SUSTAINABILITY IN MINING

There are many meanings of ‘sustainability’ and it has become synonymous with ‘environmentalism’. Nonetheless, at its core there must be continuity, preserving the natural environment for future generations. The issue is whether we would preserve the current degraded natural environment, or work for a better version, and to what extent?

The current and very topical climate debate should be seen as a major element of ‘sustainability’ along with other issues: water scarcity, overfishing, degradation of farmland, endangered species and atmospheric pollution1 - and many more.

Mining sustainability is a contradiction. Mines have beginnings, middles and ends, and every mine will eventually close, leaving at best a diminished resource for future generations. The best hope is leaving the original land in the same or in better condition, which could mean turning the open-pit into wetlands or a boating lake, the waste dumps into flat agricultural land, and so on.

Other than rehabilitation, sustainability in mining has many meanings. The Guardian newspaper quotes ‘stewardship’ and stresses socio-economic factors2; Transparency International of Canada discusses corruption3; while other authors consider, inter alia, energy efficiency, climate change and water scarcity. Nonetheless, in this article, I have narrowed it down to the technical aspects that are within the control of mining operations such as energy usage, equipment efficiency, water scarcity and rehabilitation.

Nonetheless, the ‘elephant in the room’ is climate change. I have no intention of wading into the hot and deeply divisive politics of anthropomorphic global warming, nor take sides on to what extent human activity is contributing to warming. Nonetheless as good corporate citizens it behoves miners to reduce atmospheric emissions and reduce our carbon footprint for many reasons such as clean air, preserve diminishing petroleum resources, planting forests, as well as mitigating climate change.

Electrical Power

A problem faced in many mines is to obtain enough power. Requirements can vary enormously from a few to several hundred megawatts. Getting power from a country’s national grid can be difficult through grid capacity, remoteness, terrain, environmental and social permitting, and extremely expensive. Many mines instead rely on diesel generators or in the case of Cobre Panama, a build your own 300 MW coal-fired power station.

Some mines are looking at sustainable power such as B2Gold’s 7 MW solar power plant at Otjikoto in Namibia4. The Diavik diamond mine in Canada’s North-West Territories has installed a wind farm producing 9.2 MW5. However, these are somewhat isolated examples and more needs to be done to encourage sustainable energy in the sector.

The Harvard Review6 points out that solar costs have dropped by 80% over the past decade and that the cost of battery storage is making electric vehicles more competitive. Given the environmental pressures on building long-distance powerlines, it can be

2 ‘Sustainable mining: an inherent contradiction in terms?’, The Guardian, 05 January 2015.
4 Mining Journal, ‘Sustainability Strategies in Mining’, Anne Van Riel, 12 April 2018
expected that the mining industry, generally shy of new technology, will consider solar and wind farms as solutions for their power-hungry requirements.

**Mine trucks**

All the major countries have strict vehicle emission standards and it would be suicidal for an OEM (original equipment manufacturer) not to meet those standards. They are cognizant that most major mining regulatory authorities insist on measuring and reporting emission standards. Meeting those standards assumes the equipment is kept in good condition by efficient and OEM-supported preventative and predictive maintenance programs.

There is a tendency to move towards hybrid diesel and electric fleets. Trolley assist is being employed in several First Quantum mines for uphill haulages which saves on diesel and considerably increases uphill speed.

The next upgrade from trolley assist is to use the all-electric truck. Caterpillar have introduced the 795 AF ultra-haul truck that carries a payload of 345 US tons.

While the electric mine fleet produces effectively zero emissions it cannot be widespread until mines sort out their electric supply issues, and in my experience hybrid and electric trucks are not tolerant of poor road construction. Haul roads need few irregularities (or the truck loses power from the overhead pantechnicon), and are preferably sealed.

Another energy-saving means is to reduce truck haul distances by using conveyors and in-pit crushers, or place the crusher at the top of the main pit ramp. Overland conveyors then transport the crushed ore to the plant. Cobre Panama has four large in-pit crushers matched to the ultra-trucks, and the Ixtaca project in Mexico will have the crusher located by the pit entrance.

**Water scarcity**

Water is a scarce resource in many mines, and in some countries there are prohibitive regulations on abstracting from rivers or pumping groundwater. The Esperanza mine in Chile is constructing a seashore desalination plant and intends to pump the water 145 km to the mine site. The Ixtaca silver and gold project plans on using a complex system of surface water collection for the plant and also to supply the local communities with fresh water.

**Rehabilitation**

Most mining regulatory authorities insist on a mine closure plan including a full scheme of rehabilitation that should leave the terrain in an equal or better state than the mine found it. Most legislatures also require payment of a bond to cover the rehab costs. To quote the Mineral Council of Australia:

*The industry’s approach to land rehabilitation has improved significantly over past decades. We work to improve rehabilitation methods to ensure mining’s compatibility with current and future land uses such as farming. Mining companies understand land rehabilitation is fundamental to responsible mining. It is a critical factor for ongoing community acceptance and a key indicator for corporate reporting.*

However, this somewhat rosy picture can be compromised by tailings ponds. Tailings consisting of finely ground rock particles, toxic chemicals, minerals and water, are the waste products from mining, often in a slurry or solid form.

Tailings dams can be huge - every tonne of ore sent to the process plant produces essentially one tonne of waste. Dams can be created by the ‘upstream’ method which uses the tailings themselves to form a barrier. Several upstream dams have failed,
sometimes spectacularly, such as Brumadinho, Brazil, in January 2019, which left over 300 people dead.

The rehabilitation of tailings dams can be difficult given their physical instability and chemistry. As described by the government of Victoria, Australia\(^7\), the dam should be fully dried out to allow machinery on its surface. The walls are stabilised by battering down to a lower angle, and cut-off drains are installed to prevent flows on to the surface. Tailings that are excessively acid or have high levels of heavy metals have to be capped and further treated by lime and other chemicals.

Dams then have to be maintained in perpetuity. Doubts have led to the development of filtered (solid) tailings and cyanide alternatives.

**Copper demand**

The Harvard Business Review\(^8\) points out that copper production is likely to increase owing to its role in green technology. Copper is an essential element of electric vehicles, batteries, solar panels and wind turbines. According to the Copper Development Association\(^9\) in the Vestas Model V47 and Vestas Model V80 rated at 660 kW, the motor windings contain approximately 800 lb (363 Kg) of copper. Another source\(^10\) states that for every megawatt of wind power about 3.6 tonnes of copper is needed – and for every megawatt of photovoltaic solar capacity, about 4 to 5 tonnes of copper is required. Furthermore, three times more copper is required for electric vehicles in comparison to conventional petrol driven vehicles.

Against the forecast of rising demand for copper, grade of copper is down from 4% some 200 years ago to under 1% now\(^11\), and it is still falling. The Harvard Review believes that the copper industry is going to hit a crunch point unless the industry itself uses new technology to mine lower grades.

**Conclusion**

Mining has some way to go to achieve ‘sustainability’, but a part of the problem is the loose meaning of the term. Ore bodies are finite resources and although technology allows economic extraction of lower grades, they are not sustainable resources in the way a forest or a lake is. Hence achieving sustainability is really being good environmental stewards in protecting flora and fauna, conserving energy and water, improving local communities and a whole plethora of activities. Nonetheless, many mines have recognised the need and spend prodigious amounts of money on environmental and ‘socio-economic’ protection, which is increasingly required as part of the operational permits by governments world-wide.

However, one perhaps unexpected consequence, is the need to at least continue the extraction of copper and other metals – and rare earths – if not to increase production. Green technology is a heavy user of several metals, especially copper, and rare earths. Without some tolerance of mining the Green Revolution will not succeed.

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\(^8\) Harvard Business Review, ditto

\(^9\) https://www.copper.org/environment/green/casestudies/wind_energy/wind_energy.html

\(^10\) https://www.visualcapitalist.com/copper-driving-green-energy-revolution/

\(^11\) Harvard Business Review, ditto