aggregate in road construction, while sludge from acid rock drainage treatment – which is high in iron – can be sold commercially for use in pigments. Other by-products of the mining sector can be re-used for making construction materials (such as bricks or cement), resins, glass and glazes, in agroforestry, or as part of the wastewater treatment process.

The smelting and refining stages of the minerals and metals life cycle also have their own waste streams that need to be addressed, via the processing of residues and secondary metals. These are often used alongside primary concentrates, for example, to produce metals with varying amounts of recycled content, while electronic scrap (from the 'urban mine' of discarded home appliances, computers, phones et al) can also be re-purposed as part of this process.

The report drills down into the impact recovery, reprocessing and reuse of metals is having on the industry. With an understanding of these trends, you can target your investments, business models and innovation where they will be most effective.

Innovation in action

While the challenge for mining and metals companies is to work out where best to focus, a small cohort of mining and metals companies is taking a lead. These visionaries, including Rio Tinto, Arcelor Mittal, Codelco and Novelis, are acting on the market shifts and developing new circular business models to support their customers and respond as requirements change.

The good examples

- Mineworx, Canada will see platinum group metals (PGMs) recycled from used catalytic converters.
- JX Nippon Mining & Metals recycles and re-purposes a wide variety of materials, from end-of-life mobile phones to industrial waste oil, via its own environmental services companies. Of the total volume of waste materials the group generated in 2015, 83% was re-used internally, while, in its copper recycling system, around 26% of its total scrap production is recovered.
- Mitsubishi Materials has adopted a group-wide recycling-oriented business model, recycling materials and resources across a wide range of fields and throughout its activities, including home appliances, aluminium beverage cans, tungsten and palladium. Smelting technology is used for the purpose of recycling metals at Mitsubishi's smelters and refineries, alongside the recycling of scrap for raw materials, thermal energy or recovery of valuable metals. The company also takes in clinker dust as a by-product from its cement plants, and use components like calcium as auxiliary raw materials for smelting. After use, clinker dust turns into copper slag, which is then recycled back into raw materials at the cement plants. Mitsubishi also recycles and recovers rare metals, as well as undertaking ongoing expansion of its pre-processing combustion, sampling, analysing and processing facilities, which are crucial to effective recycling.
- Sumitomo Metal Mining plans recovery rates of copper scrap almost doubling in the five years following 2010. High-purity copper scraps are processed directly in its Toyo smelter and refinery, while e-scraps (as found in circuit boards, for instance) containing low-grade precious metals and copper are pre-processed in Sumitomo's subsidiary company Oguchi Electric, before being delivered to Toyo for processing.
- Comstock Mining, a Nevada-based miner aims to improve the recovery and removal of mercury from mine tailings.
- VTT's MetGrow + project, a collaboration with 19 companies, research organizations, and universities from nine European companies is a $8.7m initiative to find ways to improve recovery of a number of waste minerals, such as cobalt, nickel and zinc, and improve Europe's self-sufficiency with regard to metal production. They plan to increase waste mineral recovery by up to 20%.
- Mint Innovation, a New Zealand technology start-up that uses microorganisms to recover metal from waste streams. The technology is unlike anything else in the mining sector, with the company envisioning a "bio-refinery" to recover gold from waste in a two-stage process.

To succeed, mining and metals companies reposition. Fast

To keep pace with the front-runners, all mining and metals companies must assess where the risks of decreased demand or substitution loom largest. It's vital to understand which materials can be recovered most effectively and know where downstream changes present threats and opportunities. Then, with the right business models, these companies can accelerate the transition to the circular economy with confidence.

Three steps to embrace circularity

a. Imbibe circular operations

Start by accelerating circular initiatives across mining and metals operations, for example, using real-time monitoring, analytics and predictive maintenance while promoting remanufacturing and end-of-life recycling.

b. Innovate new circular products and services

Secondly, engage with downstream users of your materials to co-create innovative circular products and services, enabled by advanced technologies to facilitate better recovery, reprocessing and reuse.

c. Build a circular partners' ecosystem

Finally, collaborate proactively up and down your supply chains to drive industry momentum and create a more

favourable environment to retain ownership and benefit from extended product lifecycles and improved circularity.

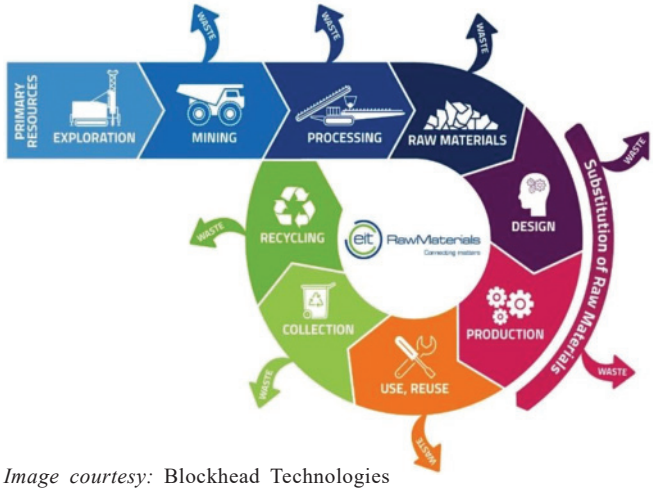

Image courtesy: Blockhead Technologies

Role of digital technologies

Digital technologies (DTs) could be critical enablers of CE by tracking the flow of products, components, and materials and making the resultant data available for improved resource management and decision making across different stages of the industry life cycle. As such, DTs can play an important role in positioning information flows that enable resource flows to become more circular. For instance, the Internet of

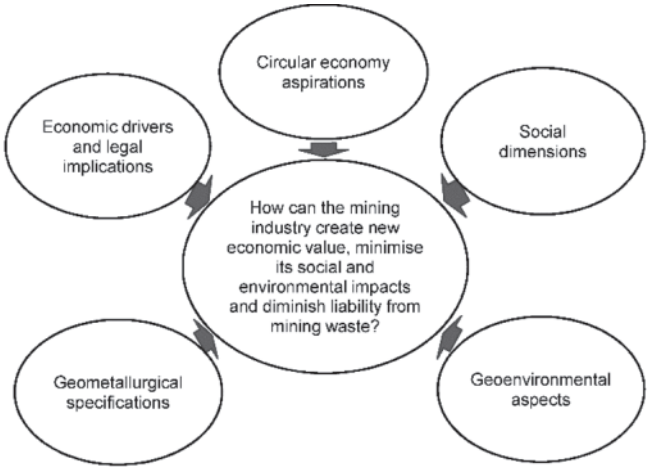

Image courtesy: mdpi.com

Things (IoT) can enable automated location tracking and monitoring of natural capital. Big data facilitates several aspects of circular strategies, such as improving waste-to-resource matching in industrial symbiosis systems via real-time gathering and processing of input-output flows. Moreover, data analytics (simply known as analytics) can serve as a tool to predict product health and wear, reduce production downtime, schedule maintenance, order spare parts, and optimize energy consumption. These examples illustrate that DTs' contribution to the CE include a range of circular strategies and business processes: from recycling to reuse, and designing new offerings to managing maintenance.