

THE INDIAN CHAMBER OF COMMERCE (ICC)

SUSTAINABLE MINING

EVOLVING THROUGH TECHNOLOGY, GOVERNANCE,
SOCIAL AND ENVIRONMENTAL STEWARDSHIP



2ND INDIA MINETECH
A SEMINAR ON MINING TECHNOLOGY

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FOREWORD



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The ever-growing population and urbanisation in developing countries along with requirements of the developed world has set the demand on a consistent growth trajectory for metals and minerals. Heavy demand generates mainly due to the aspirations of millions of people around the world seeking a better standard of living. India has immense potential for mining resources and reserves and is currently among the top 10 global producers of many minerals.

Developments are taking place rapidly and many companies in this sector are expanding their operations and are working on new projects. As the industry focuses on adapting international levels of technology, there exists untapped potential in the Indian mining equipment sector. This has necessitated calls for innovation in the mining ventures. According to a recent global research study, using the Internet of Things (IoT) to turn mechanical processes into digital ones through automation technology, will be absolutely crucial to achieving this. The future of mining will ultimately rely on combining human creativity and experience with technology's ever more sophisticated ability to collect, process and analyse vast quantities of data, and effective adopters will be able to overcome the industry's current challenges through increased productivity and efficiency, and the redeployment of the human resources to more sophisticated roles as automated technology takes on more hazardous tasks.

Activity in the mining sector is integral to modern life, with minerals mined across the world playing a vital role in the life cycle of both businesses and consumers. The societal impact and resource efficiency have been ever present challenges for this sector. The Sustainable Development Goals (SDGs) for 2030, present a prospect to convert existing challenges in the sector into opportunities. For companies involved in mineral extraction, this means identifying opportunities and to analyse their specific actions and its impact on the social, environmental and economic conditions of the local community and other stakeholders through engagement.

The key lies in technological innovation and adaptation. The industry needs to focus on enhancing sustainability of their operations by adopting technologies which carries efficiency advantages in process as well as resource consumption. Along with technology, the sector needs to reinforce robust governance framework, deeply engage and address stakeholder needs and instil environmental stewardship.

Against this background, **Indian Chamber of Commerce (ICC)** is organizing the **2nd edition of India MineTech- A seminar on Mining Technology on 30th January 2019 at Bhubaneswar, Odisha. Thinkthrough Consulting Pvt. Ltd. (TTC)** has joined hands with ICC as the Knowledge Partner for the summit. We hope this platform will bring together various major players in the industry to share, discuss and evolve suitable sustainable strategies through technological interventions.

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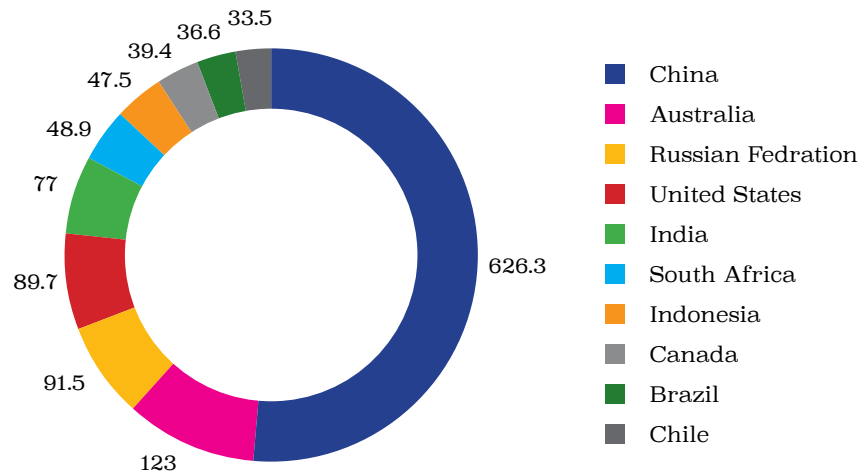
Mining Sector: Global and Indian Scenario

Mining industry is a great contributor towards the economy of the world. Currently, the mining industry shows a strong financial position around the world, with estimations that top 40 companies globally contribute more than USD 32 billion as taxes, while having a net profit margin of 12%. In addition to this, large investments in Latin America, parts of Asia and Africa indicate a boom in the mining sector.

Globally, China's economic growth has been phenomenal, and to facilitate this growth, the dependence on minerals and metals has been enormous. In 2016, China became the largest producer of metallic minerals and coal, with a production value estimation of USD 626.3 billion, which is more than the combined production of the next 9 countries in the top 10 producers of the world.

The industry in India is characterised by small mining operations in a large number, with more than 1,500 reported mines (2017-18) engaged in mineral production activities (excluding atomic, fuel and minor minerals)¹. Mining activities in India are geographically concentrated to central India and this mineral ore concentration leads to the top 10 mining states accounting for 94% mines in India (2017-18). There are 95 minerals of 5 broad categories mined in India, out of which 4 are fuels, 10 metallic minerals, and 3 atomic minerals while 55 are minor minerals (including building and other minerals). Coal is the largest mined commodity in India with 676.51 million tonnes of extraction in FY18 followed by iron ore and steel with production amounting to 210 and 102.34 million tonnes, respectively. In terms of value in India, diamond

Top 10 Metallic, Mineral and Coal Production Countries (USD Billion)



Valuation of metallic minerals and coal production in 2016 (USD Billion)

Source: ICMM, 2016

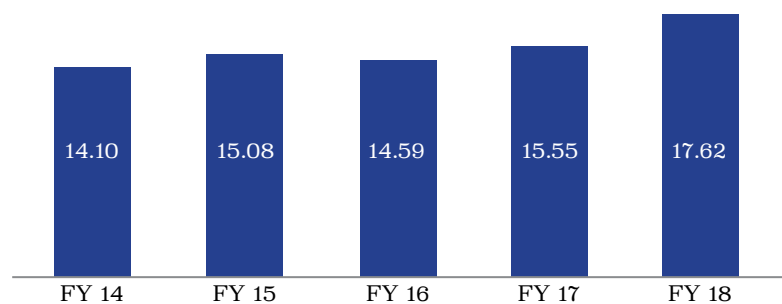
is the most valued traded mineral with the world, while other minerals show an increase in exported value after a stagnation period from 2014-16.

The growth in the Indian market is driven by the increased demand in infrastructure development and automotive production. In addition to these, cement and power industries aid the growth in metal and mining sector. Exports also contribute to the growth with India holding the advantage of cost

of production and conversion cost for steel and alumina, while the geographical location contributes towards the ease of exporting to develop as well as developing Asian nations.

The mineral production in India has been estimated to be valued at USD 14.10 billion (excluding atomic, fuel and other minerals) during 2014-15, while contributing to Gross Value Addition (GVA) of 2.3% to Indian economy, while showing a continuous growth.²

Mineral Production in India (in USD Billion)



Value of mineral production in India (excluding atomic, fuel and other minerals)

Source: India Brand Equity Fund

¹Ministry of mines, annual report, 2017-18

²India Brand equity fund, 2018 (<https://www.ibef.org/industry/metals-and-mining.aspx>)

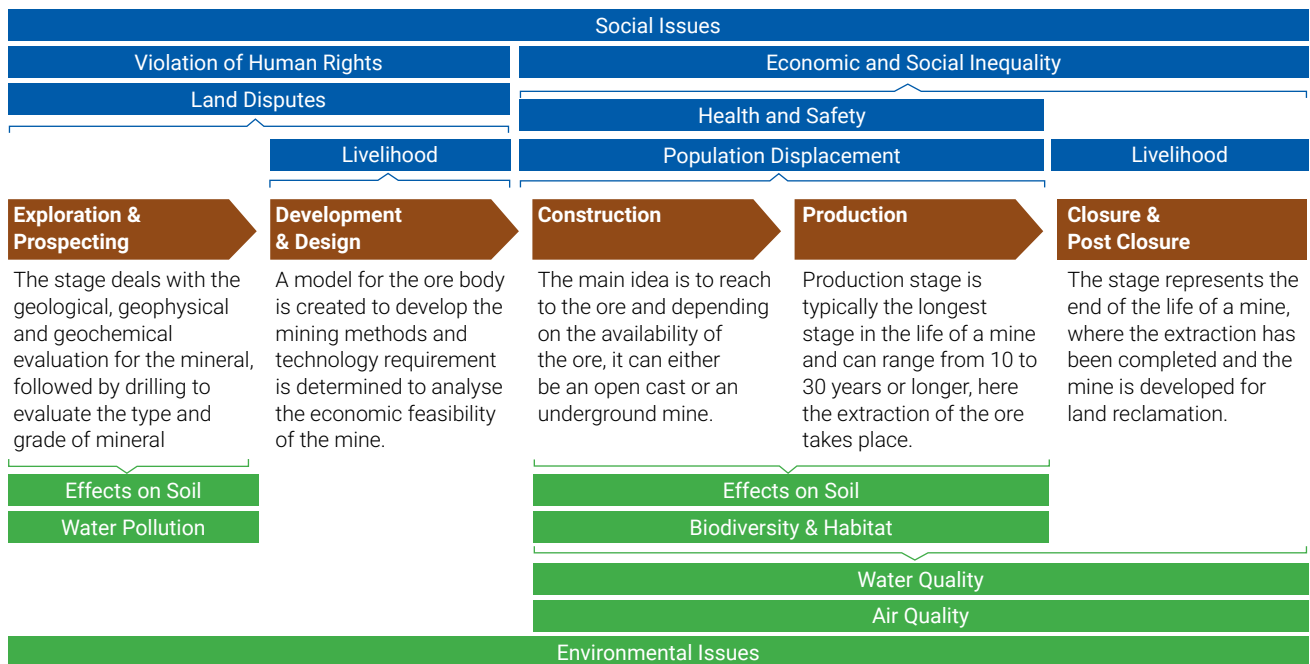
Sustainability Issues in Mining: A Social and Environmental perspective

The mining sites are generally in remote and underdeveloped locations including indigenous lands and territories which are often ecologically sensitive. Mining industry has the potential to impact the Sustainable Development Goals (SDGs), though historically a negative impact has been recorded that works against the achievement of the goals. In an Atlas published by World Economic Forum and UNDP, the SDGs have been plotted against the issues in mining sector³.

The primary impact of the mining sector is not limited just limited to environmental issues but also to a broad range of social issues that it gives rise to in the mining value chain. Some of the issues have been highlighted below and have been mapped to the value chain of mining.



Mapping and the 17 SDGs: A selection of major issue areas where mining may have an impact on each of 17 goals
Source: Mapping Mining to the Sustainable Development Goals, An Atlas, 2016



Mapping the issues in mining value chain

³ Mapping Mining to the Sustainable Development Goals: An Atlas, 2016 (<http://unsdsn.org/resources/publications/mapping-mining-to-the-sustainable-development-goals-an-atlas/>)

Environmental Issues

Air



Mining activities affect the air quality starting from the construction phase, as when material deposits are exposed at the site, unrefined material in the form of particulate material are released to air due road traffic and wind erosion. The particulates can affect human health through respiratory systems and absorption through skin or ingestion.

Water



- Water pollution is caused by metal contamination, acid mine drainage and increased sediments in streams. The damage comes in the form of acid rock drainage and dissolution of heavy metals in the ground water.
- The industry is water intensive as with the decline in the quality of the ore, the water required to extract the same amount of ore increases increasing water usage. Excess water also creates issues as it leads to effluent leakage.

Soil



Mining causes physical damage to the land with open pits and piles of waste rock, which leads to the deterioration of flora and fauna of the area with the features that may not return to the landscape after the mining activity is complete. The underground mining on the contrary can lead to collapse of overlying sheets creating sink holes in the ground.

Biodiversity



Mining poses enormous threat to biodiversity. The climatic changes in the ecosystem, often endanger the native plant and animal species, which react to the slightest disruptions in the environment.

Social Issues

Illegal mining/ Unregulated mining

In mining sector, the largest issue faced comes in the form of unregulated mining activity. The issue faced here is generally in the form of mining activity that are against the regulation in the form of extracting more minerals than prescribed by the law, while the second form which is more dangerous is in the form of mining at unsanctioned lots which are unaccountable at any end.

Population displacement

Mining projects are accompanied by physical displacement of communities. Resettlement is generally a sensitive issue, with human rights a main concern, and when improperly managed can lead to the damages not only limited to reputation but to the extent of cancellation of projects.

Economic and social inequalities

Mining activities contribute to economies of countries, however the wealth does not necessarily reach the local communities, and the interventions in the community come in the form of companies helping in the local economy, a large number of challenges pop up including unrealistic expectation from the stakeholders involved.

Livelihood related issues

The effect of mining activity on the livelihood of the local community is multi-fold, with the impact starting at the exploration phase, when the land from the community is acquired, leading to the loss of employment for the locals. Also during the closure of the mine after a period of 20 to 30 years, a generation of the locals working at the mine need a new skillset for the smooth transition to a new livelihood.

Violations on human rights

Human rights are often violated at one of more stages, throughout the lifecycle of a mine, and often the victims do not receive help from the Government leading to damages in the community.

Health and Safety

Health hazards in mining, often overlooked lead to dangerous working conditions for the workers. Cases of miners getting stuck in underground mines pose a direct threat while health related issues that accumulate over time lead to catastrophic consequences.



Indra Guha
Partner-Sustainability
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“Mining industry faces increasing pressure in many parts of the world to showcase what activities they are currently undertaking to minimise environmental damage, improve safety performance, embrace diversity and contribute to the communities in which they operate. They are also under enormous observation from society and Government to demonstrate how these challenges will be addressed in the future and how they are being incorporated into their overall business strategy.

Although approach to sustainability will differ in accordance of operational areas and the challenges they face, one thing is clear, mining companies need a sustainable management strategy if they hope to thrive in the future”

Technological Advancements in Responsible mining

Realizing sustainable development is a demanding task, it becomes essential for mining industry to escalate its dialogue with Government, local communities and the other stakeholders. The industry as a whole, in order to realise its potential for responsible mining must work towards the integration of changes in their core business activities in addition to the strengthening collaboration within industry and stakeholders.

1. New advancements in sustainable mining

Technology has the ability to transform efficiencies in any sector, making it a differentiating point for the success of the business.

Mining industry is no exception, the advancements are contribution to greater ore recovery, flexibility, increased productivity and safety, and all while reducing operational cost.

Automation, Internet of Things (IoT) and robotics are shifting the mining sector to a new level. Advancements in gravity gradiometer technology and 3D imaging technologies have equipped companies with better mineral exploring, mapping and designing capabilities, while ensuring a targeted mining operation that leads to minimized environmental damage. The technology enables geologists to create a 3D geological map combining the surface mapping data, in addition to identification of precious metal ores in the mine location.

The designing capability allows the companies to introduce a whole array of technologies, including automated drilling machines which run in sync with autonomous haulage systems that can be operated and monitored from a remote location. This allows companies to maximise efficiency, while decreasing variability and better identification of performance issues.

Vale S.A., Brazil

Innovating through technology



Initiative

Vale, understanding the impact of mining activity established its largest iron ore operation while integrating productivity, innovation and respect towards community and environment



Intervention

The mediation came in multiple dimensions with technological, environmental and logistical interventions throughout the value chain of a mine. Keeping environment in focus, the site was designed to minimise its environmental footprint.

The facility adopted a truckless system, along with mobile excavators and crushers interconnected through long distance conveyor belts measuring up to 9 km, while Internet of things (IOT) ensured that compatible systems communicate among each other for optimal efficiency. Another initiative came in the form of dry processing of the ore in a modular processing plant, established during the development and design phase



Impact

The fuel consumption has been reduced by an estimated 70%, while a water saving has been estimated to be 93%. A combined saving of about 130 thousand tCO₂e and 18,000 MWh/year in GHG emission and electricity, respectively. This has been achieved in addition to 40% reduction in deforested area

Innovation in mining, 2016 (Source: Vale Media release, 2016)

HINDALCO Industries Ltd., India**Technology integration for waste management****Initiative**

HINDALCO, for value-addition in application of process waste material and to reduce caustic soda content in bauxite residue installed a filtration unit at Utkal Alumina.

**Intervention**

High Concentration Slurry Disposal (HCSD) system has been replaced by bauxite residue filtration unit, and the value chain has been linked with cement production in the form of semi-dry bauxite residue cake.

**Impact**

The intervention has enabled HINDALCO to reduce the risk of contamination of ground water with safe disposal of 75-80% of hazardous solids.

Technology integration for waste management (Source: Hindalco sustainability report, 2016-17)

2. Increasing Energy Efficiency of Mining and Processing Operations

Mining industry is energy intensive, limited not only to processing but throughout the value chain. This provides the industry with a unique opportunity to expand possibility of achieving greater energy efficiency, while presenting a roadmap to contribute towards SDG 7: Affordable and Clean Energy.

Bharat Aluminium Company Ltd. (BALCO), India**Energy saving through a closed loop****Initiative**

Working towards the goal of energy conservation, BALCO introduced the concept of closed loop in the smelting process of aluminium.

**Intervention**

In aluminium production, water is used for cooling electrolyte in the rectifier process. Traditionally, the used water is held in hot wells for processing before being pumped to cooling towers. In the initiative taken by BALCO, the water used in the rectifier process is directly sent to the cooling tower instead of being held in hot wells, thus closing the loop in the system for the rectifier pot line.

**Impact**

The initiative has led to the reduction of energy consumption by 2.5 MWH per day, while resulting in reduced consumption of water and chemicals.

Initiative by BALCO to reduce energy consumption (Source: Vedanta Sustainability Report, 2017-18)

Rio Tinto, Australia

Innovating for safety and productivity



Initiative

Rio Tinto, realizing benefits of technology in a company, in 2008 envisioned ‘mine of the future’ to incorporate automation in mining and transport.



Intervention

Rio Tinto has the largest fleet of driverless trucks in the industry. The trucks are in action at their Pilbara iron ore operations, remotely controlled from their operations centre in Perth, 1,500 km away. In addition to safety, the fuel consumption has also been reduced.



Impact

Rio Tinto has been able to transport more than a billion tonnes of ore safely and efficiently, while centralising operations of 16 mines at an offsite location for experience sharing and overall system improvement.

Innovating for safety and productivity (Source: Rio Tinto Media release)

3. Reducing Emissions:

Emissions in mining come in multiple forms ranging from particulate emissions to tailings. Emissions have been a handicap for mining companies around the world as they are continuously trying to find creative methods to reduce emissions directly or indirectly through integration of activities within business operations.

Cairn, India

Revealing hidden capacity for reducing emissions



Initiative

Carrying capacity of pipeline for carrying hydrocarbon condensate separated from the wet gas, transferred using a 150 km pipeline was to be increased.



Intervention

The increased production meant increasing the load on pipe line and usage on alternative methods for transporting the excess through road transportation. To reduce the usage of trucks, a lubricant in the form of a drag reducing agent to reduce instability was introduced into the pipeline. This reduced the drag between the condensate and pipeline wall leading to increased flow and capacity.



Impact

The intervention increased carrying capacity from 3000 barrels to 5000 barrels per day, while reducing GHG emission by 900 tCO₂ equivalent per year by avoiding the use of transporting by road.

Intervention for emission reduction (Source: Vedanta Sustainability Report, 2017-18)

Interventions for Social Impact

Mining industry has a significant social impact on the local community, as it brings along with it a plethora of economic activities and challenges related to human rights and livelihood. The term social inclusion comes in play where companies can take an inclusive approach by working with stakeholders to comprehend the impacts of mining activities. It becomes essential to engage specially with community along with the Government for social impacts to take place.

1. Nurturing local businesses

In some instances, the companies work towards creating social impact through supporting local business by providing technical, managerial support and mentoring to local business for growth and sustainability.

Vale S.A., Brazil

Agir Initiative



Initiative

Vale foundation created an Agir Program in Portugal as a social technology tool focused on incubation and acceleration of local and family businesses. The initiative started in 2013 is present in over 20 municipalities providing support to business for thriving autonomously and sustainably.



Intervention

The support comes in three phases, starting with prospecting, which consists of mapping, training and mentoring of local entrepreneurs, followed by incubation, which focuses on financial management, production and governance, while the last phase concentrates on monitoring and providing autonomy to the business.



Impact

The Agir has benefitted more than 1,000 entrepreneurs and incubated 80 businesses, especially in the recyclable waste, increasing the revenue by 300% while preventing 100 tons of landfill.

Supporting local business (Source: Vale Sustainability Report, 2017)

2. Environmental restoration

Post closure, an ecological restoration activity has to be conducted aimed at creating multifunctional ecosystems in a mine waste dump. Ecological restorations have to be planned well in advance of the closure on the mine and companies are planning and executing these activities enthusiastically.

HINDALCO Industries Ltd., India

Strategizing ecological restoration



Initiative

As a part of the environment protection activities, HINDALCO has started to move towards ecological restoration in the closed mines, by efforts in scientific afforestation, in addition to mine closure plans.



Intervention

A full-fledged in-house nursery spreading over an area of five acres having capacity of 2.0 lakh saplings at Utkal Alumina has been developed to facilitate afforestation at location for ecological restoration.



Impact

The system helps the company in active reclamation of the excavated areas and so far, the company has been able to reclaim 453 hectares of land.

Environmental restoration activities of Hindalco, (Source: Hindalco Sustainability Report, 2016-17)

3. Corporate Social Responsibility: More than a regulation

Mining generates a substantial amount of revenue from operations and taxes, while generating opportunities locally for jobs and businesses. In India, the law encourages companies to devote a portion of the profit towards activities that nurtures a change at the social level. There are numerous examples where companies have incurred a social impact near the operational areas. Mining sector has also taken benefit of this to have social impact through SHG's in rural communities.

MSPL limited, India

Utilizing CSR to drive social impact



Initiative

RMML under its CSR program under Baldota Foundation, facilitated the formation of Self Help Groups (SHG) focusing on women empowerment.



Intervention

RMML has so far organised six months training to 890 women on tailoring and provided free sewing machines to enable them to generate income and also provided basic computer skills to 967 candidates, while creating awareness about leadership and women's rights.



Impact

A revolving fund of INR 85 lakhs has been provided to 110 Women's SHG's while creating alternate credit to 1,625 families.

CSR activity creating social impact,
(Source: Ramgad Minerals & Mining Limited (RMML) CSR Report, 2015-17)



Ajay Pandey

Partner-Development Sector Advisory,
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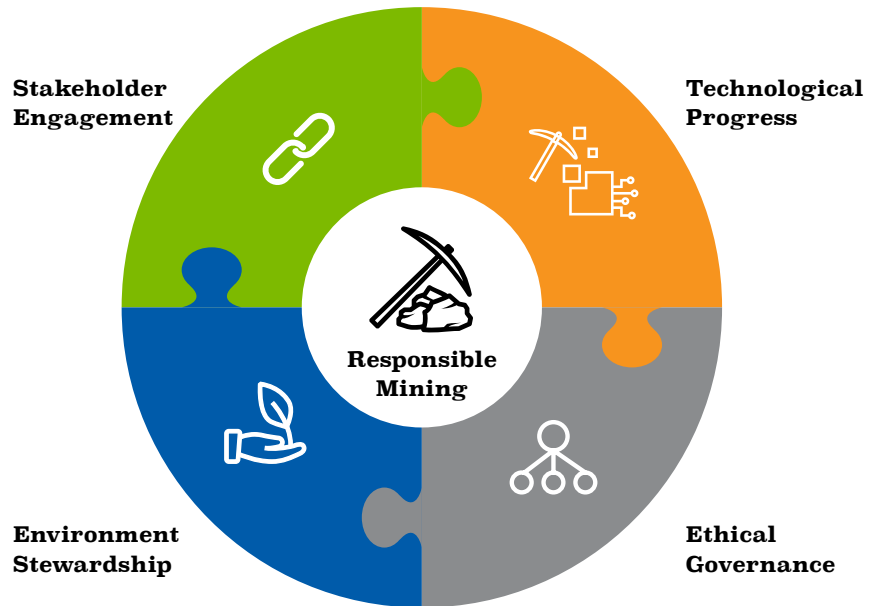
“CSR is one of the critical success factors for the mining industry. A comprehensive strategy should aim at development of market and economy, alongside strengthening local community around which it operates. Creating opportunities for the local people along with ensuring their wellbeing through responsible production will give the industry a social license to operate. Therefore, CSR rather than being thought of as a cost centre, should be used as a tool for creating a strong social impact, while ensuring benefits for different stakeholder groups and bringing in associated business leverages.”



Way forward

Civilization has a heavy dependence on the mining industry, as minerals and metals play a vital role in meeting the needs of the modern society. The infrastructure of a developed as well as a developing nation has minerals and metals as its building block, and standard of living grows, the demand for minerals and metals also expand. This needs to be accompanied by adoption of responsible practices by companies around the globe, while working on a multi-tier arrangement for growth.

- Technological Progress**
 Cost reduction remains to be a tool in the portfolio for the companies towards the goal, and often technology is the key priority used as a vehicle for efficiency gains. The technology integration in mining activities has the potential to widen the gap between top low-cost producers and the smaller players. Technological integration in the operations, for a developing country like India are going to play a crucial role in the competitiveness in the international market, especially to endure price volatility. In addition to this, technologies for zero waste or low waste mining are the next step in this direction.
 - Stakeholder Engagement**
 A mine unless properly managed, can have adverse social consequences. On the one hand, mining disturbs ecological regimes and dependence of the local community, while on the other hand, unless accompanied by proactive measures to promote inclusiveness through social education, health and other interventions, can lead to alienation of the local population.
- Need analysis** can be an effective tool to clarify problems and identify appropriate interventions or solutions for



the community around the mining operation site. The goodwill of the company is hugely boosted once the it understands and cares for the local community. Responsible community engagement can be achieved by a systematic need analysis, planned and conducted throughout the life of a mine for the goal of social inclusion.

The changing **expectations of stakeholders** can be addressed through assessing the current and potential environmental and social impact of the mine's activities and building relationships with the stakeholder, starting at the first stage itself. This can be achieved through transparency with stakeholders, collaborations and an inclusive approach towards the community. The companies must create a sense of shared value with both local community and Government, to leverage collaborative modes of engagement to achieve social inclusion in mine's operations.

- Environmental Stewardship**
 Instilling environmental stewardship for mining firms is a monumental task, which would require companies to adopt creative techniques and integrate the principles of sustainability in their core activities. The thought of environmental protection and minimising footprint has to be implemented from the initial stages itself to reduce the impact of mining activities.

Scenario analysis in the mining sector is very a useful tool to understand the implications of physical (drought, cyclone etc.) and transitional (policy change, market demand etc.) risks and accordingly build up longer term strategic thinking around these risks. Through application of a number of possible futures to the business, one can assess the strategic resilience and management response choices.

Circularity in mining needs to be explored to manage and

mitigate the large quantities of waste that is produced throughout the life cycle of a mine. The linkages for using waste from the mining activities in either in mining or other mineral dependent value chains can be formulated to form a closed loop in the sector.

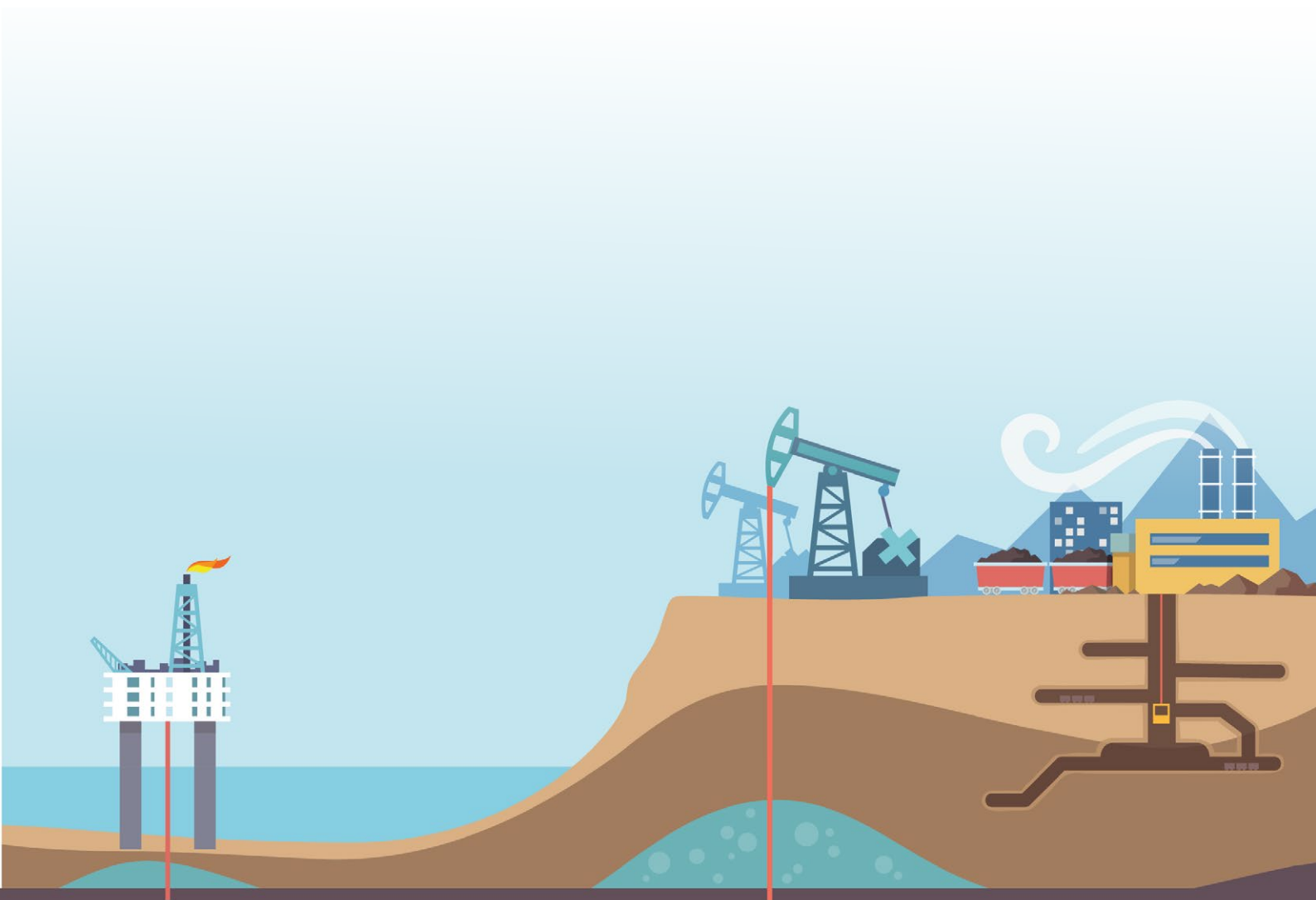
Water stewardship approaches need to be accelerated, which means finding ways to align company strategies with responsible consumption and production. Waste water recycling has already become a common sight in majority of the firms engaged in mining, but this needs to be supported through activities such as conducting a water

risk assessment, monitoring and management of water, rethinking of traditional mining practices and taking a shared value approach to water use.

Air emissions also needs to be prioritised, not just from the point of the health and safety of the workers in the mine but also from the perspective of the quality of air in the community. The industry as a whole, is engaged in accounting and reporting on its emissions over a time period and through technology does look for methods for emission reduction, but the sector needs to develop metrics and incentives to guide performance.

- **Ethical Governance**

The move towards responsible mining, is something that is not going to happen overnight and requires the realignment of management. From the perspective of governance, if management is willing to embrace new operational models, including the need to operate in an ecosystem, transform stakeholder relationships, and have an unbiased approach to decision making, only then can the ambition of responsible mining be achieved.





INDIAN CHAMBER OF COMMERCE

About ICC

Founded in 1925, Indian Chamber of Commerce (ICC) is the leading and only National Chamber of Commerce operating from Kolkata, and one of the most pro-active and forward-looking Chambers in the country today. Its membership spans some of the most prominent and major industrial groups in India. ICC's forte is its ability to anticipate the needs of the future, respond to challenges, and prepare the stakeholders in the economy to benefit from these changes and opportunities.

Set up by a group of pioneering industrialists led by Mr G D Birla, the Indian Chamber of Commerce was closely associated with the Indian Freedom Movement, as the first organised voice of indigenous Indian Industry. Several of the distinguished industry leaders in India, such as Mr. B M Birla, Sir Ardeshir Dalal, Sir Badridas

Goenka, Mr. S P Jain, Lala Karam Chand Thapar, Mr. Russi Mody, Mr. Ashok Jain, Mr. Sanjiv Goenka, have led the ICC as its President. Currently, Mr. Rudra Chatterjee is leading the Chamber as its President.

ICC is the only Chamber from India to win the first prize in World Chambers Competition in Quebec, Canada.

ICC's North-East Initiative has gained a new momentum and dynamism over the last few years. ICC has a special focus upon India's trade & commerce relations with South & South-East Asian nations, in sync with India's 'Look East' Policy, and has played a key role in building synergies between India and her Asian neighbours through Trade & Business Delegation Exchanges, and large Investment Summits.

ICC also has a very strong focus upon Economic Research & Policy issues - it regularly undertakes Macro-economic Surveys/Studies, prepares State Investment Climate Reports and Sector Reports, provides necessary Policy Inputs & Budget Recommendations to Governments at State & Central levels.

The Indian Chamber of Commerce headquartered in Kolkata, over the last few years has truly emerged as a national Chamber of repute, with full-fledged offices in New Delhi, Mumbai, Guwahati, Ranchi and Bhubaneswar & Hyderabad functioning efficiently, and building meaningful synergies among Industry and Government by addressing strategic issues of national significance.

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About TTC

TTC is a multidisciplinary professional services organization that specializes in providing advisory support to sustainable development initiatives, and strives to engage with clients to address critical challenges by providing access to the best possible expertise and solutions for achieving efficiency and creating the desired impact. TTC provides complete range of solutions on sustainable development, ranging from sustainability strategy, reporting, assurance, climate change (mitigation, adaptation, finance), energy issues, healthcare,

CSR to ethical business, and supporting corporates, foundations, government, civil societies, multilateral/bilateral agencies and impact funds, assisting across diverse thematic areas, often focusing on the 'multi-sector approach', facilitating the synergy between the sectors for holistic sustainable development.

We derive our strength through our unique structure which is based on our strong multidisciplinary team, our Global Advisory Council and our Strategic Partners.

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The background features a gradient from light blue at the top to orange and purple at the bottom. Silhouettes of construction equipment, including an excavator on a hill and two excavators in the foreground, are visible. In the center-right, there is a silhouette of an industrial facility with multiple towers and scaffolding. The overall scene is set against a sunset or sunrise sky.

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