

# Utkrisht Bharat in Mining

Technological interventions to  
transform the growth of Indian  
Mining Sector

October 2023



thyssenkrupp



Confederation of Indian Industry



Building a better  
working world

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thyssenkrupp Industries India Pvt. Ltd

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Ernst & Young LLP



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## Please contact

### Confederation of Indian Industry

#### The Mantosh Sondhi Centre

23, Institutional Area, Lodi Road, New Delhi  
- 110 003 (India) T: 91 11 45771000 /  
24629994-7 \* F: 91 11 24626149

### thyssenkrupp Industries India Pvt. Ltd.

#### Corporate Office

Pimpri, Pune 411 018, India  
Telephone : +91 20 2742 5461 - 64  
Fax : +91 20 2742 5350  
E-mail : contactus.tkii@thyssenkrupp.com

#### Mining office

Eco-Space, Premises No.701, Block-A7th  
Floor, New Town, Rajarhat, Kolkata - 700 156.  
India  
Telephone : +91 33 6605 5200 / 01  
Fax : +91 33 6605 5218  
[www.thyssenkrupp-industries-india.com](http://www.thyssenkrupp-industries-india.com)

**A** **Message from Mr. Vivek Bhatia**  
**Chairman CII - Mining & Construction Equipment Division**  
**Managing Director & CEO, thyssenkrupp Industries India**  
**Pvt. Ltd.**

**B** **Message from Shri. Vinayak Vipul**  
**India Consulting Leader Metals & Mining Leader - EY**

**1** **Executive Summary**

**2** **Current State of Indian Mining & Mining Equipment Sector**

- 2.1 Introduction
- 2.2 Indian Mineral Reserves
- 2.3 Current Market Scenario of Mining & Mining Equipment in India
- 2.4 Initiative Taken by Government & Private Players
- 2.5 India's position in Mining Equipment Sector in Regional Markets
- 2.6 Learning for India from China
- 2.7 Contribution towards 'Make In India' Initiative
- 2.8 GDP Growth Outlook
- 2.9 Contribution of Mining Sector to Indian Economy
- 2.10 Import of Mineral & Coal into India
- 2.11 Mining Market/Prospect for Odisha
- 2.12 Growth Projections for Years Ahead
- 2.13 Future Outlook
- 2.14 Evolving Regulatory & Policy Landscape

**3** **Challenges faced by Indian Mining & Mining Equipment Sector**

- 3.1 People Intensive Methods
- 3.2 Price Competitiveness
- 3.3 Seasonal Production - Impact of Weather
- 3.4 Environmental Considerations & Impact
- 3.5 Challenges faces by MDOs
- 3.6 Dearth of Skilled Manpower
- 3.7 Gaps in Technology Adoption
- 3.8 Availability of Low Cost- Long Term Financing
- 3.9 Overseas dependency on Critical Components
- 3.10 Environmental Challenges

## **4 Multistakeholder view for further development of Indian mining & mining equipment sector**

- 4.1 Social License to Mine
- 4.2 Policy & Regulatory Environment
- 4.3 Financial Investment & Funding
- 4.4 Equipment Manufacturers & Technology Providers
- 4.5 Mine Planners
- 4.6 Mining Companies & Operators
- 4.7 Mining Workers Technological shift
- 4.8 Promote Sustainable Initiatives

## **5 Positive Examples from Indian Industry**

- 5.1 Mechanization & Continuous Mining approach
- 5.2 Digitalization of Mining Operations
- 5.3 CFBCs for Washery Rejects

## **6 Case studies from mining industry**

- 6.1 Case Study 1
- 6.2 Case Study 2

## **7 Technological Solutions Indian Mine Operators Must Consider**

- 7.1 Mobile Crushing Plants
- 7.2 Next Generation of Bucket Wheel Excavators
- 7.3 Next Generation Conveying solutions
- 7.4 In-pit Crushing & Conveying System
- 7.5 Automation
- 7.6 Digitalization and Industrial Internet of Things (IIOT)

## **8 Twelve-point action agenda for Utkrisht Bharat in Mining and Mining Equipment Sector**

## **F Note to the Reader (About the authors)**

## **G Acknowledgement**

## **H Bibliography**

# Content



## Mr. Vivek Bhatia

**Chairman CII - Mining & Construction Equipment Division  
Managing Director & CEO, thyssenkrupp Industries India Pvt. Ltd.**

We are delighted to have the opportunity to collaborate with CII in developing this thought paper "Utkrisht Bharat in Mining - Technological interventions to transform the growth of Indian Mining Sector".

Mining is a core sector and the bedrock upon which the strong Indian industrial base stands. It is the reason we have been able to build a thriving core of the manufacturing industry and are able to generate and provide power on a competitive basis.

India is richly endowed with minerals and coal. Yet, it is surprising that we are import-dependent. For example, 35% of our coal requirement is imported. This is a real contradiction that is hard to explain.

India's high import dependence indicates several challenges which the mining and coal sectors face. Issues relating to productivity, cost, environment and social factors make them more complex in an Indian context.

At a national level, the government has unleashed an ambitious program to promote the mining and coal sector. Through a series of reforms, it is intended to attract the best of players and the best of technologies to realize the potential of our country and our rich resource base. It is against this evolving context and keeping these factors in mind that we have come out with this report.

We do not claim to be comprehensive in this effort, nor can a review of technology be complete - it is by nature an evolving topic. Rather, it is our intent to provide an impulse to industry players and stakeholders. By considering new and available technologies around the world, by considering selected case studies, we hope to inspire the mining fraternity to consider and explore new ways and means. Through this report, we aim to shed some light on what is possible.



# Message

“ This report can help the industry to identify key areas of interest and further develop specific innovation programs and strategies. ”

Needless to say, the reality of each specific mine requires careful consideration and a thoughtful balance of technology and cost. And so, each project detail what would work best in their specific context.

Along with my fellow authors and colleagues, I take the opportunity to thank so many industry stalwarts and experts who have been generous with inputs and guidance. There were many who supported us in the creation of this report - this included ministry officials, several clients and friends in the industry and as well our colleagues across the world. Thank you!

We look forward to remaining engaged on many of the topics captured herein, and in particular look forward to your thoughts and reflections on going through this report.

Through this report and through the ideas captured herein, I am hopeful that we will be able to make our contribution towards Aatma Nirbhar Bharat in the sphere of mining. This would be a wonderful outcome.



## Shri. Vinayak Vipul

**Partner- EY Parthenon, Strategy & Operations  
Consulting India Leader -Metals & Mining**

We are pleased to co-author the thought leadership paper with thyssenkrupp for the Construction and mining equipment summit organized by CII focused on "Utkrisht Bharat in Mining".

The future of the mining equipment market in India looks positive driven by strong growth in the mining sector. The mining sector is one of the core industries of the economy and accounted for ~2.5% of India's nominal GVA in FY22-23.

The growth shown by the sector is powered by the development in the automotive and transport industries specifically the EV market which is projected to grow at a CAGR of ~50% between 2022-2030, innovations in processing equipment & manufacturing technologies, and ongoing R&D activities to develop innovative, cheaper, and effective products.

The government's thrust on harnessing renewable energy resources, boosting the energy & power sectors, encouraging electric vehicles, Atmanirbhar Bharat Abhiyan and Make in India spells good news for the Indian mining industry, and thereby for the Indian mining equipment sector.

The steps India has been taking are in the right direction and are catapulting India in achieving the vision of being the global leaders in the segment. The opportunity is immense when we look at our peers like China where its market size is ~ \$ 41,000M compared to India's ~\$ 3,700M. To drive self-sufficiency in mineral resources, the government is encouraging exploration of the country's rich resource potential through implementation of several policy reforms.

Policy reforms have made it easy for private mining players, domestic & foreign, to enter the sector by participating in mining auctions. 100% FDI in mining & exploration of non-core minerals and 50% FDI through JVs with PSUs are now allowed. This is fostering development in both mining and mining equipment industry, resulting in job opportunities.

To make the Government's vision of 'Atmanirbhar Bharat Abhiyan' and 'Make in India' a reality, huge investment to support the mining industry is the need of the hour.

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# Message

“ As we navigate the complexities of the mining and mining equipment sector, we embrace innovation, sustainable practices, and strategic collaborations to unearth a brighter future, driven by progress, productivity, and purpose. ”

JVs with PSUs are now allowed. This is fostering development in both mining and mining equipment industry, resulting in job opportunities. To make the Government's vision of 'Atmanirbhar Bharat Abhiyan' and 'Make in India' a reality, significant investment to support the mining industry is the need of the hour.

Some of the challenges that the sector faces are declining ore quality, labor-intensive methods, cost competitiveness, seasonal production impacts, environmental concerns, technology adoption, financing, overseas dependency, and waste management.

Despite these challenges, the mining industry and the equipment sector needs to fuel its growth through technology adoption, improving efficiency, and adopting sustainable practices. Addressing these issues entails investing in automation, workforce development, cost reduction measures, sustainable operations, and strategic partnerships to secure long-term financing and strengthen the sector's resilience.

Digitization and automation are driving dramatic improvements in mine productivity, safety, and reliability. CESC etc. are handling projects to develop

coal mines that demand latest technologies equipment. The emerging trends that significantly influence the mining equipment sector encompass underground automation systems to enhance mining efficiency, automated power crushers for streamlined crushing & compaction tasks, versatile excavators serving construction and mining purposes, the adoption of hybrid electric motors for cost-efficiency, and the utilization of rail-veyor technology for efficient bulk material transportation solutions.

This thought leadership focuses on the role of all stakeholders in the mining and mining equipment's sector. We believe that through policy support and private initiative, sustainable growth can be achieved in the sector. Sustainable Development Goals (SDGs) can be delivered through automation and digitization, contributing to making Atma nirbhar bhara in Mining.

# 1

## Executive Summary



Indian mining and coal sectors are the bedrock upon which a robust industrial base has developed and continues to thrive. India is well endowed with rich mineral deposits. As on date, over 95 minerals are mined in the country. India is among the ten in terms of reserves of iron ore and top five in coal which are two important minerals for supporting our steel and power sectors. With large reserves, India is amongst the leading global producers for iron ore and coal. Despite that, we are still importing significant amount of our needs. To address this anomaly, the Government of India has triggered a series of reforms and policy changes. Indeed, the mining sector has the potential to achieve the stated vision of Atmanirbhar Bharat and thereby contribute towards the further growth and economic development of the country.

However, it would not be possible to realize the vision of Atmanirbhar Bharat in Mining without a deeper consideration of the prevailing situation and robust understanding of the roadblocks and challenges that the sector is facing. In fact, when comparing the FOB prices of coal for various leading internal producers of coal, we realize that these prices are ~20-30% higher compared to other large countries such as Indonesia. This is an important area that needs to be addressed. Growing production levels must be achieved at competitive costs to ensure the overall competitiveness of all downstream industries.

There are several areas that require attention in the prevailing approach to mining in India. For a start, current operations are highly people intensive, indicating a potential for further mechanization and deployment of new technologies. It is also important to note that current production methods are subject to seasonality - there is a 25% reduction in production levels during the monsoon period. Further, mining operations are increasingly challenged on account of more complex and stringent environmental norms and compliances.

Considering the prevailing situation, action is required on several fronts to ensure the successful development of the sector. Firstly, no mining operation can be successful without the goodwill, support, and active participation of local populations. The sector needs focus on ecological and sustainability aspects of mining operations, to ensure that they have a social license to operate. This requires interventions across mine planning and the adoption of more environmental friendly methods, reducing blasting and minimal usage of diesel to reduce emissions.

At a government level, it must sustain the momentum of policy reforms to enable the growth of mining operations. Considering the fact that all mining operations are capital intensive, it must support the sector financially, to make sure that sufficient funds are available for investments and growth.

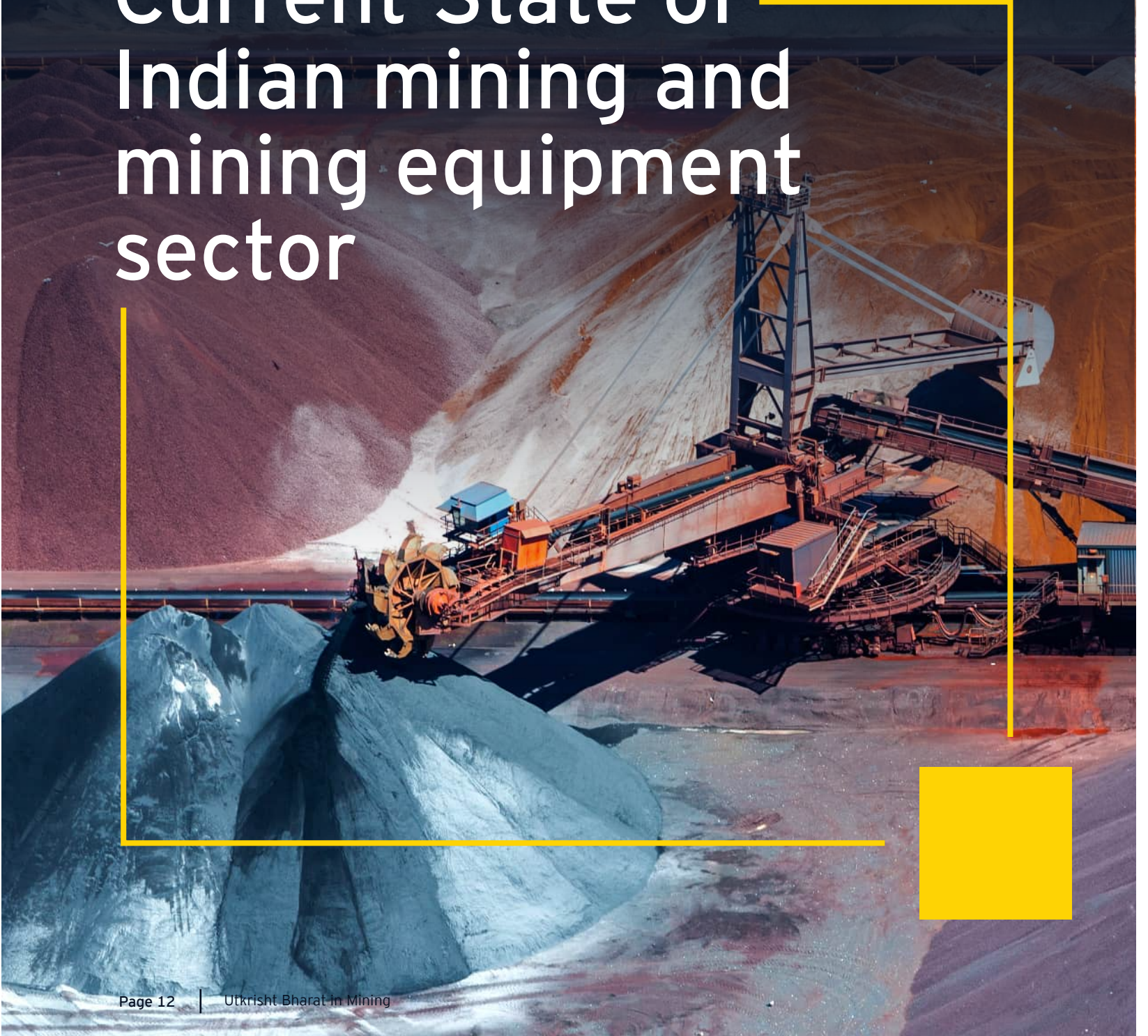
There is an urgent need to adopt technologies that can provide an immediate boost to the sector. Some of these relating to in-pit crushing through semi/fully mobile crushing plants, conveyerization of mines, automation, and digitalization, described in the document. Should this be of interest to the reader, further information on all of these areas can be obtained from the authors of the report. Through a few case studies, it has been shown that practical applications of these technologies are feasible in an Indian context and, through sustained efforts, a range of issues can be resolved.

All of these technologies will also help increase electrification of mining operations. An immediate impact would be the reduction of diesel consumption. Further, electricity can be sourced from renewable sources, dramatically impacting the environmental footprint and emissions resulting from the mining operations. Several, several of these technologies boost the reliability of operations particularly in continuous mining mode, impact of adverse weather can be overcome. This implies high throughput throughout the year. With the inclusion of digitalization and automation, the system reliability can be further improved.

Through the successful application of the technologies captured in this report, it is possible to achieve 20-30% reduction in operational expenses and improve the overall financial attractiveness of mining operations. In summary, all stakeholders need to work together to achieve the successful growth of the mining and coal sector in India. We have attempted to capture the key focus areas through a twelve-point action agenda for mining in India. We do sincerely hope this report triggers a deeper reflection on the challenges and opportunities before the mining sector and in the process, we propel our nation towards Aatma Nirbharta in this critical sector!

# 2

## Current State of Indian mining and mining equipment sector



2.1

## Introduction

India is abundantly rich in minerals, and boasts a production of up to 95 minerals which includes four fuel related minerals (e.g., coal), 10 metallic minerals (e.g., iron ore), 23 non-metallic minerals (e.g. limestone), three atomic minerals (e.g. uranium) and 55 minor minerals, 1 which are extracted from a vast network of approximately 1,300 mines. Moreover, India is self-sufficient or close to self-sufficiency in several key minerals, including bauxite, chromite, limestone, iron ore, sillimanite etc. However, in minerals like manganese, kyanite and coal India experiences a deficiency and thus needs to import them to satisfy its demands. To keep the industry globally competitive, India plans to maximize the use of its domestic reserves to meet its requirement for coking coal to reduce iron ore to iron.

While India is indeed well-endowed with minerals, the sector still holds significant untapped potential. The country has ample opportunities for further development as it seeks to explore and harness its yet-unrealized mineral resources.

To accomplish 'Atmanirbhar Bharat' The Government of India is working towards the development of the metals and mining sector by launching key policy initiatives and regulatory interventions in the auction process, levy of duties, and land availability. Though coal remains the major demand driver in mining, India still imports a large quantity of it. The demand for coal is expected to grow steadily till India has adequate alternative renewable energy options. Hence the government of India has taken the necessary steps to ramp up coal production to over 1 billion tons by 2023-24, which is expected to increase the demand for mining equipment to new heights. The private sector has also adopted new technologies, automation, and digitization. However, there is still a considerable scope of improvement.

2.2

## Indian Mineral Reserves

India is a mineral rich nation with substantial mineral reserves and a long history of mining that dates back to over 6,000 years to the time of Indus Valley Civilization. The minerals (both major and minor) that India is endowed with form a key resource for major industries such as steel, cement and power amongst others. With the quantum of reserves that India has of various minerals and coal, mining sector has a huge role to play in the Indian Economy. In this report we will focus on the mainstays of Indian mining industry viz. iron ore and coal.

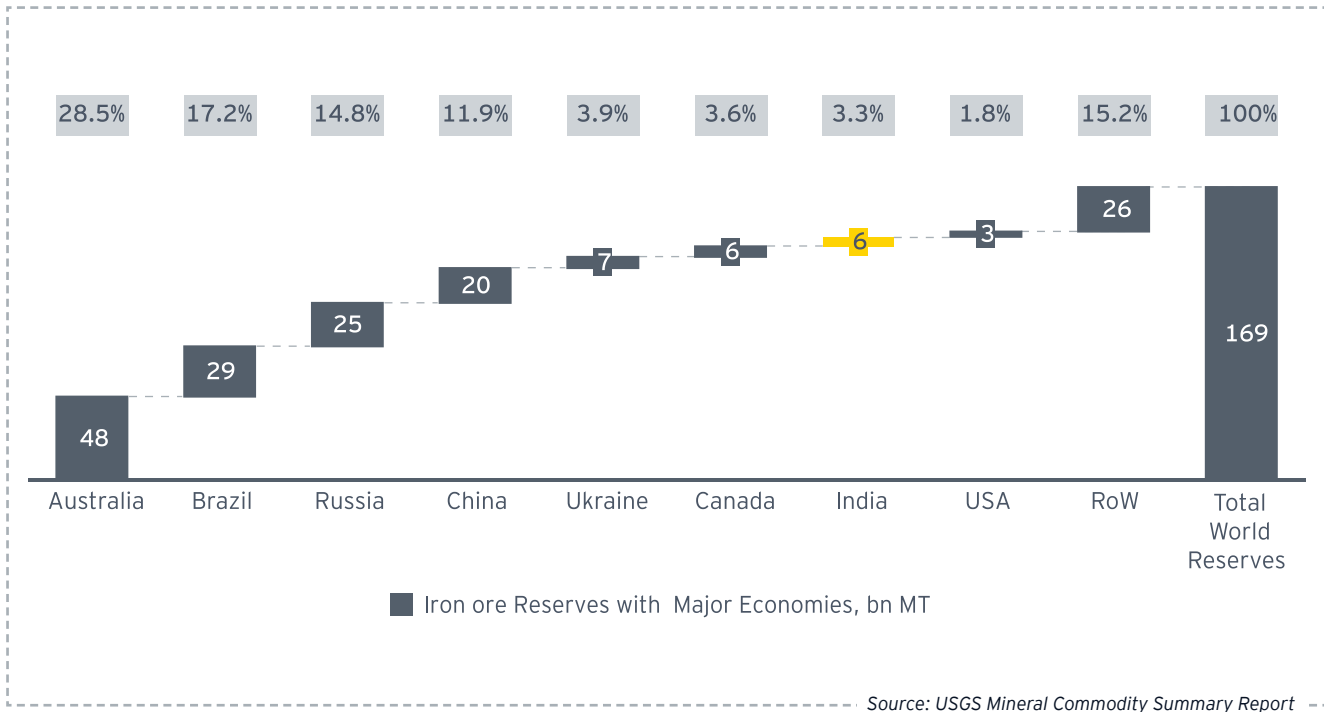
In iron ore, India is amongst the top ten resource rich nations. Indian iron ore reserves are pre-dominantly of Banded Iron Formation (BIF) dating back to the Precambrian age<sup>2</sup>. Our ore reserves comprise of hematite and magnetite of which the former is the most important on account of its higher-grade quality and is the primarily consumed ore type in the Indian steel industry.

India is amongst the top five nations in terms of coal reserves. Indian coal reserves are primarily of bituminous type of non-coking grade characterized by higher ash content.

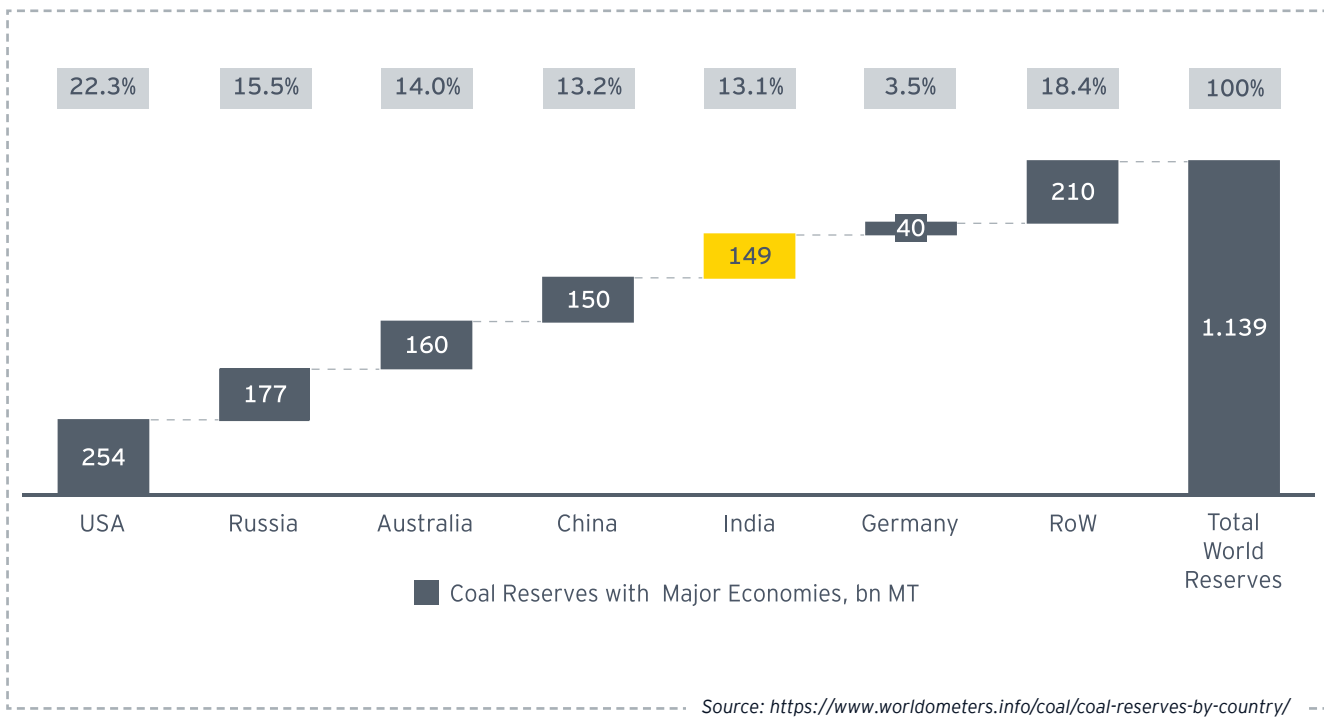


Historical Evolution

**Exhibit-1a: Iron Ore Reserves with Major Global Economy [bMT, %]**



**Exhibit-1b: Coal/Lignite Reserves with Major Global Economies**



## 2.3

### Current market scenario of mining and mining equipment in India

The booming industry of construction for commercial and residential structures would keep the demand for metallic minerals intact. The enormous pace at which infrastructure development is happening in the country reveals multiple opportunities for growth in the mining sector. Additionally, the industry is also benefiting from the expanding notion of energy efficiency in major construction projects.

India possesses a significant degree of self-sufficiency in the production of iron ore. Due to the pandemic the production of Iron Ore decreased by 17% in FY21. However, in FY22 the production has observed a growth of 24% owing to the spur in demand of steel and the focus of Indian government to boost infrastructure activities.

Aligning with the shifting paradigm of on-time project delivery with quality and with the initiative of the 'Make in India' campaign, there is an augmented demand for modernized and mechanized methods of mining leading to an increase in demand for smart and connected equipment solutions. Equipment manufacturers should implement digitization and adapt to automated and self-operating innovative technologies for competitive and long-term sustainable growth.

## 2.4

### Initiatives taken by the government and private players

Initiatives undertaken by the Indian government like 'Auction of Mineral Blocks National Mineral Policy (NMP) 2019', 'Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY)', 'District Mineral Foundation (DMF)' and 'Make in India' are empowering equipment manufacturers to boost the country's construction and manufacturing industry and solidify its position as a major manufacturing hub on the international scale.

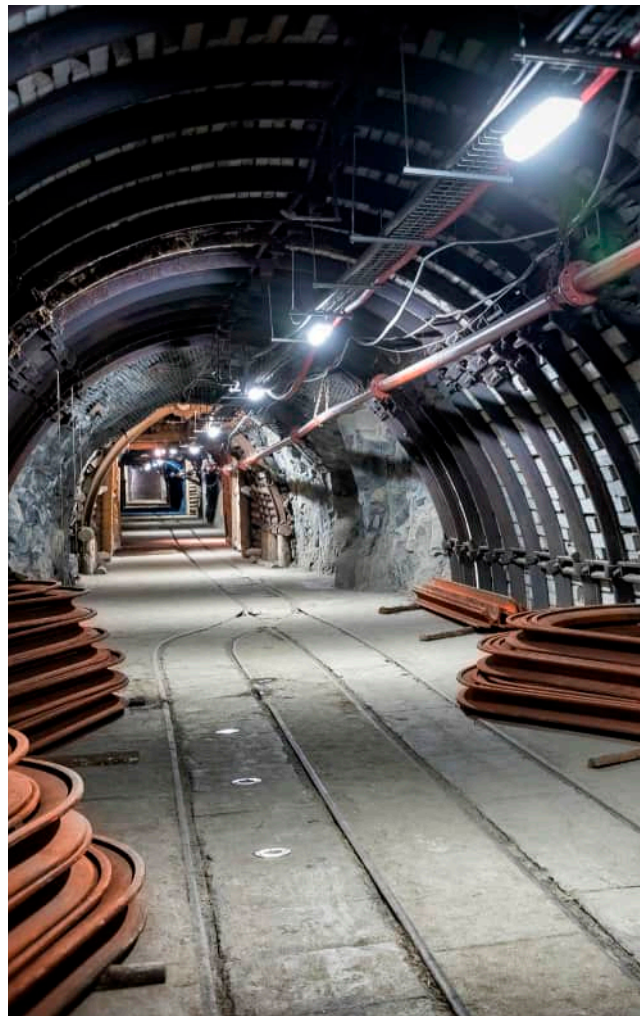
Mining equipment manufacturers like thyssenkrupp, Komatsu India and JCB have been working towards building customized equipment that is adept to work in the Indian conditions. Players such as Schwing Stetter

India have introduced innovative solutions for the mining sector, like self-loading concrete mixers that reduce the carbon footprint and minimize environmental impact in mining and construction projects.

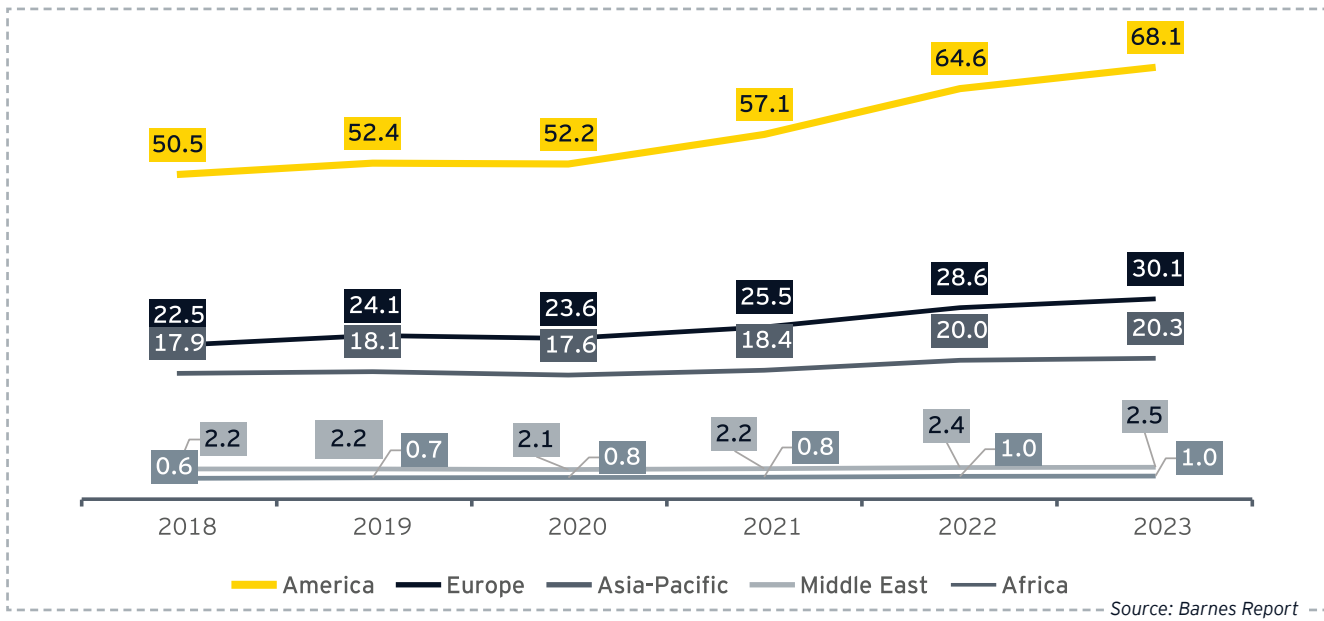
## 2.5

### India's position in the mining equipment sector in regional markets

According to a Barnes report, the market in the Asia-Pacific region for mining equipment is estimated to be \$68.1 billion in 2023, which is 56.8 percent of the overall global contribution. It is supported by the facts that 60% of the world population resides in the area and the area is endowed with large quantities of natural reserves of minerals. The growth in the region is expected to be 5.4% from 2023 to 2024. The growth rates are just less than that of Africa where the growth is projected at 7.4%, but the overall contribution of the Africa region is just 0.9% of the global share.

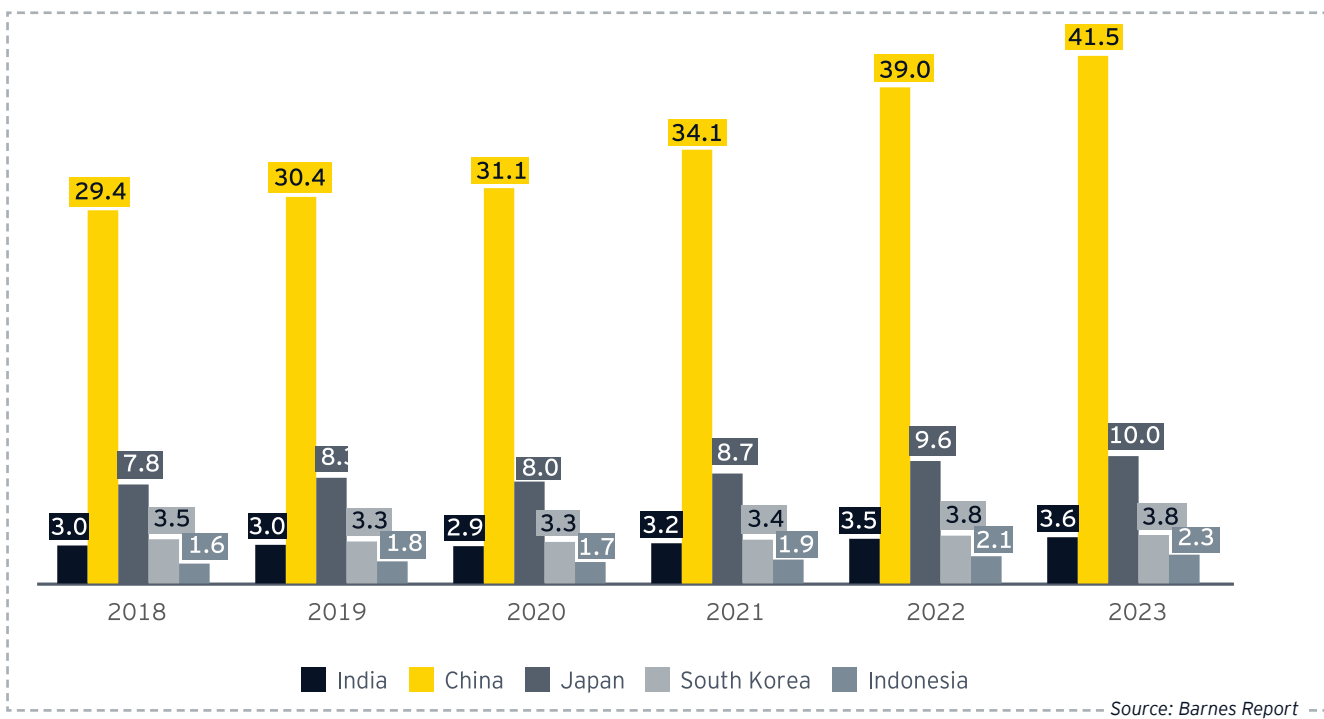


**Exhibit-1c: Market size comparison across global regions (US \$B)**



Looking at the regional distribution within the Asia Pacific region, the five top contributors are China (61%), Japan (15%), South Korea (6%), India (5%), and Indonesia (3%) respectively. Despite India being a geography which houses ~20% of the world's population and ~33.33% of the Asia Pacific population and an area which is rich in minerals, it contributes merely 5 percent to the Asia Pacific region indicating there is a lot of scope of growth for the mining equipment sector to flourish. While India was experiencing growth in the range of 7%-14% in the past few years the growth plummeted to 3.5% in 2023 due to the deteriorating global macroeconomic conditions and the forecast of 2024 is also on the same lines. The same trend has also been observed in other geographies as well and given global efforts such as G20 summit, we might see a turn-around. To regain the momentum of growth once the global macroeconomic scenario improves, India needs to be ready, and ramp up its efforts.

**Exhibit-1 d: Market size of Top 5 countries in Asia Pacific (US \$B)**





With the government's massive efforts and ease of regulations, huge investments from the private sector are the need of the hour to explore and harness the country's rich resource potential leading to an increase in the domestic production of various minerals. The recent announcements focused on incentivizing exploration, and boosting domestic production are a welcome recognition of the importance of the mining industry to 'Atmanirbhar Bharat'.

2.6

## Learnings for India

China's economy has witnessed immense growth in the past couple of decades. It has been investing heavily in infrastructure in recent years. This has led to a boom in construction activity in China. In 2022, China's GDP was \$17.6 trillion, which is around five times that of the India's \$3.385 trillion. Given China's larger base, India can definitely have lessons to learn from China's industrial and mining sectors.

China's industrial policy focused on prioritizing the development of critical infrastructure, creating the transportation and logistics networks required to enhance its trade capacity and support its export-oriented economy. India has been focusing on the same, and needs to continue its effort by bringing in more liberal policies and ensuring that ease of doing business is enabled.

In addition to traditional infrastructure such as roads and bridges, China has also made significant strides in enhancing municipal infrastructure, including sewage and water systems. India needs to ramp up its efforts to ensure that the municipal infrastructure for the upcoming SEZs and smart cities is built in such a way that ensures smooth operations.

India will need to focus on growing its construction sector, as this will provide an impetus to other sectors' growth and thereby overall GDP. India can leverage learnings from China's journey to mitigate pitfalls. Crucially, China is incorporating environmentally sustainable green principles in its upcoming phase of infrastructure development needs. As the Chinese government has learned through challenging experiences, adverse repercussions stemming from infrastructure projects can lead to social unrest and hinder economic growth. India needs to ensure that the infrastructure development happens in a sustainable fashion.

2.7

## Contribution towards Make in India initiative

The Make in India initiative has had a profound impact on the mining industry. A lot of Indian players, such as BEML and TIL, and international players, like thyssenkrupp and Komatsu, have set up their domestic manufacturing facilities over the last few years. Excavators, dump trucks, and drilling machines are some of the equipment for which a lot of indigenous production has started. These equipment are not only being used domestically, but for exports too. The rapidly growing production landscape has inevitably led to increased demand for material handling equipment and services. Equipment manufacturers are also focused on increasing productivity, improving safety protocols, enhancing comfort levels, and achieving technological advances. The initiatives undertaken by the government have led to reduced import costs thereby resulting in a more affordable product. The government's thrust on the energy and power sector, smart city, housing for all, harnessing renewable energy resources, electric vehicles, infrastructure development, Atmanirbhar Bharat Abhiyan, and Make in India spells good news for the Indian mining industry.

In the past few years, the Indian Government adopted several measures to boost the domestic supply of coal and reduce dependency on imports. The export duty on iron ores/concentrates and iron ore pellets was raised to 50% and 45% respectively. Over the forecast period (2022-26), India's coal production is expected to post a CAGR of 7.5%, to reach 1,153.3 MT by 2026, the commencement of various upcoming projects, along with supportive regulatory reforms.

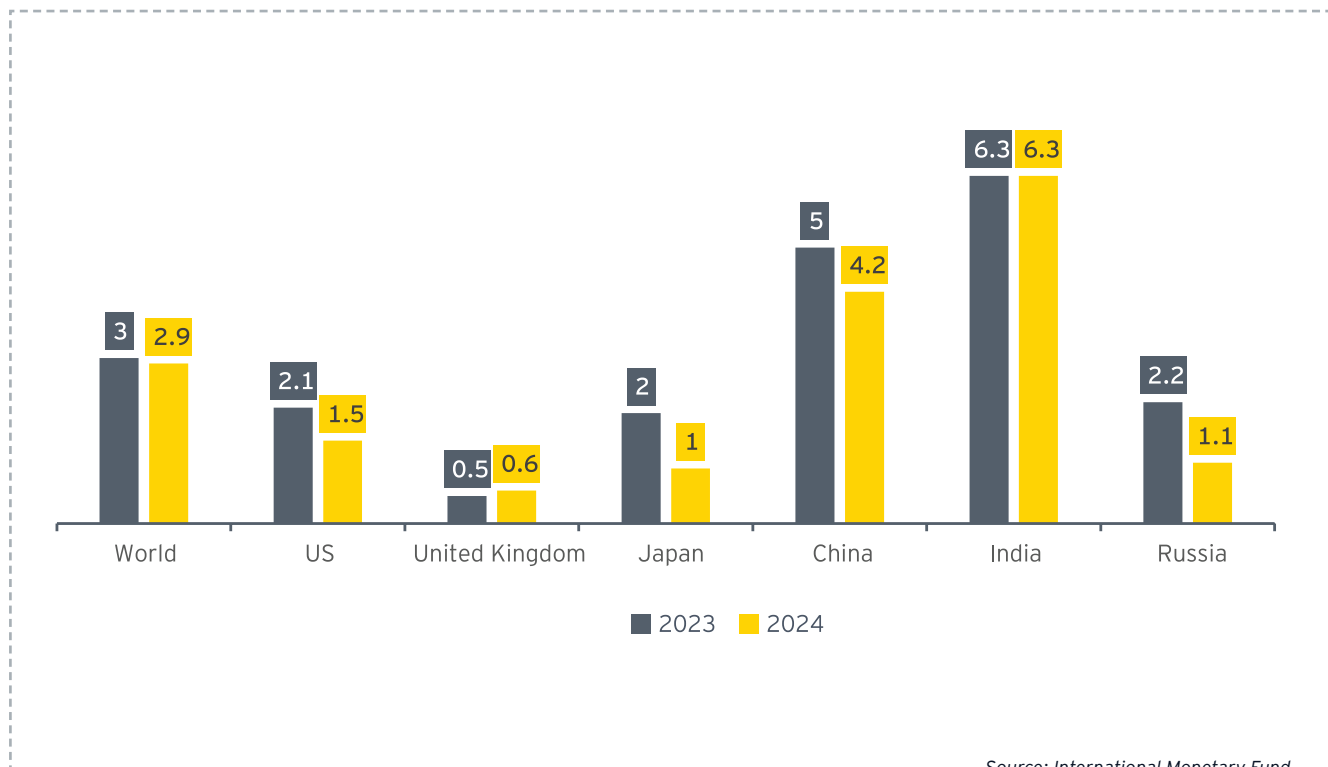
2.8

## GDP growth outlook

India is following the path to achieve its target of becoming a US\$5 trillion economy by 2025. The International Monetary Fund (IMF) has revised India's economic forecast for the current year to 6.3% from the earlier 6.1% as per the October 2023 World Economic

Outlook (WEO) report. These forecasts highlight India's emergence as a positive factor for global growth. The IMF predictions for China remain at 5.2% for 2023 and 4.0% for next year.

### Exhibit-1 e: Real GDP, annual percent change



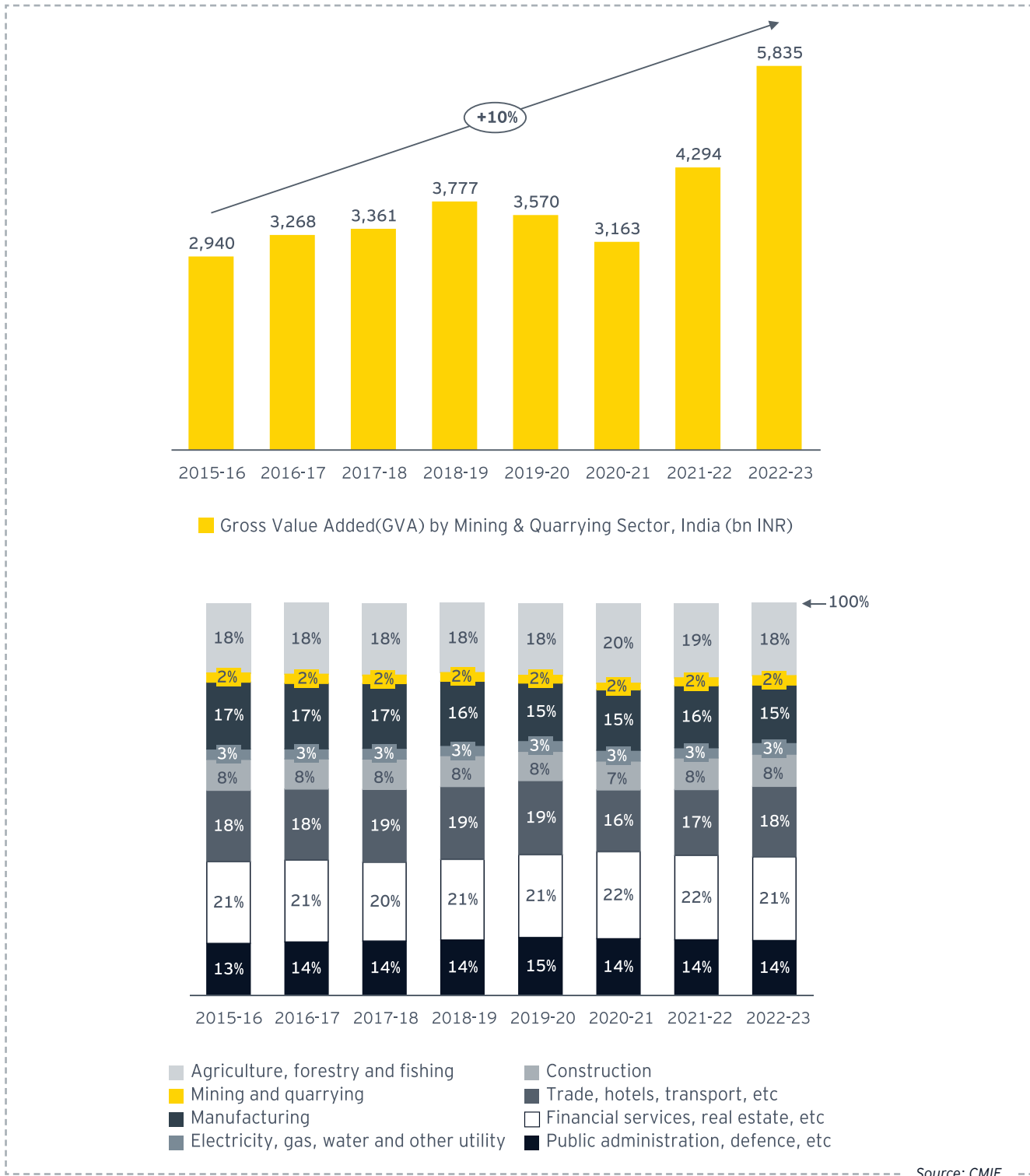
2.9

## Contribution of the mining sector to the Indian economy

The importance of mining can be assessed from the fact that for every 1% incremental growth in mining and quarrying sector results in approximately 1.3% incremental growth in industrial production and 0.3 percent incremental growth in India's GDP. The mining

sector's contribution to Indian GVA has improved over the years with a CAGR of 9% over the last 5 years. Also, the mining sector contribution to overall Indian GVA has remained robust at ~2%.

## Exhibit 2: GVA Added by Mining & Quarrying and % GDP Contribution

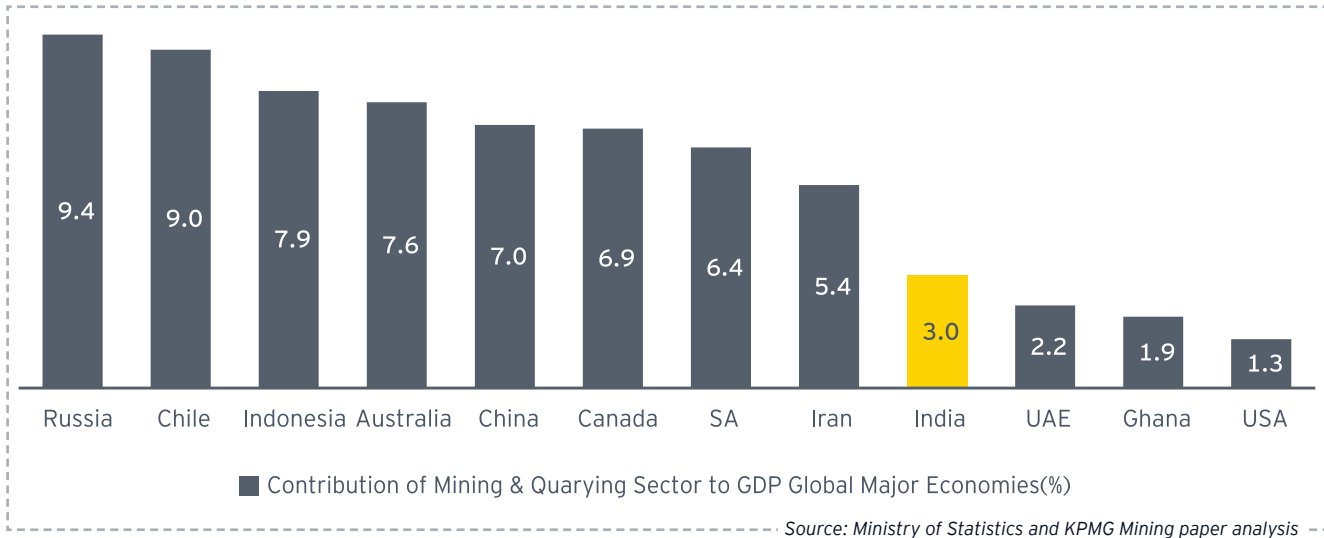


Realizing our aspirations for further growth, which also requires a substantial investment in infrastructure, will not be possible without due attention to the further development of mining and coal sectors in India.

There is no doubt that India figures amongst the nations where the mining sector is a significant contributor

towards the national economy. As a comparison with other major global economies, contribution from mining and quarrying to their overall GDP is as high as 7-10% for countries like Russia, Chile, China, Indonesia, Australia, for India it is less than 3%.

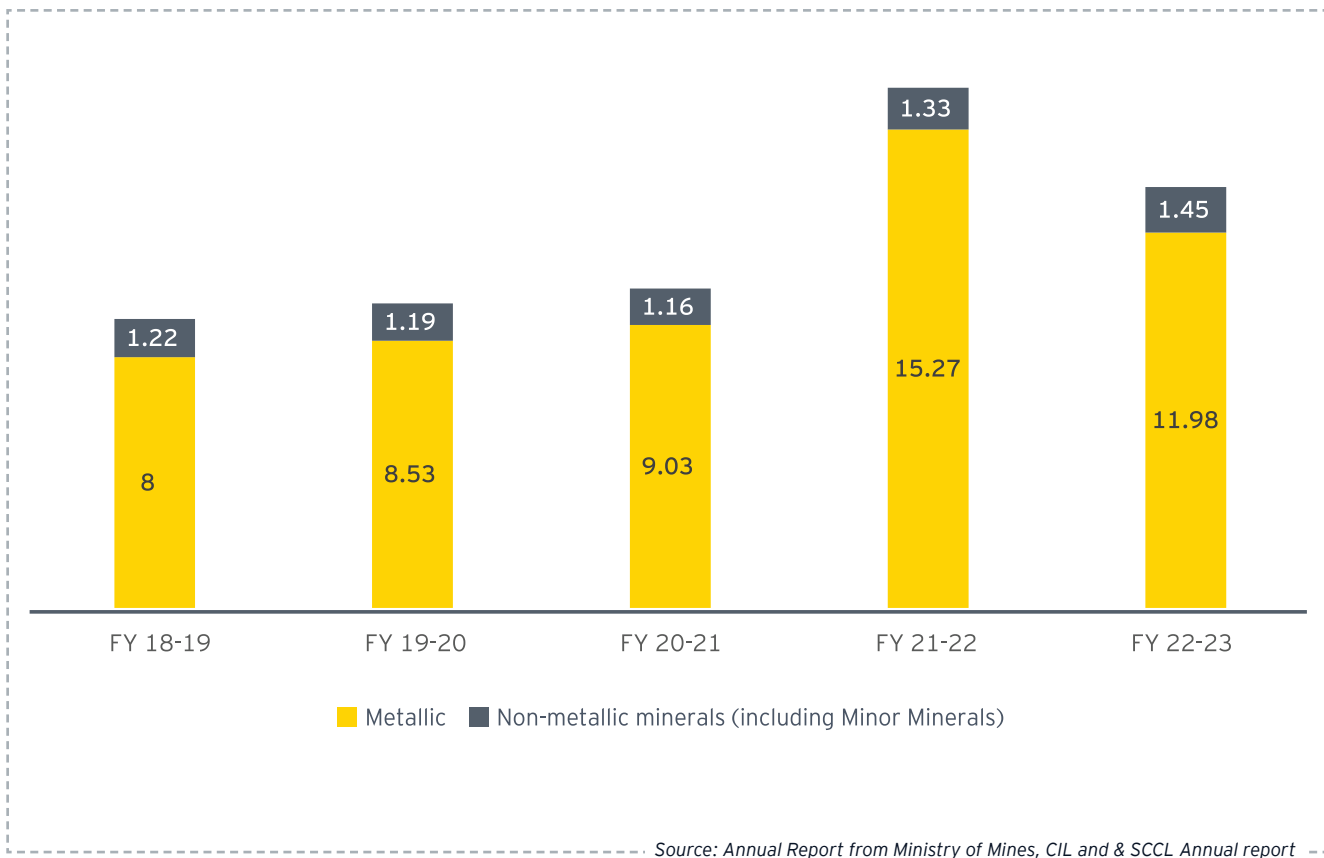
**Exhibit-3: %GDP Contribution by Mining and Quarrying - Major Global Economies**



Over the period of five years, the growth in metallic production was 10% and growth in non-metallic production was 3%. The split up of the production between metallic and non-metallic, minor minerals was 49% and 51% respectively. Indian coal production for the last four years has increased 5.5% by volume and has improved by

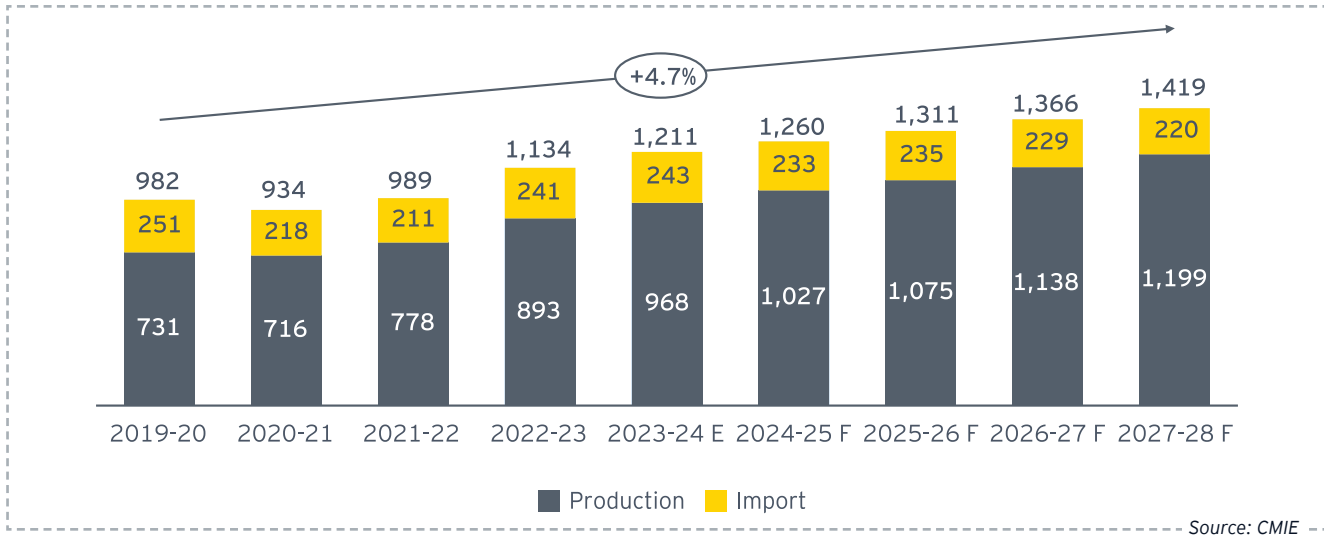
7.4% by value indicating a strong revenue potential in the mining operations of India. Around 81% of total mineral reserves in India is coal, which makes it one of the strongest mineral reserves of India.

**Exhibit-4: Value of Minerals Production by groups (excluding atomic & fuel minerals) ( US \$B)**



## Exhibit-5: Production Volume - Domestic Coal + Imports [MTPA, % CAGR]

Coal Domestic Production and Import: Target Coal Production, m MT (Including the other coal domestic producers)



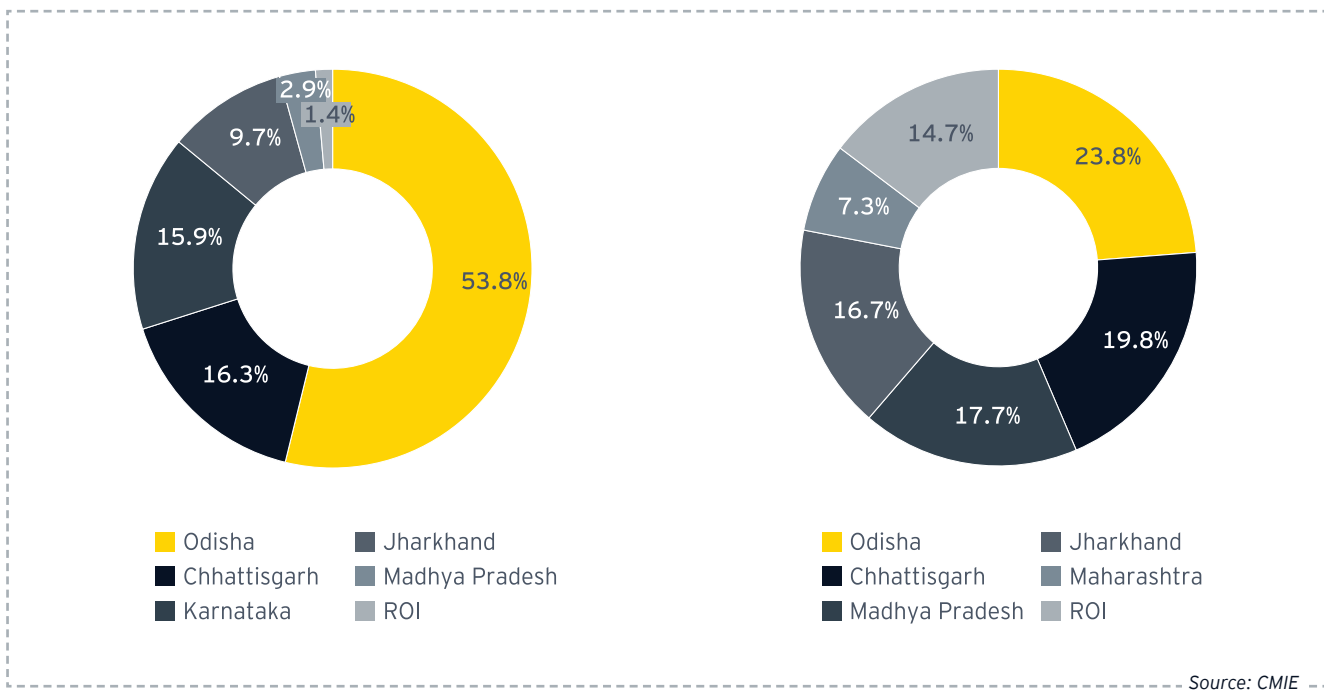
Top five states account for 66% of total value of mineral produced in India. Bulk of the iron ore and coal production in India is confined to five major states. Odisha is in leading position with 23.66%, in terms of percentage of estimated value of these minerals production in the country. Next in order is Rajasthan (17.27%), followed

by Andhra Pradesh (8.62%), Chhattisgarh (8.49%) and Karnataka (8.37%). Similarly, for coal production Odisha, Jharkhand, Chhattisgarh, Madhya Pradesh and Telangana contributes to 86% of overall production in India through various mines owned by CIL, SCCL, etc.

## Exhibit-6: State Wise Contribution of Iron Ore and Coal Production %

State Wise Contribution to Iron ore Production, % Distribution for 2021-22

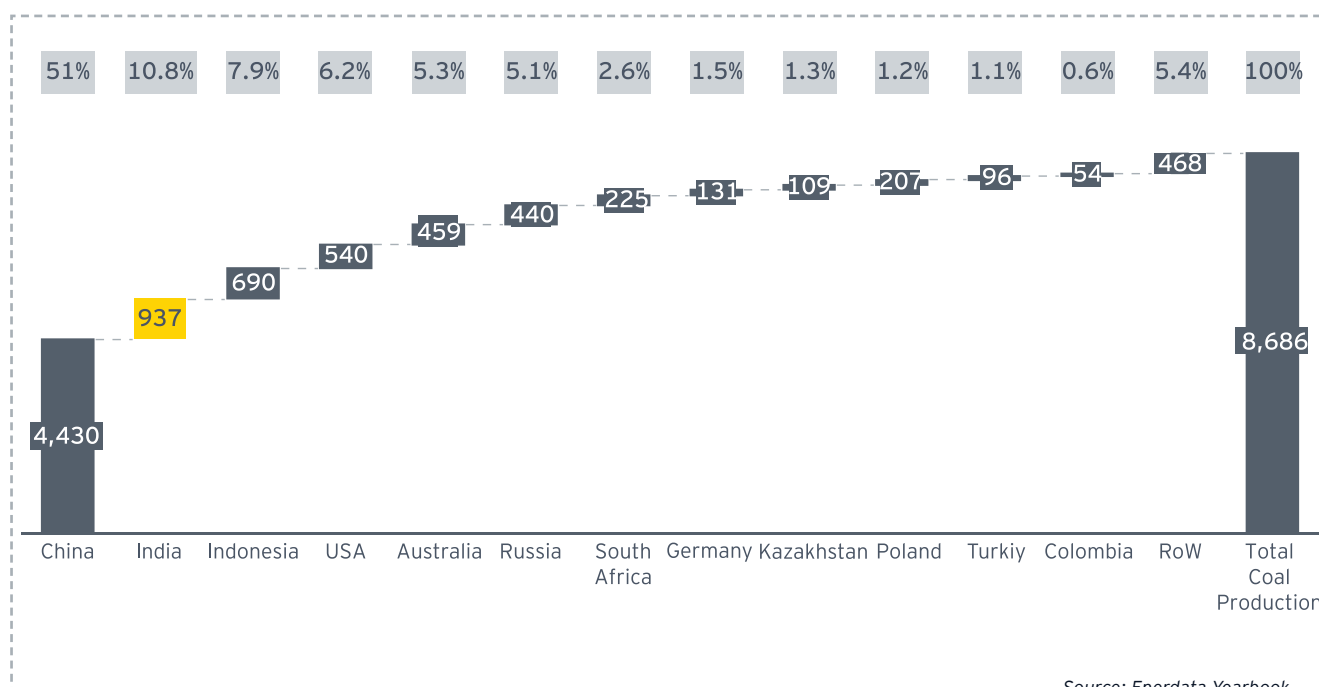
State Wise Contribution to Production of Coal, % Distribution for 2021-22



In terms of Iron ore production, Odisha is the leading producer contributing ~54%, followed by Chhatisgarh, Karnataka, Jharkhand, Madhya Pradesh. However, the per capita income in these states are lesser than the national average. On the contrary, states such as Gujarat, Andhra Pradesh, Telangana and Maharashtra which contributes to only 25% of the India's Mining GDP and 22% of the sectoral employment has higher per capita income than the national average. Key mineral-rich states in Australia show a reverse trend wherein they are said to have a

higher per capita income than the national average. So, with the commercialization of mines, more investment would be flowing from the private players on upgradation of infrastructure near the mining vicinity and thereby retaining the skill set in states. In the next 5 to 6 years, Mining sector would increase direct employment by 700,000 and indirect employment by 20+ lakhs, thus creating a major boost for India's economy.

### Exhibit-7: Coal Production Year 2022 by Major Global Economies [m MT, %]



### 2.10 Import of mineral and coal into India

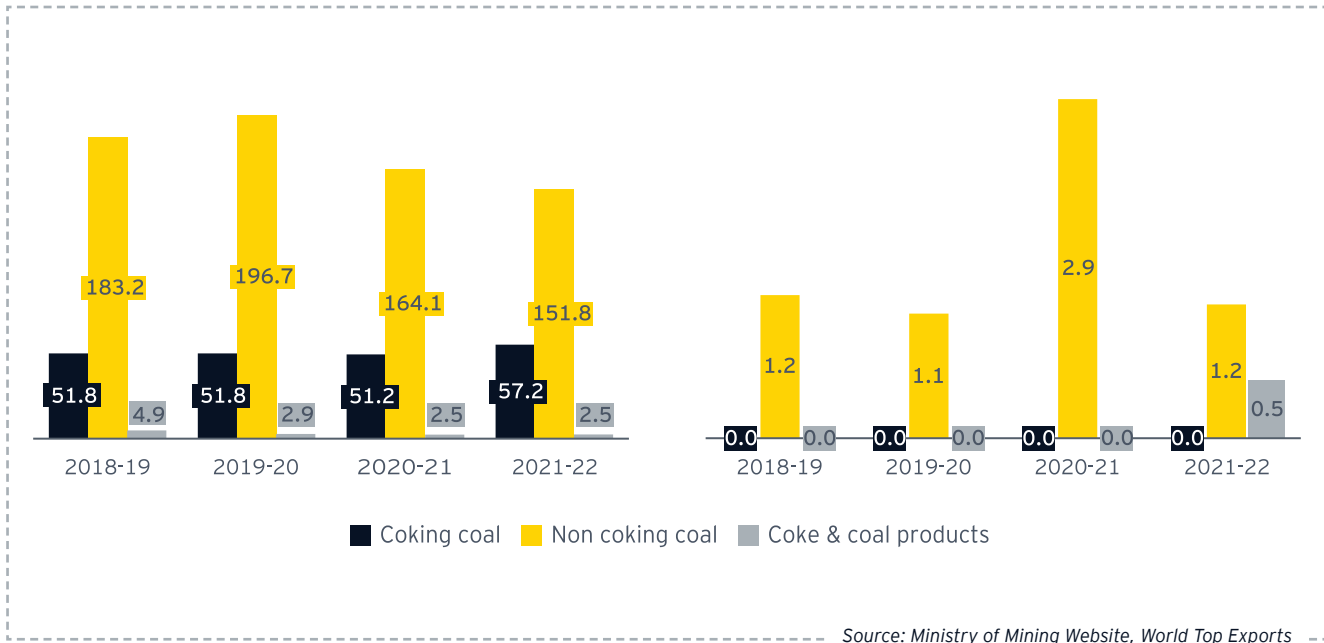
The split between avoidable and unavoidable imports for coal stands at 45% and 55% leaving a space for 100+ million tons of capacity increase in the upcoming years. With imports increasing by a marginal 3.2% YoY in FY2020, states and private power agencies have been asked to utilize the domestic supply of coal. Through the auction of private coal blocks, INR35000 crores is to be invested over the period of 5-7 years, which will not just make India self-reliant but also it will increase employment opportunities. The imports have declined by 4% for

minerals and have increased by 3.2% for coal. Coal is majorly imported from countries like Australia, Indonesia and South Africa which accounts for more than 75% of total imports by India.

### Exhibit-8: Imports Data of Ores and Minerals (MTPA)

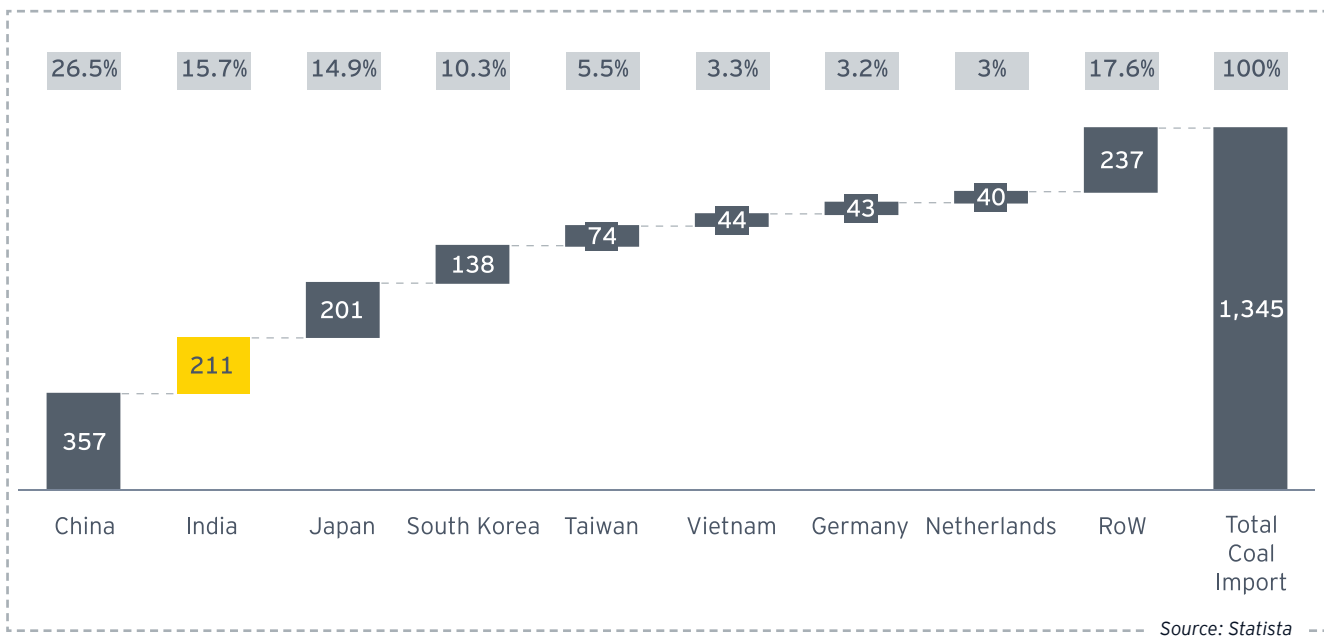
Import data

Export data



The mining sector in India has also evolved over the years to adopt various technologies like large capacity shovels, dumpers, draglines, IPCC, surface miners, to name a few, for open cast mines. Some of the mines in NCL, MCL and SECL are large mines by any global standards producing between 20 MTPA and higher.

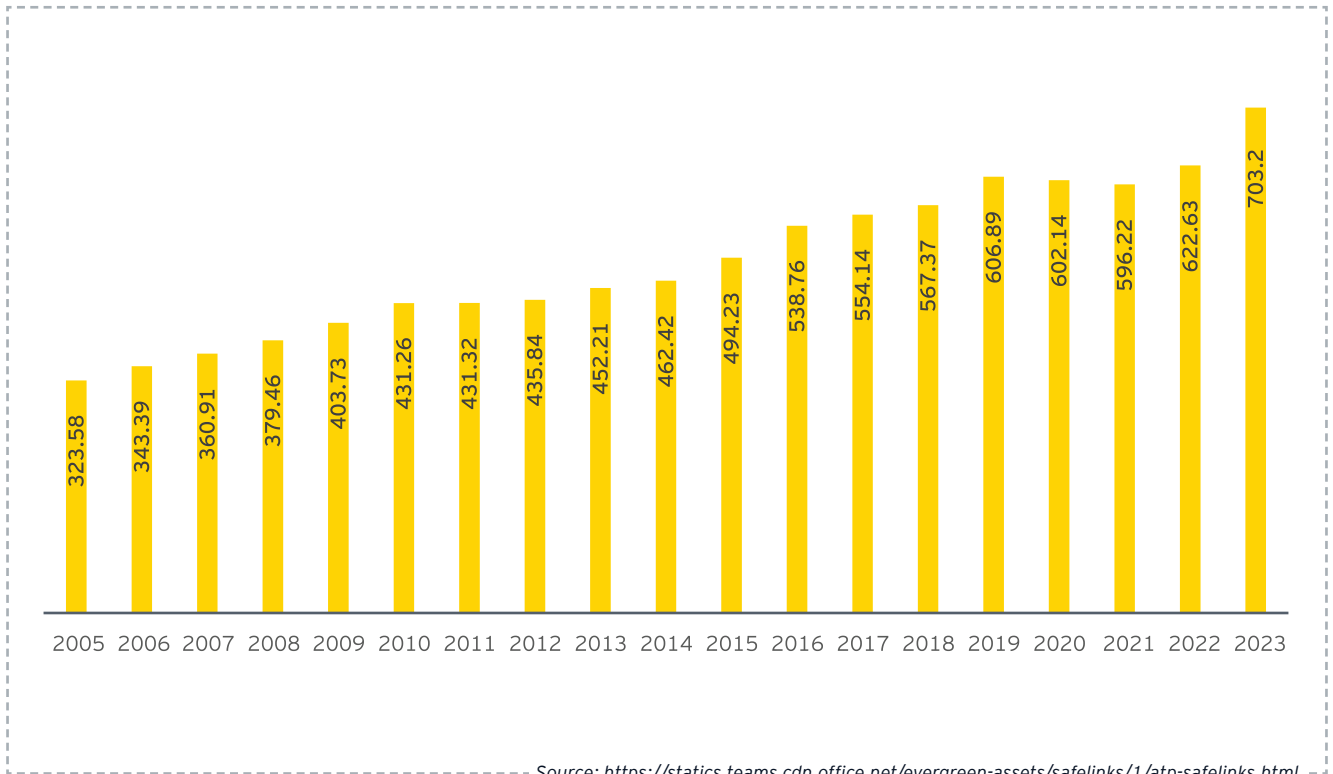
### Exhibit-9: Coal Imports Yr. 2021 by Major Global Economies [mMT]



India stands at second position with respect to total imports made in coal, next to China. Major economies such as Japan, India and China contribute approximately 50% of the total imports made throughout the world. The major economies are moving towards renewable segment, and hence, the productivity enhancement on the existing reserves has become a major criterion to reduce the imports by the countries.



### Exhibit 10: Trend of CIL coal production volumes over the years (Mn. MT)





2.11

Mining Market/Prospect for Odisha

Odisha's GDP grew at 7.82% in 2022-23 which is higher than pre-COVID average growth of 7.1% (2012-13 to 2019-20). Odisha has been recognized for implementing reforms and adopting modern technology in the mining sector. The following figure provides an overview of the share of minerals produced from India and specifically ranking Odisha among the top five states.

Exhibit-11: Comparison of Odisha GDP growth rate (in %) with India

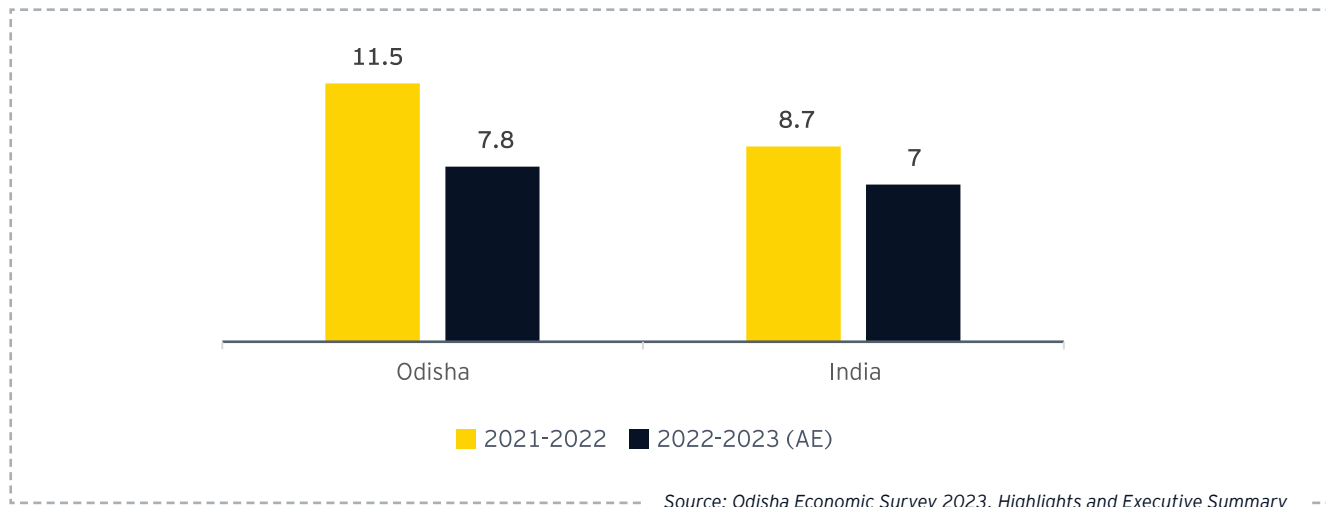
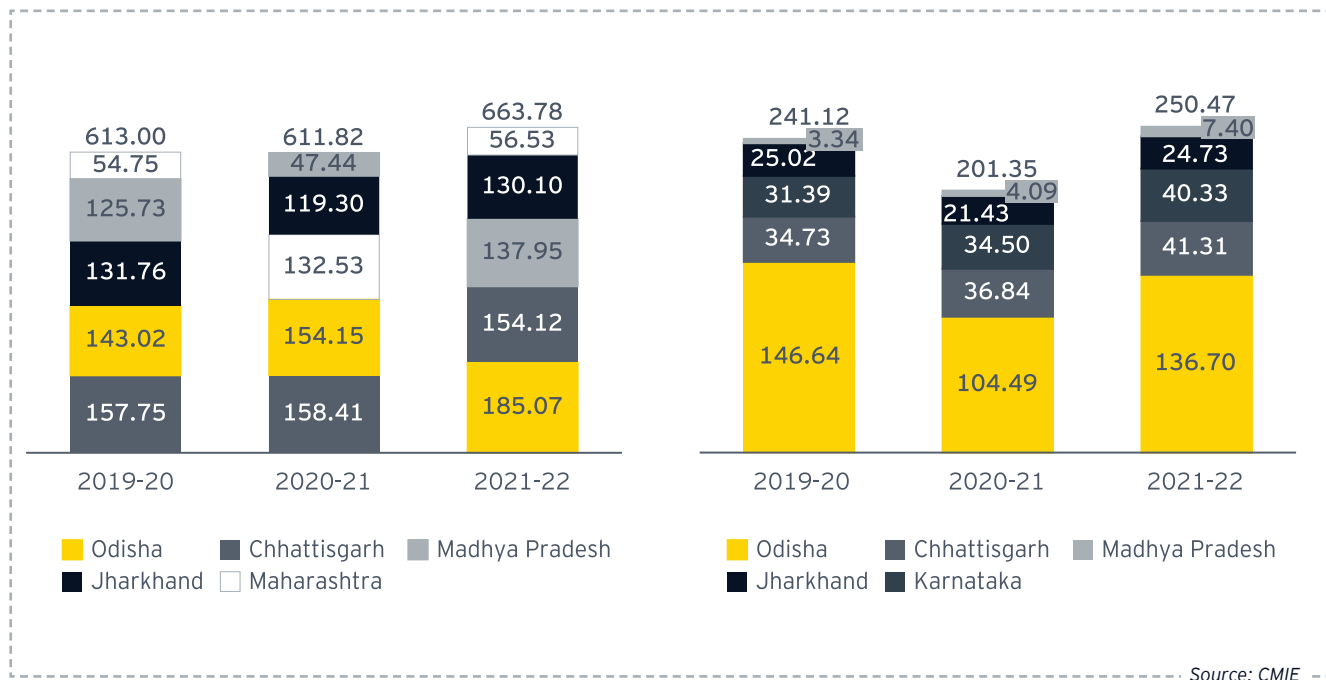


Exhibit-11a: State Wise Contribution of Minerals and Coal Production [MTPA]

Top 5 coal producing states [MTPA]

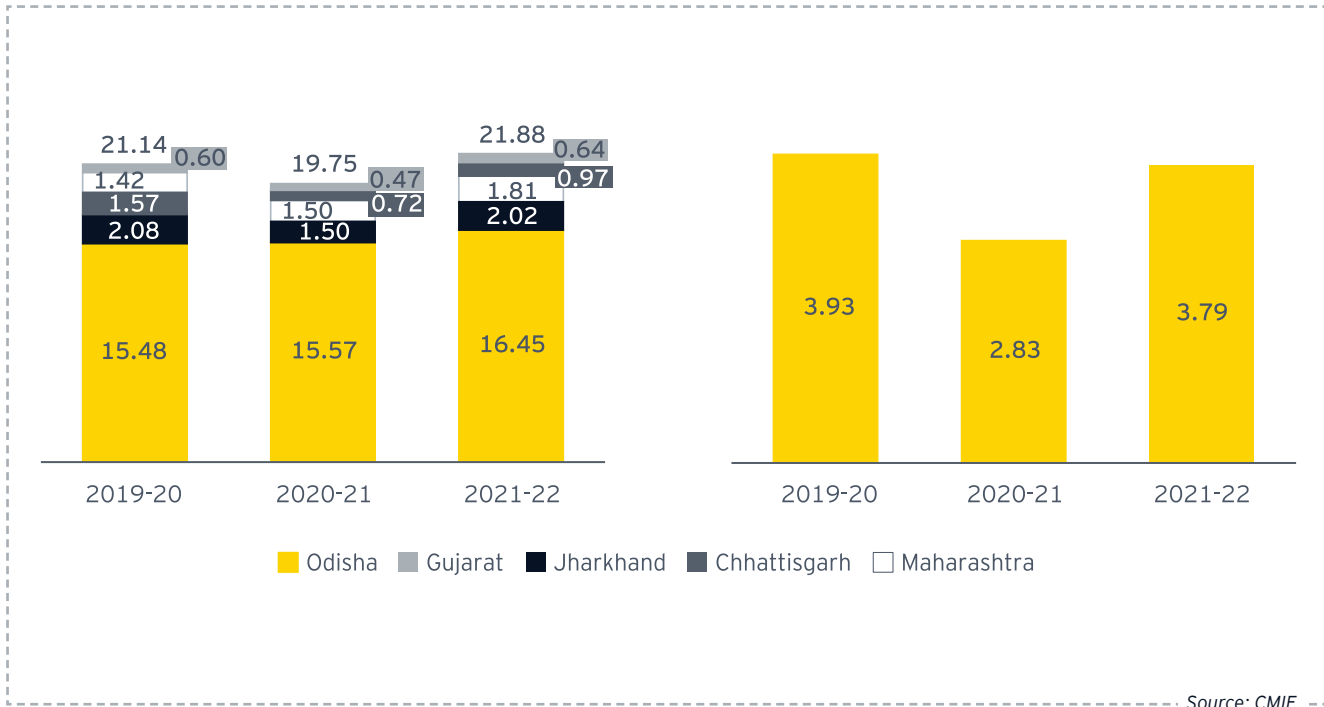
Top 5 iron ore producing states [MTPA]



### Exhibit-11b: State Wise Contribution of Minerals and Coal Production [MTPA]

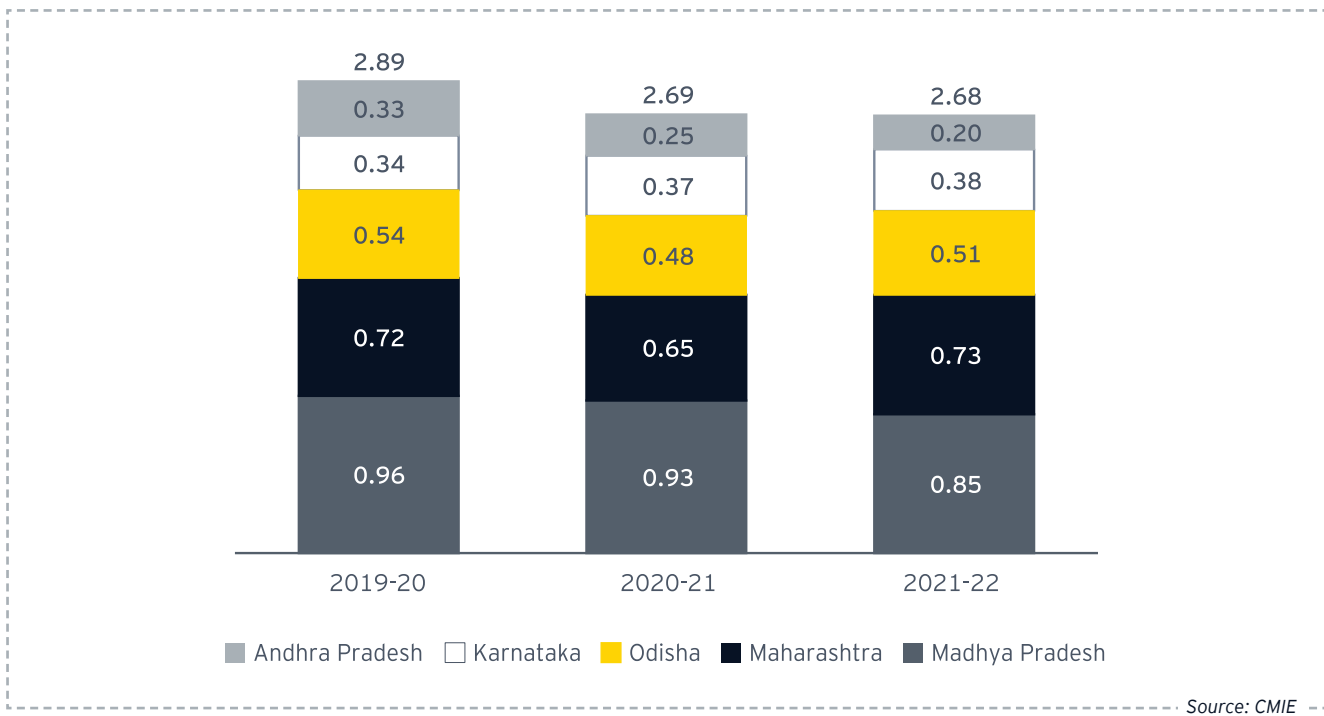
Top 5 bauxite producing states [MTPA]

Only chromite producing state in India [MTPA]



### Exhibit-11c: State Wise Contribution of Minerals & Coal Production [MTPA]

Top 5 manganese producing states [MTPA]



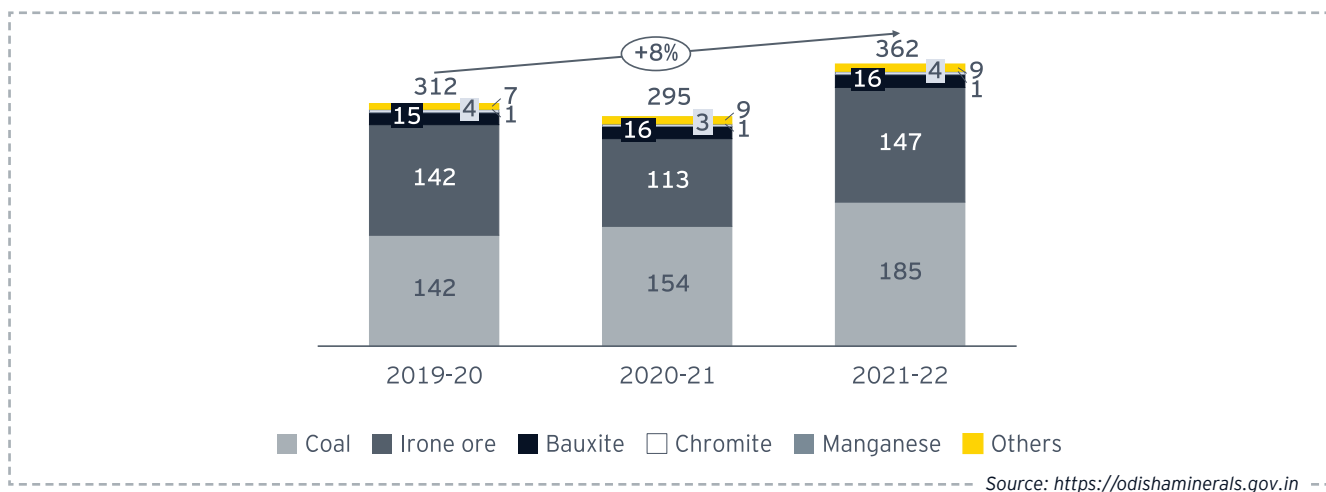
## Mining in Odisha

Odisha is the mineral hub of India and has rich mineral reserves, primarily constituting chromite, manganese, bauxite, iron ore, and coal. Its mineral belt spread across over 600 sq km. The mining and quarrying sector grew at 7.4 percent in 2022-23 and constituted about 10.2% of the state's GVA in 2022-23 and, the share of the state in the country's mining and quarrying stood at 2.9%.

Over the years, Odisha has seen its mineral/ore production increase every year and from 2019-20 to 2021-22, mineral production has increased by about 8% from 312 MT to 362 MT.

### Exhibit-12: Mineral and Ore Production in State of Odisha [MTPA]

#### Breakdown of mineral/ore production in Odisha [MTPA]

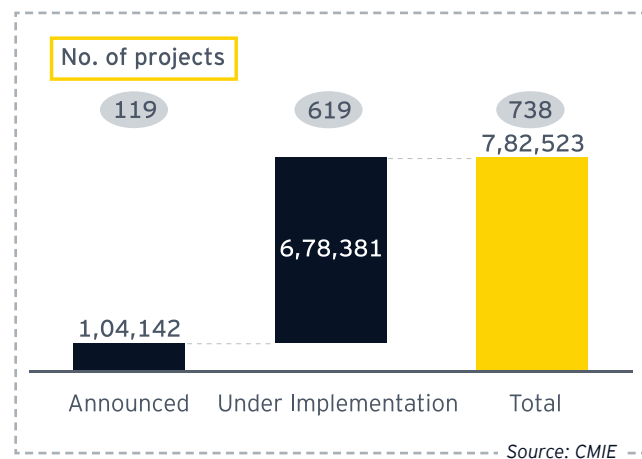


## Mining investment activities in Odisha

Odisha has been classified as an 'Achiever' state in the "Ease of Doing Business" rankings by the Government of India. The state has also undertaken significant measures to develop an investor-friendly industrial ecosystem through the Government of Odisha's Single Window for Investor Facilitation and Tracking (GO SWIFT). Over the last few years due to auction of mines, timely renewal of mining leases, mineral revenues to the State have increased tenfold. In 2016-17, mineral revenues were to the tune of INR4,925 crore which has gone up to INR49,859 crore in 2021-22. All the above factors have played a crucial role in the state attracting a significant number of mining projects from both government and private entities.

### Exhibit-12b: Investment in Mining Sector in State of Odisha

#### Value of mining project investments in Odisha [INR Cr]



## 2.12

### GDP Growth Outlook

India has set an ambitious target for GDP growth in double digits in the next 5 to 10 years in the overall economy. As per IHS Markit, India would grow at 3.90% for the next 10 years in the coal mining space as against its peers such as Vietnam at 5.56% and Indonesia at 4.46%.

Coal mining in India has largely remained with big players like CIL and its subsidiaries for more than four decades. Government of India through Coal India Limited (CIL) has set an ambitious target of 1 billion tons by 2023-24 with its current annual capacity being at 660 million metric tons. The production target of CIL for FY 2024 is targeted at 780 million metric tons.

However, the sector has been opened up for captive usage from FY2015, and with the new commercial mining policy, India is set for a new path of a catalytic growth in the coal and mining sector. With commercialization of coal blocks announced as a part of AatmaNirbhar Bharat Scheme, India is set to keep the coal imports at minimum level, and to explore completely the untapped potential of coal. The move of commercialization is also set to bring competitiveness and allow the use of best possible technology into mining to enhance the productivity.

## 2.13

### Future outlook

India has the potential to become a global mining equipment manufacturing hub, thanks to its skilled workforce, low labor costs, and a favorable business environment. The government's efforts to simplify business processes and provide a supportive environment for manufacturing have helped manufacturers to improve their efficiency, productivity, and competitiveness.

The mining equipment industry would be stable in the near-medium term thanks to the government's continuous focus on infrastructure development. The three critical sectors for driving demand are the transportation infrastructure (roads, rail, airports, ports), urban infrastructure (mass rail transit systems, water supply and sanitation, urban housing), and rural infrastructure (rural roads, irrigation, rural housing).

To boost domestic manufacturing of earth-moving equipment used in mines, Coal India Ltd has announced phasing out of imports over the period of 5-6 years.

As India offers significant potential as an OEM hub due to lower costs and the availability of skilled labor, new equipment manufacturers are expected to establish a base in India. Companies are now moving towards localization of parts as imports are becoming expensive which is increasing the scope of growth in the sector and allied sectors.

With the private participation and constant effort of the government for the development of the mining sector significant growth can be achieved in the upcoming years. Though the growth of the metal and mining industry has been historically driven by domestic consumption moving forward both domestic demand and augmentation of exports will be a critical factor in the growth of the industry and its contribution to GDP growth.



2.14

## Evolving regulatory and policy landscape

The mining and coal sector is also at the cusp of major change through the new policies announced by Honourable Minister of Mines and Minister of Coal, Shri Pralhad Joshi, resulting in auction of new blocks for mining. With this development, commercial mining activities are set to expand and scale up to higher production levels, provide top products and services, and integrate India more closely with global supply chains. This process of change will not only drive further investment in the coal sector but will also drive a significant increase in employment opportunities at the same time. These efforts will supplement ~780 Million metric ton per annual coal production projected by Coal India till FY 2023-2024. The coal mines auction process is expected to lay a strong foundation for energy security in the country by producing additional coal to offset the significant number of imports of coal despite huge reserves in India.

To realize this ambitious vision, there is a clear expectation from the Government of India that stakeholders need to adopt sustainable and technological solutions in mining to make it globally competitive. The shift from a discontinuous mining technique to a greener and continuous mode of mining tends to make the sector more resilient by keeping weather disturbances and other operational uncertainties away. This certainly is a great opportunity to explore and incorporate new technologies like in-pit crushing plants (semi-mobile or fully mobile), conveyorization of mines, employment of continuous mining equipment (bucketwheel excavators, spreaders, mobile transfer conveyors, conveyor bridges, tripper cars, cable reel cars, etc.), digitalization and automation amongst others to drive the next phase of growth.

# 3

## Challenges faced by Indian Mining Sector



The mining industry is currently driven by megatrends including declining ore grades, deeper ore seams, rising labor cost, and increasing energy cost. All of these are adding to the cost of mining and resource extraction. Indian mining is facing a similar issue with the depletion of high-quality ore grades and easy-to-access deposits. This leads to higher energy and water consumption in addition to rising waste levels on account of overburden and processing requirements.

### 3.1

#### People intensive methods

Throughout the cycle, currently focus has been on expansion rather than improvement in productivity to satisfy rising demands. There is no doubt that Indian mining industry is labor intensive. The mines being in remote locations of Odisha, Jharkhand, Chhattisgarh, Karnataka and Andhra Pradesh, it has become extremely

difficult to rope in and to retain highly skilled workforce for a long time. Therefore, there is a major push towards automation across various mining units. Apart from high labor intensity, major costs facing miners in the present approach of mining in India are drilling, blasting, fuel and consumables.



3.2

Price competitiveness

Productivity improvements and increasing efficiency to reduce cost are key economic challenges which the industry must address. This is a priority area is evident from the fact that Indian price/metric tons for mining of coal is not very competitive compared to the global benchmarks. On an FOB price basis, Indian coal is approximately 39% more expensive compared to similar grade coal from Indonesia, compared to higher grade coal from South Africa, Indian costs on FOB basis are higher.

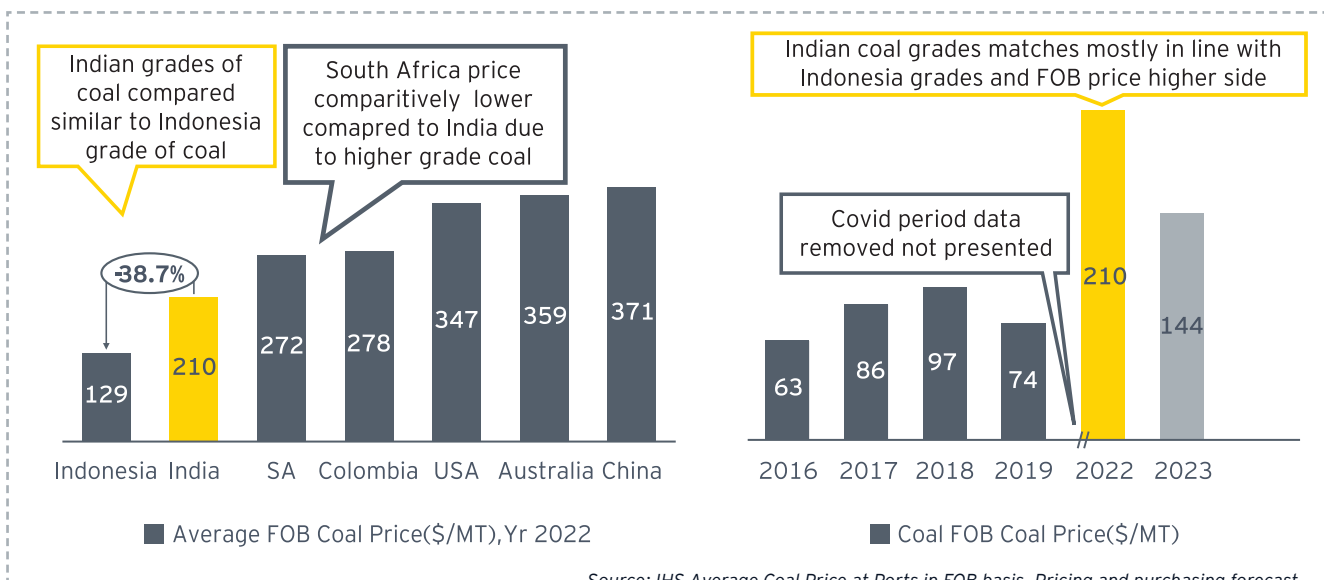
Even though, the gap will narrow when comparing on landed price in India, this is a clear indicator of mining efficiency. Higher cost of imported coal has a direct bearing on the competitiveness of downstream industries. Ultimately, higher cost of power from coal has a cascading impact on the entire economy. It is therefore important for India to find ways and means to reduce the cost of mining further



Over the years coal production has been less during the monsoon season

Exhibit-13: Coal price at major port of shipping across countries in 2022 [\$ per MT, %]

Average coal price at ports of major export countries in US\$ per MT and India: historical and forecast





### 3.3

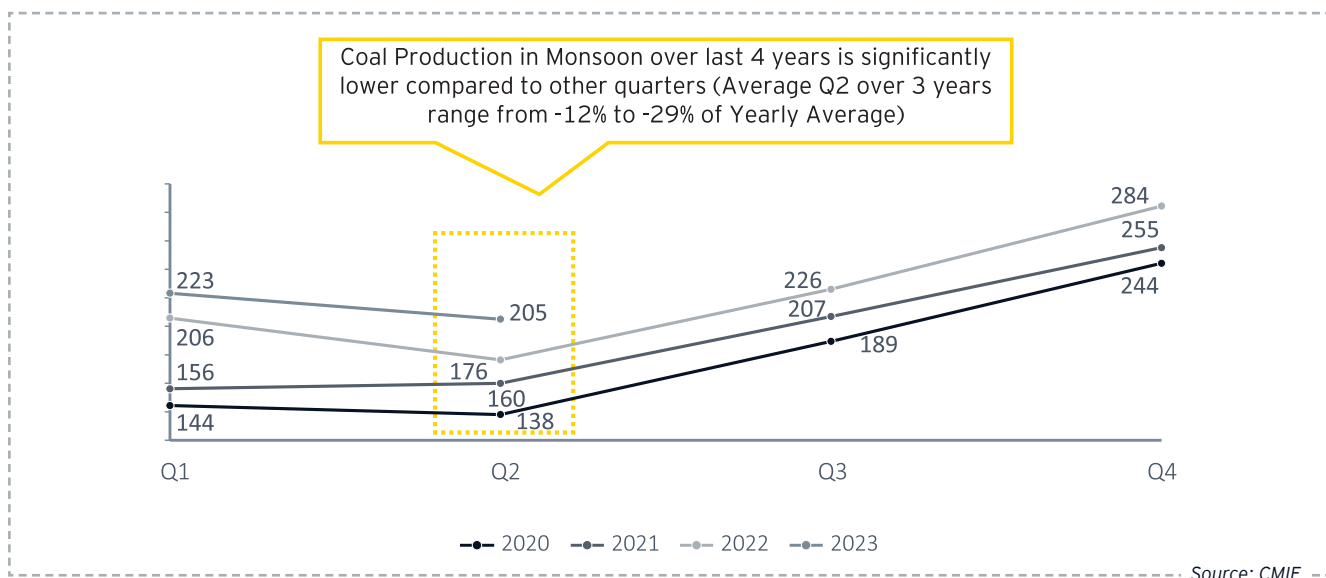
## Seasonal production - impact of weather

Over the years, coal production has been lower than target levels during the monsoon season. Quarterly production data indicates that there is around 25% reduction in production levels during the rainy season. This is a significant loss, and indicates the latent potential for improvement. Further it also indicates that current approaches relying on labor intensive methods as well

as dumper-shovel methods are highly susceptible to weather events. Some mining operations however have also deployed conveyor systems that make it possible to transport hard rock, ore or overburden from a mine more efficiently by the shortest direct route irrespective of weather conditions.

### Exhibit-14: Impact of Monsoon on coal production in India

#### Total coal production: Actual Quarterly Coal Production from FY 2019-20 to 2023-24, in m MT



### 3.4

## Environmental considerations and impact

Current and future challenges associated with mining developments are only partially technical, with a wide spectrum of interconnected 'non-technical risks' that cannot necessarily be addressed through risk management mind-sets. Therefore, in addition to 'below ground' aspects, the industry is increasingly facing challenges situated 'above ground'.

India is a populous country and there are challenges in acquisition of land. Moreover, there are human habitations close to the mines. Major portion of land, forests, villages

within mine areas pose challenges for mining companies. This requires innovative approaches to manage waste to minimize the cost of re-handling the waste at a later date for relocating to its final destination.

Pollution associated with mining is also a great challenge especially for the communities living in the vicinity of the mines. In many mining areas, this leads to conflict higher buffer zones between the mine and villages thereby negatively impacting mine plans and the extent of resources that can be extracted.

3.5

### Challenges faced by MDOs

For large capacity mines (10 MTPA and above) and with operating leases for 25 years or so, MDO organizations would definitely like to improve their operating margins and avoid disruptions during the lifecycle of the mine. However, due to many of the non-technical factors, it becomes important to prioritize 'flexibility' over preferred technical solutions. Consequently, many MDO operators are forced to opt for conventional and labor-intensive mining approaches.

Another aspect is the higher upfront capex of technological solutions - where most MDOs accept that there will be OPEX gains, they are hesitant to move forward with higher capex. It is pertinent to mention here that with policy clarity and stable long-term contracts for mining operations, bankability of such initiatives improves many-fold making it easier to finance the upfront investments.

In certain instances, technological choices become fixed during the mine planning phase conducted in the initial stages. Despite the presence of alternative possibilities, effecting change can be arduous and may not always be readily executable once operations have commenced.

3.6

### Dearth of skilled manpower

With Original Equipment Manufacturers (OEMs) investing in world-class technologies the mining and mining equipment industry in India is witnessing a big 'Technology Revolution'. The availability of skilled workers is anticipated to be a challenge due to an increase in the demand for trained operators and mechanics. Specialized courses on mining equipment operations are not a part of vocational training at industrial training institutes and the high cost of equipment makes hands-on training expensive.

ECE training institutes run by OEMs tend to be expensive for low-income groups. A proficient and certified heavy machinery operator, well-trained and skilled, can significantly contribute to enhancing profitability.

3.7

### Gaps in technology adoption

Automation and robotics can help improve productivity, safety, and efficiency in the mining and mining sectors. However, the adoption of automation and robotics in the Indian mining and mining equipment sector is still low. Telematics and GPS can help to track and manage mining equipment more effectively. However, its adoption in the Indian mining and mining equipment sector is low.

Electric and hybrid equipment can help reduce emissions and improve fuel efficiency. However, adoption of electric and hybrid equipment is still in its early stages.

3.8

### Availability of low cost-long term financing

Financing becomes an issue, as OEMs offer limited financing options, and the payment terms for first-time users are unfavorable. NBFCs are the largest players in this sector with about 70-75% share of financing. The IL&FS default caused a liquidity crisis among NBFC lenders who have become cautious of lending to the sector since recovery is a big challenge. The availability of low-cost, long-term financing is a challenge for the industry due to the following factors:

- 1. High risk:** The mining sector is a capital-intensive sector with a long gestation period. This makes it a high-risk sector for lenders
- 2. Lack of collateral:** Many companies in the mining sector do not have sufficient collateral to secure loans. This makes it difficult for them to access finance
- 3. High interest rates:** Interest rates in India are generally high, which makes it expensive for companies to borrow money
- 4. Short repayment terms:** Lenders are often reluctant to offer long-term loans to companies in the mining sector. This is because the sector is cyclical, and companies may not be able to repay their loans on time

3.9

### Overseas dependency on Critical Components

India is heavily dependent on imports for mining equipment. The Indian government aims to reduce the annual imports of heavy mining equipment valued at more than INR35 billion (\$465 million) by fostering the domestic production of such machinery. According to the coal ministry, Coal India alone imports high-capacity equipment incurring a customs duty of INR 10 billion. India seeks to reduce its dependency on imported heavy machinery and enhance domestic manufacturing capabilities and minimize downtime, which can occur when imported equipment breaks down due to spare parts issues.

In addition, market fluctuations make capacity planning difficult for component providers. As the market is very price and value-conscious, the suppliers are constrained for operating margins, as a result, they tend to focus on items at the lower end of the technology spectrum, relying on imports for value-added items.

There is a high dependence on the import of precision components, hydraulics, undercarriages, and electricals/electronics from Korea and Japan. Consequently, there is a gap in terms of technology adoption at the supplier end, where the market demand is not met with indigenously manufactured components.

3.10

### Environmental challenges

The mining equipment sector generates a significant amount of waste. This waste includes used tires, batteries and lubricants. This requires a proper end-of-life treatment mechanism in place.

There is an increased focus on ESG in the mining sector due to which the companies want their suppliers to have high ESG ratings, supply sustainably advantaged equipment and preferably have a decarbonization target in place.

Mining equipments consume a significant amount of water. This water is used for cooling engines, washing machines, and other purposes.

# 4

## Multi stakeholder view for development of mining and mining equipment sector

## 4.1

### Social license to mine

Mining creates a large array of challenges and opportunities. In addition to established criteria of efficiency and productivity, social and environmental factors have increasingly received attention locally at a country level as well as at the global level.

Social and environment challenges now constitute a significant risk, as the costs associated with taking care of social disruptions and mitigation of ecological impact (which can be quantified by environmental scientists using well established procedures) are quite substantial. If these aspects are not properly addressed to the satisfaction of all stakeholders, the resulting disruptions can derail the entire mining activity and result in negative financial consequences. The industry therefore must be prepared, and rightly so, to address societal expectations for a more sustainable operation.

As part of a recent initiative to understand this topic better, thyssenkrupp constituted a think tank consisting of members drawn from industry and academia with social and anthropology backgrounds and diverse ethnic representation. The resulting report stresses the need for:

- ▶ Equipment and systems that acknowledge need for respect to social and environmental aspects
- ▶ Scale and magnitudes must assist reduction of environmental degradations
- ▶ Interaction with all stakeholders for addressing their social and environmental expectations

Compact bucket wheel excavator, in-pit crushing and conveying systems (semi-mobile or fully mobile) and downstream equipment for the coal mining industry attaches due respect to these above aspects. While downstream equipment and facilities are in scale up mode in India, key equipment for mining face is these question. 'Blast Free Mining' is certainly critical for improving corporate-community relationships and increasing societal acceptance of mining. These are a few of the areas that require thoughtful consideration.

## 4.2

### Policy and regulatory environment

Government, mine owners, consultants, MDOs, commercial miners, funding agencies and equipment suppliers need to work together and formulate an approach that is executable with due respect to societal and environmental aspects while being economically feasible. Government bodies should take the lead to lay down policy guidelines and constitute a multi-stakeholder team to develop the necessary recommendations. Government, as a stakeholder, can create an investor-friendly environment by ensuring that:

- ▶ Laws/regulations are transparent and stable.
- ▶ Taxes/royalties are stable, transparent, and set at certain levels which balance the state's need for revenue against investors' need to secure an optimum return on investment (RoI), proportionate to the risks involved in the venture.
- ▶ Facilitation is a key function of the government to attract investment in mining. There is a need for the Ministry of Coal and Mines to be a one-stop-shop for mining investment. So, a prospective mine operator, seeking to undertake exploration/exploitation, might be able to obtain all the necessary permits online or by visiting the Ministry of Coal and Mines.

Much progress has been made in recent years with a number of initiatives being taken by the government. The National Mineral Policy 2019 has helped improve transparency and is intended to improve regulation and enforcement of norms as well to ensure well balanced socio-economic development of mining. With the Mines and Minerals (Development and Regulation) (MMDR) Act, 2020, the sector has seen a further boost in the coming years, particularly from an ease of doing business perspective.

### 4.3

## Financial investment and funding

Investors include not only owners and shareholders with a direct interest in the ventures related to mining but also financial institutions.

With the right ecosystem in place, mine operators would be able to tap domestic and international markets for funding heavy upfront capital expenditure. A low cost of funding is a crucial aspect of ensuring low cost of mining and globally competitive operations. Additionally, the government may choose to maintain an equity participation in mining ventures not only for financial gains but in order to gain influence on the conduct of operations or to secure supplies of products from the mine.

Attracting foreign investors into mining operations will require a stable policy environment which reduces the risk of profit loss due to change in regulations. Equally important is ensuring long term operational leases and expeditious assignment of necessary permits and approvals for a seamless operation. A significant improvement in the 'Ease of Doing Business' is a great step forward in this direction, however more actions are required to attract international players into the mining space. This is particularly true for coal, where concerns with green-house gas emissions have made investment in coal mining much more complicated and difficult to realize.

### 4.4

## Equipment manufacturers and technology providers

Technologies can transform and increase efficiencies in any sector, making it a point of differentiation for any business to thrive. Mining and coal sector is no exception. In the mining industry, advancements contribute to greater recovery from the ores by employing minimum resources, flexibility in operations, enhanced productivity while ensuring optimum standards of safety, and reducing operational cost.

Employing greater level of automation, application of Industrial Internet of Things (IoT) and robotics are the niche areas where OEMs can focus upon to achieve their required objectives. Also, this will allow companies to maximize efficiency, while decreasing variability and better identification of performance issues.

Development of mine plans and specific project plans must take into due consideration the latest available technologies. Further, mine operators such as Coal India and its subsidiaries and NTPC need to maintain their emphasis on research and development and demonstrate necessary leadership in the introduction and adoption of new technologies. The introduction of surface miners is a great success story in Indian mining. However, more such success stories are necessary. A constant pipeline of new generation equipment and methods can help India become a leader as the most competitive mining nation.

### 4.5

## Mine planners

Mine planning bodies like CMPDI, consulting entities or even in-house teams have an outsized impact on the development and success of mining operations. They are intimately involved in the entire phase from exploration of minerals to infrastructure engineering to environmental management concepts and management systems for mining operations till the very end with mine closure plans. Their role in dealing with multi-dimensional environmental complexities of the coal and mineral sector promoting environment-friendly designs for meeting the expectation of all stakeholders is vital.

The constant challenge before these teams is keeping abreast of new developments and being at the forefront of development of new ideas and solutions which address the unique challenges faced by the mining sector in India. As such it would be a good idea to foster a more collaborative and consultative approach through the formation of a Mining Think Tank which will bring mine planning bodies at the centre of an exchange with technology providers, operators, MDOs and investors. An initiative such as this will enable a constant generation of ideas and enable a clear line of sight on emerging challenges facing the industry and the best way to address the same.



## Mining companies and operators

As we reflect on the multitude of topics that mining executives must deal with, we realize that this is certainly an unenviable task. Still, we recommend that those who are engaged in/have an oversight on active mine operations should focus on three key priorities:

- ▶ Developing a scenario-based business strategy
- ▶ Climate-proofing mining operations
- ▶ Engaging stakeholders with an inspiring narrative - articulating an inspiring mission and communicating the same to all stakeholders through a constant process of dialogue.

### Scenarios based business strategy

Any mining operation is far from certain and faces many unforeseen challenges. Therefore, miners need a strategy that is adaptable to a range of possible scenarios. While structuring their approach, mining companies should focus upon following:

- ▶ Developing an inventory of operational risk factors specific to the mine and their impact on business. These include equipment in use, local topography, labor and staff, local climate, and weather patterns to name a few.
- ▶ Impact of climate change related regulations and policies and their effect on demand and resultant pricing for commodities
- ▶ Impact of stakeholders including national and local government initiatives and potential consequences of actions of local societies on mine operations
- ▶ Focus on innovations/new technologies which might benefit the customers and change customer preferences. A prime example is the COVID pandemic that has led to/accelerated changes in customer behavior and consumption patterns through adoption of new technologies at a speed that was not anticipated.
- ▶ Various scenarios and simulations need to be run by mining companies to gauge the implications of the same and appropriate responsive strategies must be in place.

### Climate-proofing operations

Mining activities are resource intensive, and they are generally carried out in areas which are ecologically sensitive and vulnerable to climate change. So, to

climate-proof their usual operations, mining companies need to focus upon these areas:

- ▶ Reducing direct and indirect carbon emissions - electrification is a means to reduce the requirement of diesel. There is a potential to source electricity from green/renewable sources
- ▶ Ensuring operational resilience to the effects of changes in the climate - including from regulations (local, national, global) being developed because of climate change
- ▶ Making climate conscious decisions integral to business decisions and establishing internal incentives so that this becomes a priority across all parts of mining operations
- ▶ After assessing various scenarios and simulations relating to the impact from climate change, diverse response options should be devised so as to ensure business resilience is built up to tackle unfavorable developments.

### Engaging stakeholders with an inspiring narrative

There is intense environmental scrutiny on mining activities, not only from a perspective of disruption to ecological disruption to status quo prior to start, but also from the adverse impact from day-to-day operations and end of mine rehabilitation. This is even more severe when the focus of mining operations is on coal.

Under these circumstances, a failure to properly articulate actions being taken for safe and sustainable mining practices potentially can bring operations to a halt and even result in cancellation of rights to mine in extreme cases.

Mining companies must aim to communicate more openly and actively. There is an urgent need to become more inspiring in explaining their position on climate change as the part of their business mission. The foundation of the mission should have a shared sense of purpose and values among all the stakeholders involved. Regulators and shareholders have a role to play in supporting companies in their efforts to tackle climate change issues and in helping define a meaningful agenda. However, there is no room for doubt here, clearly the bulk of responsibility lies squarely with mining executives.

## Mining workers' technological shift

Mining has traditionally been a labor-intensive industry. This is particularly relevant in remote mine locations where there is often a paucity of meaningful employment opportunities. Many studies indicate that mining and coal sectors have to play a crucial role in driving up employment in their areas of operation. As per an assessment during the 12th plan period, for every 1% increase in economic growth, mining as a sector generates 13x more employment than agriculture and 6x more employment than manufacturing.

However, it is also true that mining is increasingly becoming more and more mechanized with the introduction of modern and more sophisticated equipment. Particularly with the incorporation of digital technologies, Internet-Of-Things and sensors in all aspects of the operation, it is now moving towards the cutting edge of technology.

With this evolving scenario, the following key drivers will shape the future of work and skills required in the mining sector:

- ▶ Skill development and enhancement programs:
- ▶ Across the value chain, it needs to be ensured that training programs (and foundation courses) must deliver the core skills that will allow staff and workers to embrace new technological opportunities.

Skill development programs will need to educate existing workforce to the new world of work, through innovative training; re- training/ re-skilling important for smooth transition for new types of tasks. This would be key for avoiding redundancy and at the same time to ensuring that right skill sets are available to drive the necessary productivity improvements in operations. Further, dynamic learning initiatives must be incorporated during the life cycle to ensure that people keep pace with technological progress and other factors of change.

- ▶ Key focus areas need to be on operation and maintenance of next generation of machines which have a higher degree of electronics, sensors and digital capabilities embedded in them. A focus is required in the new areas apart from the regular electrical, hydraulic, and mechanical aspects that have been the core skills till date.
- ▶ Attracting talent for mining sector: Mining industry needs to recognize that the opportunities available to young talents have multiplied several folds. It is not enough to offer a job, but to attract talent with a broader sense of purpose, and as well an environment enabling career growth. This is particularly complicated as the next generation may not always perceive mining as sustainable or environmentally friendly which requires focused efforts to engage with young talent at an early stage to establish a positive image of mining industry as a career opportunity.

Towards this end, mining industry must engage and collaborate with training institutions more closely to upgrade the existing curriculums to refocus on building skills that will cater to the requirements of new approaches to mining. At a worker level, it is worthwhile to evaluate dual-education initiatives such as those successfully employed in Germany to revitalize the existing ITI and trade skill institutions in India. The apprenticeship approach employed in Germany fosters a close connect early on with young talent and through early exposure to practical work environments, fosters the development of right skills, and a greater appreciation of the operations and work involved. This is a win-win for industry and students as it helps develop critical skills and bonds with talent that ensures a more stable work force.



## Promote sustainable initiatives

The environmental impact of the sector poses a serious threat to its growth. Some of the steps that can help in improving sustainability in the sector includes:

### Promote the use of renewable energy sources

The Indian government can promote the use of renewable energy sources in the mining industry by providing financial incentives to companies that use renewable energy, such as tax breaks or subsidies. The government can also invest in research and development of renewable energy technologies for the sector. Coal India has recently planned to install 600 MW of solar panels across its multiple plants. Hindustan Zinc also has planned to add 115 MW of solar, with existing 474 MW of thermal power and 274 MW of wind energy.

### Maintain energy efficient standards

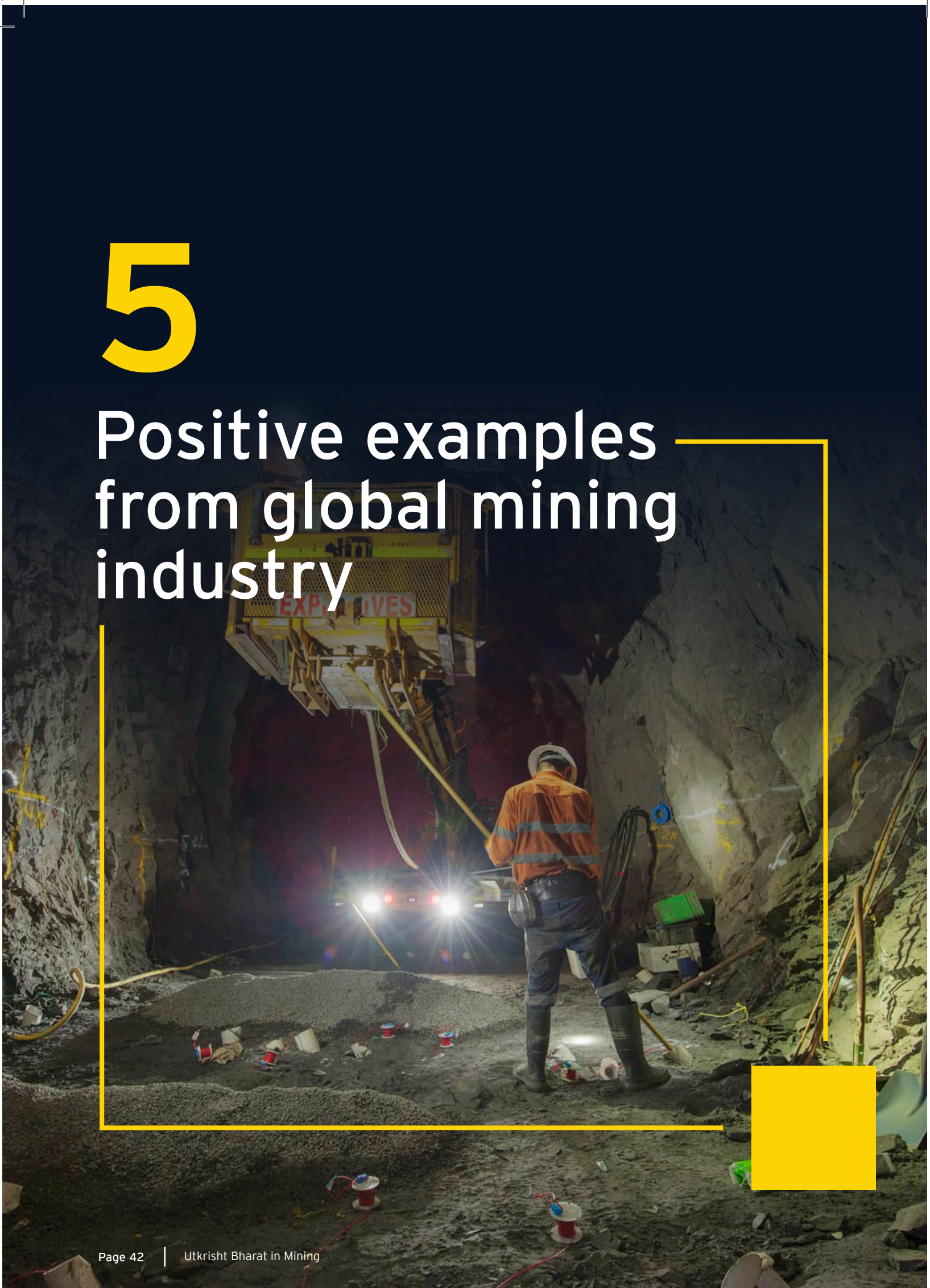
ESG is gaining importance in mining sector enabling it to achieve the Sustainable Development Goals (SDG's) through socio-economic benefits, supply of raw materials, employment, and livelihoods. Union Ministry has asked Indian mines and mineral industry to reduce the carbon footprint by 30-40% by the year 2030 through sustainable initiatives. Opportunities for emissions reduction in mining includes decarbonizing the electric supply, implementing smart microgrids and electrifying equipment. Adoption of cleaner fuels like hydrogen is being explored by Tata Steel in India for steel generation to cut down the emissions by 30-40%.

### Initiatives for Green Mining

Decarbonization of power and transport sector has moved forward due to the use of renewable energy-based solutions. Industries like iron, steel and cement have also started to focus their attention on sustainable options like decarbonizing technological interventions to substitute the production process with the cleaner alternatives. Tracking carbon capture, utilization, and storage, replacing convention energy sources with hydrogen or alternate fuels can promote adoption of the clean technologies. Scrap re-usage can help in conserving energy used in mining.

# 5

## Positive examples from global mining industry



## 5.1

### Mechanization and continuous mining approach

Indian mines for coal, iron ore, bauxite, limestone, and other minerals should try to use mechanization to the maximum extent using continuous or semi-continuous mining technologies. The aim should be to use conveyor systems preferably long-distance belt conveyors both trough and pipe conveyors which can transport materials over undulating terrain with horizontal and vertical curves thereby increasing efficiency of material of material transportation. Using this mode of transportation, the material transfer from one conveyor to another can be reduced or even eliminated thus increasing

efficiency, reducing material loss, reducing pollution. These conveyors can travel downhill or up the slope and cross rivers and valleys with minimal damage to the environment, flora, and fauna. For mining operations, new technologies like semi-mobile crushing plants or bucketwheel excavator systems should also be evaluated as over a period of time they have the potential of significantly improving efficiency by employing few large capacity equipment and eliminating dependence on labor intensive methods.

## 5.2

### Digitalization of mining operations

#### Adoption of IIOT at a major mine in Brazil

A mining client wanted to review their mining process adopted at the mine with the goal of reducing fuel consumption, water consumption and CO<sub>2</sub> emissions. This was a unique challenge with multiple dimensions - requiring technological, environmental, and logistical interventions throughout the value chain of a mine. The solutions were developed keeping in mind the need to minimize environmental footprint of the mining operations.

The solution proposed was to adopt a truck-less system, along with mobile excavators and crushers interconnected through long distance conveyor belts measuring up to 9 km. Judicious use of Internet of things (IIOT) technology ensured that compatible systems communicate amongst each other for optimal efficiency. Further, it was proposed to adopt dry processing of the ore in a modular processing plant, efficacy of which had been established during the development and design phase.

The result for the mine operator has been tremendous with fuel consumption reduced by an estimated 30% and savings in water consumption estimated to be 7%. Through the adoption of new technologies, a combined saving of about 130 thousand tCO<sub>2</sub> and 18,000 MWh/year in GHG emission and electricity, respectively was achieved. Further, the client was able to achieve a 40% reduction in deforested area as a result of this intervention.

#### Mine of the future in Australia

Major mining entities in Australia have been at the forefront of innovation and digitalization. This is necessitated on account of the remote location of the mines, large scale of operations/distances involved and as well the limited workforce available to manage operations at such remote locations.

A key enabler of mining operations has been MAS (Mine Automation System) which essentially operates like a network server application, pulling together data at sites and mining it for information. MAS provides this

information in a common format, using sophisticated algorithms. It can be displayed visually using data visualization techniques or through more conventional operational type dashboards with graphs, charts and tables. A 3D gaming engine is developed for getting a line of sight into the operations. Anybody can fly over a site and dive down to the detailed information that they need at the click of a few buttons. Tasks such as hovering over an excavator, following a haul truck or examining an ore-body are made possible. Any new features of the software can be remotely rolled out to all sites around the world in a matter of hours, capturing synergies across the businesses and yielding big savings in time, effort and expense.

With this approach, the mining company has been able to operate effectively one of the largest fleets of driver less trucks in the industry. These trucks are fully remotely controlled which ensures a higher level of safety and reduced level of fuel consumption.

## 5.3

### CFBCs for washery rejects

Indian coal is unique in particular due to the high ash content of our coal. This poses several challenges for end users. In general, high ash content creates problems and challenges for coal users that include, but are not limited to,

- ▶ higher erosion rates of equipment,
- ▶ difficulty in pulverization of fuel,
- ▶ poor emissivity and flame temperature,
- ▶ low radiative transfer reducing thermal efficiency,
- ▶ generation of excessive amounts of fly-ash containing large amounts of un-burnt carbon
- ▶ needs for ensuring 100% utilization of resultant ash as per government regulations

Driven by a need to address these challenges and also driven by the increased environmental regulations in a competitive power market scenario, major coal mining companies and MDO are installing/planning to install coal washeries to improve the quality of coal by reducing ash content of the coal. However, this results in the generation of significant amounts of coal washery rejects which need to be managed appropriately.





Fortunately, coal washery rejects can be utilized as fuel for Circulating Fluidized Bed Combustion (CFBC) boiler-based power unit. This has a twin benefit of ensuring proper utilization of waste and at the same time the power generated can support mining operations. This is particularly useful as many mining operations are far from any electricity grids. Adopting CFBCs for managing washery rejects helps mining operations become self-sufficient in their energy requirements and also eliminate the need to diesel-power, enabling a net reduction in emissions. Cold cyclone-based technologies are highly suited to these applications as they are highly efficient, can burn the coal washery rejects in a controlled manner and ensure latest emission regulations for SO<sub>x</sub> and NO<sub>x</sub> are met.

# 6

## Case studies from mining industry



6.1

## Case Study 1

### Continuous Mining at Neyveli Lignite Corporation - NLC India Ltd.



**Shri. K. S. Anandan**  
Retired Ex Director  
Mines, NLCIL.

“On this occasion I convey my best wish to CII and thyssenkrupp Industries India Pvt. Ltd. and EY, hope the deliberations will lead to fruitful and productive outcomes.

#### About Neyveli Lignite Corporation - NLC India Ltd.

Neyveli Lignite Corporation - NLC India Ltd. is a pioneer in the field of lignite mining in India. NLCIL presently operates four opencast lignite mines namely Mine-I of 10.5 MTPA, Mine-II of 15 MTPA. Mine-IA of 3.0 MTPA at Neyveli, Tamil Nadu and Barsingsar Lignite Project (BLP) at Rajasthan of 2.1 MTPA, thus producing 30.6 MTPA of lignite.

#### Overview

Lignite is a low calorific fossil fuel for producing electricity. About 38.75 billion tones (BT) of lignite reserves of various categories have been identified in India of which around 31.4 billion tons are available in Neyveli region. Neyveli Lignite Mines are situated about 200 km Southwest of Chennai in South India. They are the biggest opencast lignite mines in South East Asia. The lignite produced is primarily used for power generation. In terms of mine characteristics:

- ▶ Thickness of overburden varies from 45 meters to 110 meters.
- ▶ Lignite thickness varies from 8 meters to 26 meters.
- ▶ Average stripping ratio at NLCIL mines is 1:5.5 and in Mine I A alone it is 1:7.

The continuous mining technology using Bucket Wheel Excavators, belt conveyors and spreaders are deployed in Neyveli mines for excavation of overburden as well as lignite. The decision to go in for continuous mining system was taken in view of the strata conditions of Neyveli, which was not conducive to conventional system of mining by deploying shovels and dumpers.

The technology designed to handle comparatively soft overburden and lignite in German lignite mines was imported and adopted in Neyveli lignite mines in early 1960s. More diverse and difficult conditions were encountered at Neyveli lignite mines. Accordingly, the BWEs were modified and improved in design to tackle hard sandstone and also sticky clayey soil successfully at Neyveli mines. By and large, BWEs underwent major technological advances to suit Neyveli hard strata conditions.

## The challenges to be addressed were as follows

- ▶ To increase the capacity of the mines in accordance with the expansion of the Power Station capacity.
- ▶ To increase the performance of Bucket Wheel Excavators (BWEs) in the hard strata and in the sticky strata.
- ▶ To reduce the choking of the conveyor belts.

## Approach adopted

Physical and geological investigations at NLCIL showed that the nature of sandstone in the overburden strata varies from very coarse-grained hard sandstone to very fine-grained friable sandstone. The hematite nodules embedded in the formation offer a very high resistance to the teeth of bucket wheel excavator. Earlier, the machines that were installed had to be stopped for a major portion of the time for changing the teeth alone. Many field tests were carried out and some improvements were realized by changing the following:

- ▶ The design of the teeth (initially spade shape teeth used in front of bucket had been changed to ripper type). The angle of fixing them to the bucket and cutting lips.

Improvements were also made and carried out progressively in other main parts of the machines such as turn table, under carriage, crawlers and pivot points.

In addition to hard abrasive overburden soil, an entirely different strata were also encountered in Mine II of NLCIL, which is located 5 km, south of mine. A blackish alluvial clay formation occurs on the top 7 to 17 m thickness in the southern portion of second mine. When wet, this clay absorbs water, swell (about 1.6 to 1.7 times) and become plastic (plasticity index of about 35%), soft and slushy. This soil (Alluvial Clayey Overburden) was choking the bucket and the excavated soil was not freely discharging from the buckets. The capacity of the buckets was therefore getting reduced due to the clay build up on sides and the back of the bucket resulting in low excavation rates. At times the entire bucket was fully choked/packed with clay. About 25% to 30% of the soil excavated spilled onto the ground necessitating repeated dozing for clearing and re-handling of the soil. Further, the existing conveyors were made of fabric ply belts which

had limitations on the length and hence the number of transfer points were increased resulted in choking of transfer points.

The choking problem was eliminated by increasing the handling capacity of the conveyor by 25% to 30% more than the loading equipment capacity. The introduction of steel cord belts eliminated number of short conveyors. As the heavy drive heads of higher drive powers were introduced, they were moved using hydraulic walking pads. Presently, the drive head stations with all electrical and drive units weighing more than 500 tons are in use and moved easily by a crawler mechanism called "Transport Crawlers". With the introduction of steel cord belt further improvements were also made for improving the performance of the conveyors.

## Results and improvement in performance

All the specialized mining equipment and BWEs, conveyors, spreaders etc. installed for Mine-I expansion have been improved and modified further to suit the conditions specific to NLCIL mines. Similarly, equipment deployed at Mine-II are all of advance design to suit NLCIL mine conditions. Due to these modifications and improvements, the performance of mines improved and targets achieved.

The mining equipment procured for Mine-IA and Mine-I Expansion are PLC controlled. Hence, the working hours of these equipment are reaching more than 6000 hours per year. The equipment for Mine-II expansion, all incorporated the latest available technology like VVVF, PLC amongst others.

To reduce the need for frequent changes in bucket teeth and to avoid the resultant down time, tungsten inserts were brazed on to the teeth. As a result, the life of the teeth could be progressively improved to more than 250 hours with constant innovation and improvement. However, the shock loads on account of hard and abrasive soil conditions, reflected on the other machinery parts, particularly the bucket wheel drives, bearings, shafts and ultimately the loading boom structures. These were therefore strengthened and modified suitably with the co-operation of the manufacturers and the material composition was improved to withstand greater stresses and strains in the structural parts.





Several modifications were carried out for the satisfactory handling of the sticky clay and proper discharge from the buckets. Various experiments were conducted and finally bucket lining of high-density polyethylene, teflon sheets proved to be effective and is being done meticulously till now. Similarly, the solid back of the buckets was cut open and chains were used at the back of the buckets. The sticking of the soil was reduced considerably in the chain backed bucket due to the whipping action of the chains and the soil is getting discharged thereafter from the bucket easily, resulting in improved production performance.

The installation of suspended garland type idlers instead of fixed idlers was one of the major modifications in the conveyor design. These idlers have an in-built tendency to make the belt run centrally, so that damage to the belt

could be avoided. They provide additional cushioning to stabilize the soil just as it exits the tail station or transfer points. The return belt is also supported on two-part suspended garland rollers.

Every mine operation is unique and presents its own challenges. However, the experience at NLCIL clearly indicated that with close collaboration between OEMs and Operators, many of these challenges can be easily addressed resulting in the smooth operations and cost savings.

## Coal Handling Plant at NCL Jayant OCP



**Shri. Somnath**

“I convey my thanks to CII, EY and thyssenkrupp Industries India Pvt Ltd for highlighting the importance of mechanization of Indian mines which will be highly beneficial for the nation by reducing environmental pollution, carbon footprint and other social benefits.

### About Northern Coalfields Limited India

Northern Coalfields Limited (NCL), Singrauli is a major contributor towards fulfilling energy requirement of the nation. NCL is a wholly owned subsidiary of Coal India Limited, under the Ministry of Coal, Government of India and Mini Ratna (Category-I) company since 2007.

NCL operates primarily with the objective of producing coal with due regard to social upliftment, sustainable development and environmental up gradation.

### Overview

Jayant Opencast Project of Northern Coalfields Limited is located in Singrauli district of Madhya Pradesh and forms a part of Singrauli Coalfield of Northern Coalfields Limited. Singrauli Coalfield covering an area of about 2202 sq.km located mainly in Singrauli district of Madhya Pradesh, while a small part of 80 sq.km in the east, falls in Sonebhadra district of Uttar Pradesh. The Kachni river divides the coal fields into two parts viz. the major south-western part (main basin) and a smaller northeastern part called Moher sub-basin which is the centre of all economic activities, as on date as far as, coal and electric power are concerned.

Jayant Opencast Project has a full-fledged Coal Handling Plant of 10Mtpa capacity to handle 10.00 Mtpa of ROM coal produced from the mine. The Existing 10MTPA CHP broadly consists of one receiving and crushing complex having 3 no. of receiving pits each equipped with a gyratory crusher, two bunkers each of 30,000 T capacity for storage of crushed coal, 2 silos for loading into MGR wagons and one PR loading system for loading of coal into PR wagons, associated conveyors and other auxiliary facilities.

### Challenges to be addressed

To cater to the increased demand of power grade coal, the production from Jayant OCP has been envisaged to be increased from 10MTPA to 25MTPA (15MTPA incremental). To handle incremental production of 15MTPA from the mine, capacity of Coal Handling Plant is required to be augmented.

The new facilities should have the provisions of:

- ▶ Receiving and crushing of ROM coal inside the quarry to -100 mm size
- ▶ Transportation of crushed coal by series of conveyors to the existing bunker and a new bunker which will augment the storage facility
- ▶ Necessary arrangement or modifications in the existing CHP to receive coal from new CHP to facilitate interconnectivity between the existing and the new CHP
- ▶ The quality of the coal is power grade and will be supplied to power houses through Indian Railways and through MGR of NTPC.



## Features

The system capacity of the coal handling plant shall be designed in such a way so that it can cater to fluctuations in the coal production within an overall rated production of 25.00 MTPA from the quarry.

In the Eastern section, a semi -mobile primary crushing plant and a twin shaft secondary sizer has been installed for blasted coal and truck receiving hopper constructed for surface miner coal along with conveyor system of 1600 TPH rated capacity (peak capacity 1900 TPH).

A similar facility with a semi -mobile primary crushing plant and a twin shaft secondary sizer for blasted coal and truck receiving hopper for surface miner coal along with conveyor system of 1600 TPH capacity (peak capacity 1900 TPH) is set up in the Western section also.

The primary crushing plant in the eastern and western sections comprises of receiving hopper, apron feeder and twin shaft sizer of through-put nominal capacity of 1600TPH. Coal from both the above sections is fed to a newly constructed bunker of 30,000T capacity, from where it is reclaimed and loaded into MGR/PR wagons through a proposed 4000T silo with Rapid Wagon Loading System.

In the central section also a semi -mobile primary crushing plant and a twin shaft secondary sizer is installed along with conveyor system of 1600 TPH rated capacity (peak capacity 1900 TPH).

The primary crushing plant in the central section comprises of receiving hopper, apron feeder and twin shaft sizer equipment of through-put nominal capacity of 1600TPH. Coal from the central system can be fed either to the proposed eastern/ western circuit to feed into proposed bunker or to the existing PR bunker from where, it will be reclaimed and loaded into MGR/PR wagons through existing silo.

## Benefits

1. Semi mobile crushers are being used in Coal India Limited subsidiaries for the first time in place of Gyratory Crushers. The installation of semi mobile crushers has helped in reducing the project cost to a substantial extent. Moreover, these semi mobile crushing units can be shifted and reinstalled as the mines progress.
2. Road Transportation of the additional 15 MTPA of coal production has been eliminated thereby reducing environmental pollution, conservation of diesel fuel etc. These will contribute a lot towards sustainability of mining activities and conservation of natural resources.

# 7

## Technological solutions Indian mine operators must consider



In this section, we summarize the most important technologies that require a careful consideration for adoption. Reflecting on the prevailing situation in Indian mines and with due consideration of available technologies, it is clear that the goal and need of rapid capacity expansion can be realized and accelerated through the judicious use of new technologies.

When used in combination and with careful mine planning exercises, it is possible to achieve 20-30% reduction in

operational costs. Considering the price gap between Indian coal and Indonesian coal of the same grade on FOB basis is ~30%, a saving in our cost of mining will go a long way in making Indian mining competitive on a global scale. More importantly, as a core industry, this will have a cascading impact on the competitiveness of the entire Indian economy. Therefore, a technology upgrade in mining operations is an essential need of the hour and vital to realize the ambition of Aatma Nirbhar Bharat.

## 7.1

### Mobile Crushing Plants

Many mine operations transfer the material post blasting to a crushing location at the top of the pit. However, crushing at source enables truck haulage to be replaced with belt conveyor that results in lower number of trucks in fleet for the same production capacity. This also ensures less fuel consumption, operators and spares. This system reduces CAPEX and OPEX for the overall lifecycle of the mine and increases the efficiency of the truck fleet to a focused and targeted scope. With mobile or semi-mobile crushing plants, there is an overall reduction in noise level and air pollution making the system more environment-friendly and more acceptable especially where mining is close to inhabited areas.

Fully mobile and semi-mobile configurations are available to suit the specific conditions at the base of the open cast mine, providing necessary flexibility to suit specific mine applications.



## 7.2

### Next generation of bucket wheel excavators

With latest machines, it is possible to cut up 3 benches, covering a height of ~20 m from one position. These machines can be deployed in multiple flexible configurations to suit specific operations /they can simply discharge the material on the ground or load directly onto dumpers or to conveyors thereby enabling continuous operations. These machines are suitable for all weather, continuous operations with almost no slowdown of operations due to rain, fog, nighttime, or other adverse weather conditions.



They are fully electric equipment and systems working in a continuous mode, thus reducing the requirement of trucks.

Currently, through thyssenkrupp, these machines are Made in India. thyssenkrupp India ensures full support from the mining planning phase all the way to O&M support.

### 7.3

## Next generation conveying solutions

Long distance belt conveyors both trough and pipe conveyors can transport materials over undulating terrain with horizontal and vertical curves thereby increasing efficiency of material transportation. Using this mode of material transportation, the material transfer from one

conveyor to another can be reduced or even eliminated thus increasing efficiency, reducing materials loss and pollution. These conveyors can travel downhill or up the slope and cross rivers and valleys with minimal damage to the environment, flora and fauna.



### 7.4

## In-pit crushing and conveying system

Mining companies recently committed to spend billions over the next years to reduce its carbon footprint and have "net zero" emissions by 2050. As the leading firms are looking towards sustainable mining practices, in-pit crushing and conveying systems can be a possible solution for reducing the carbon footprints of the mining processes.

There is an important differentiation between the acronyms ex-pit crushing and conveying (EPCC) and in-pit crushing and conveying (IPCC). With (EPCC) the crushers and conveyors are located outside the pit or at the pit rim whereas with (IPCC) they are inside the pit. The degree to which crushing has to be done, the location of the crusher, and the possible mobility or relocations of the crusher come in various permutations. Generally, the



flexibility of truck and shovel systems allows the mining system to be adapted to the pit. However, as continuous mining systems are less flexible, the mine design has to be tailored to the requirements of the system - this is especially relevant for fully-mobile mining systems.

- ▶ Relocatable and modular ramp conveyors key for an effective IPCC system are modular in-pit conveyors which are easy to assemble and relocate and they can be extended over time. This gives mine planners more flexibility and does not result in permanent installations in the pit where mine walls are blocked over a long period of time. Only with modular and semi-mobile systems it is

possible to apply common (or slightly altered) strategic planning methodologies in order to increase value of the operation.

- ▶ Low-profile truck dump station using sizers is one that makes the system not only smaller but also more mobile.

7.5

## Automation



The degree of automation in Indian mines is growing by the day. There are now a multitude of system level improvements that can be achieved through proven automation techniques which have the potential to improve the performance of existing machines, reduce manpower requirements, improve safety, and eliminate waste. However, at the same time, for a lack of investment, vision or even awareness, several mining operations have not evaluated the opportunities available.

## Digitalization and Industrial Internet of Things (IIOT)

An area where leading global mining operations are focused on is digitalization. We find a mixed picture on this front in Indian mining operations. The most progressive mines are moving fast on this front, while there are still others unable to move beyond legacy systems. The technologies available have the potential to deliver dramatic improvements in maintenance cost reduction and system reliability thereby substantially reducing the risk of unforeseen outages. This is a huge advantage in mining where remote locations imply that short term interventions are hard to achieve. Overall, mining operators need to work on a well-defined road map to progressively introduce digitalization in all aspects of their operations.

A few of the latest focus areas on digitalization worldwide are as follows:

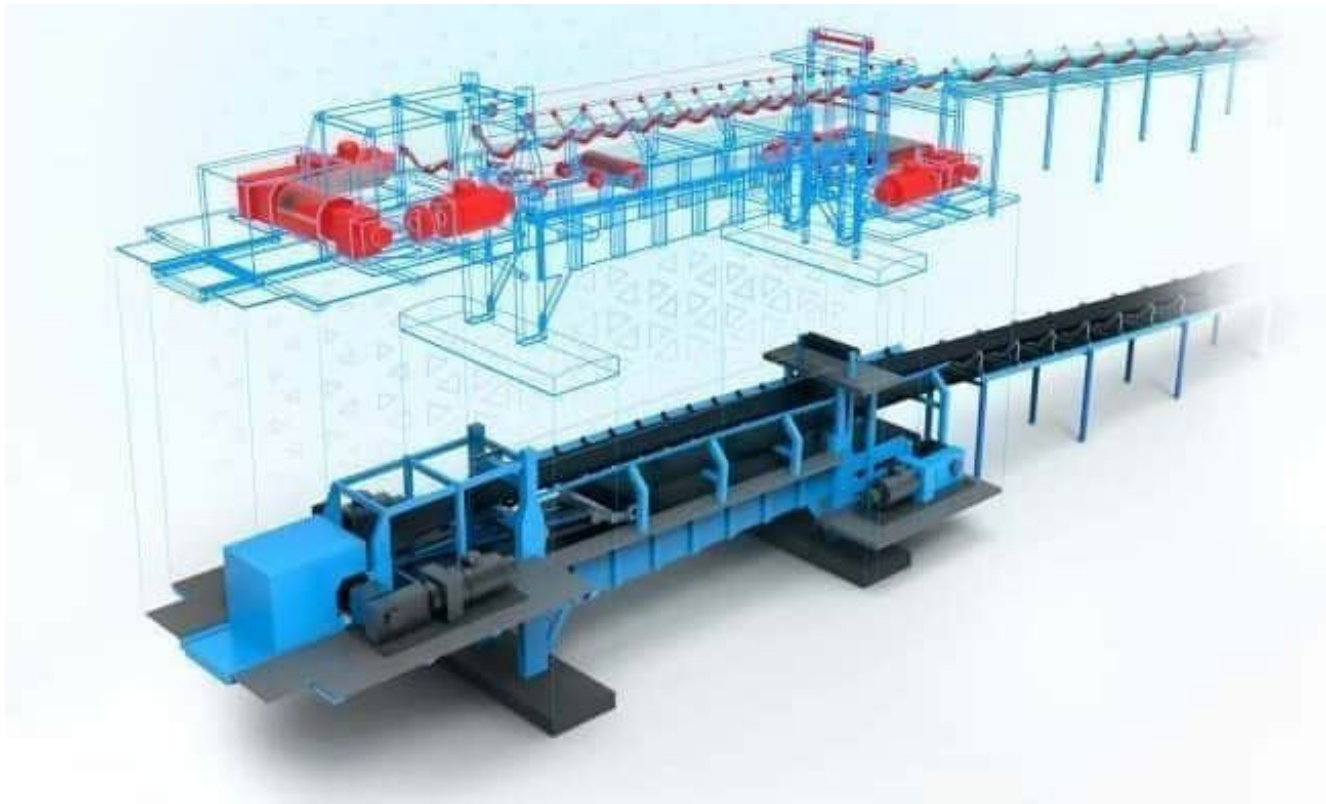
### Digital Twin of operations

Digital prototype for existing facilities like equipment, machines etc. with real time simulations can be done to optimize operations and respond to various unprecedented events. This can help in several ways such as increasing efficiency, reducing power, reducing

unplanned downtime, increasing equipment availability, increasing component life by ensuring use till point of predicted failure and thereby reducing unplanned maintenance. An added benefit is optimized spare inventory as a result of this process which can reduce working capital requirements.

Further, digital twins are a great means of evaluating new operational setups and assessing how they will perform. Using this approach requires a dedicated and secure storage solution typically a secure cloud server for storing confidential operating data of the mine. With supporting investments in connectivity, 24x7 monitoring of operational data is possible, which can be continuously processed through predictive algorithms, presented through intuitive visualization, with seamless reporting and triggers with recommendations for operational interventions.

Mine operators in some cases are working independently in these areas, however, increasingly, there is close collaboration ongoing between OEMs, mine operators and information technology specialists.





## Wireless seeds for dust reduction

This is a theoretical process to visualize the real object during various modes of operation and maintenance. This system-based approach enables environmentally friendly and energy saving loading of bulk goods in order to avoid any impairment to the immediate environment and to comply with legal regulations by reducing emissions of dust during the automated transportation of digitally monitored bulk goods.

USP of this technology is efficient dust control to minimize use of resources and costs for suppressing formation of dust. It helps in complying with environmental laws and is simple to integrate into existing systems.

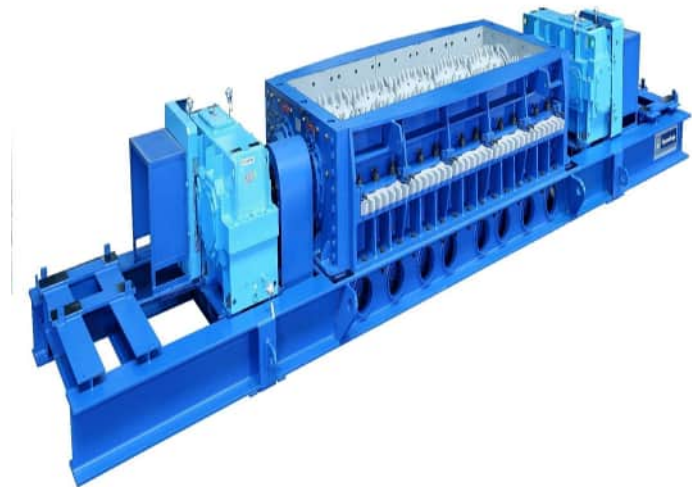
## Stockpile Management System

Stockpile management is a critical topic for mine operators. With currently available technology, 360° radar sensors mounted at the front of the machine in combination with the precise long travel position measurement create a detailed 3D representation of the stockpile while reclaiming and stacking. The 3D data can be used for stockyard management system which holds material information about the whole stockyard thus, optimizing the stacking process. It is an assistance tool for the operator as well as helping in man less operation of the machine. It assists in determining the first cut point, bench height, angle of repose and many other measures.

Alternative approaches include high quality image sensing at times clubbed with drones operating at regular intervals to track and monitor the stockpiles.

## Maintenance Assistance System (MAS)

Maintenance is a regular task, but it cumbersome especially when assets are spread across a large area. Poor maintenance however can have significant consequences for operations and profitability. MAS is a very effective means of dealing with planned and scheduled maintenance tasks, calculation of usage-based maintenance intervals and on time ordering of parts/materials/lubricants/oils. A latest generation MAS tackles this by providing regular alerts regarding planned tasks as per a pre-defined maintenance calendar. It provides easy access to equipment condition, manuals and spare parts catalogue. Maintenance history is properly logged and provides trend analysis. All of this in a digital format through a range of easy to access devices.



# 8

## Twelve - point action agenda for Utkrisht Bharat in Mining and Mining Equipment Sector

## 01

Current focus of discussions in mining is on realizing volumes and eliminating imports towards achieving the vision of an AatmaNirbhar Bharat. There is certainly an urgent need to become self-reliant by ensuring we leverage our substantial resource base effectively. However, it is suggested that the focus must be on volumes and competitiveness together. Without a competitive price of input raw material for downstream industries, the country will not realize the benefit of self-reliance translating into competitive manufacturing. We must ensure that for all the minerals mined in India our mining operations are as competitive as any other major mining country leading to lowest possible cost.

## 02

The Indian Government has demonstrated strong resolve in reforming/updating policies and regulations in the last few years. These efforts have accelerated the opening of the mining sector by making it more attractive for investors and mine operators. This is a welcome initiative. However, regulations and policies need to constantly evolve to maintain a competitive industry. We recommend creation of a multi-stakeholder think-tank comprising of all stakeholders (Government, miners, end users, equipment OEMs, educational institutions) to regularly review the status of Indian mining sector and to advise on a regular basis on further development of mining policy for the country with a focus on improving cost competitiveness of the sector.

## 03

Social license to mine is a top priority in the current socio-economic context. A successful mining operation relies on the goodwill, acceptance, and support of local communities to run harmoniously. Towards this objective, we suggest that ecologically friendly technologies particularly blast free mining must be promoted and adopted to improve the social acceptance of mining operations and to minimize the ecological impact of mining.

## 04

Innovation and technology adoption is vital for productivity improvement and competitiveness. We strongly urge and suggest the fast-track evaluation and adoption of new technologies by mine operators including private sector players and PSUs. A specific focus is required for the adoption of new technologies and we suggest a review of internal processes to simplify and fast track adoption of new technologies by PSUs. In particular, apart from volume targets, there should be targets set for cost per ton of mineral mined and for the utilization of R&D funds. Further the quantity of R&D funds should be increased to accommodate larger and more ambitious initiatives.

## 05

Digitalization and automation are driving dramatic improvements in mine productivity, safety, and reliability. We suggest the formation of a multi-stakeholder taskforce to promote the development and adoption of digital technologies for the mining sector to meet the needs of Indian mining companies. Further, this multi-stakeholder taskforce should consider how to promote start-ups to participate in the development of such solutions.

## 06

Current mining equipment and processes are diesel intensive. This is a burden on our balance of payments as bulk of crude oil used in India is imported. This also puts mining to uncertainties due to fluctuations in crude oil prices. We suggest that the sector considers electrification of operations to the extent possible. This is possible with technologies currently available in India. Further, with electrification, the resource for power generation can be indigenous coal, washery rejects or even renewable energy. The flexibility will allow mining operations to reduce their green-house gas emissions over time and becoming more and more sustainable.



## 07

Indian coal is known to have a high ash content. This required extensive washing for coal beneficiation. Further policy incentives are required to promote the increase in number of coals washeries along with the increase in mining. Additionally, it should be made mandatory to ensure the utilization of washery rejects through technologies such as combustion in CFBC boilers to avoid the accumulation of this waste which is also an ecological hazard.

## 08

Mining operations are capital intensive which is recovered over the life of operation. At the same time, the balance sheets and fund flow for many firms are stretched due to the impact of COVID-19. The banking sector is also cautious in lending particularly as several banks are focused on managing large NPAs. Under the prevailing circumstances, access to low cost financing is an important requirement to support the growth of mining sector. Considering the example of power sector where dedicated lenders such as PFC and REC have galvanized growth, we suggest suitable provisions for dedicated funds for promoting and supporting investments in mining. Emphasis should be placed on financing support to those mining operations which deploy latest, environmentally friendly technologies.

## 09

Mining is a core sector for the Indian economy and at the forefront of the efforts towards making an AatmaNirbhar Bharat. The equipment and machinery used for the mining operations should also reflect this philosophy. We suggest special incentives to promote the localization and manufacturing of mining equipment in India. Such incentives will also attract the latest and most advanced technologies to India further boosting the competitiveness of the sector.

## 10

Mining and coal sectors are one of the major employers in India. Investments in these sectors have a major impact on employment particularly in remote mining areas where employment opportunities are less. However, the nature of mining operations is changing and becoming more technology intensive in all areas. There is a need to review the nature of skill and approaches to talent development to be more synchronized to the evolving needs of the industry. We suggest a more focused approach towards development of mining level skills at both the ITI and University levels.

## 11

At the same time, planning for integrated mine closure is necessary, considering environmental, social, and economic factors at an early stage of mine development and throughout the life of an asset. Early planning of mine closure will make it easier and more cost effective to achieve final closure objectives and can improve the prospects for relinquishment. This can be achieved through collaborative efforts between the Government and the Industry.

## 12

While significant progress in occupational health and safety across the mining and metals industry has been made in recent years, there is a need towards strengthening health and safety performance further and reducing operational fatalities to zero. This can be made possible through building adequate capability to ensure high quality risk assessments and suitable technological interventions to mitigate risk.



# Note to the Reader

About the Authors





**Mr. Vivek Bhatia**  
Chairman CII MCED,  
MD & CEO,  
thyssenkrupp



**Shri. Indranil Roy**  
Director, Mining,  
thyssenkrupp



**Vinayak Vipul**  
Partner, Strategy &  
operations,  
EY Parthenon



**Shri. Suresh Agasti**  
Vice president,  
Strategy &  
Transformation  
thyssenkrupp



**Shri. T.V.S.S. Srinivas**  
Head Product  
lifecycle mngt.,  
thyssenkrupp



**Shri Amin Irani**  
Head of  
Communications,  
thyssenkrupp



**Lakshya**  
Senior consultant,  
Strategy & operations,  
EY Parthenon



**Sachin Gaurav**  
Senior consultant,  
Strategy & operations,  
EY Parthenon

CII along with thyssenkrupp Industries India Pvt Ltd. and EY India have made this extensive report namely "Utkrisht Bharat in Mining - Technological interventions to transform the growth of Indian Mining Sector".

Mining creates a large array of challenges and opportunities. In addition to established criteria such as efficiency and productivity, social and environmental factors have increasingly received attention locally and on a global scale.

These challenges now constitute a significant risk as the costs associated with social disruptions and ecological degradation have grown considerably, to the point where they can threaten the future of mining companies. The gap between developing and developed countries is closing in this regard.

The industry therefore faces societal expectations to further change its business-as-usual approach and mentality if it wants to gain or maintain acceptance.

Addressing these challenges require new technological solutions and also cultural changes in the way mining operations are organized and conducted.

While the industry has been evolving over the last two decades, progress in terms of higher efficiency and better social and environmental performance has been hampered by a number of factors, including the persistence of conventional technologies and business models.

The social and environmental challenges will likely become more pronounced as mineral and metal demands rise, whereas ore grades decline and fewer easy to access deposits are available.

This report can help the industry to identify key areas of interest that can be developed further into specific innovation programs and strategies; and reflect on whether the mining industries current capabilities, culture and business approaches are suitable to holistically understand the various challenges of mining, including ecological side effects and social

dimensions, as part of the development of innovative solutions and to consider which strategic partnerships, collaborations and formats are required to address the mining sector's challenges and harness the opportunities we outlined.

On this occasion we convey our best wish and hope the deliberations will lead to fruitful and productive outcomes.

# Acknowledgment





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The section outlines all references, used while developing the report

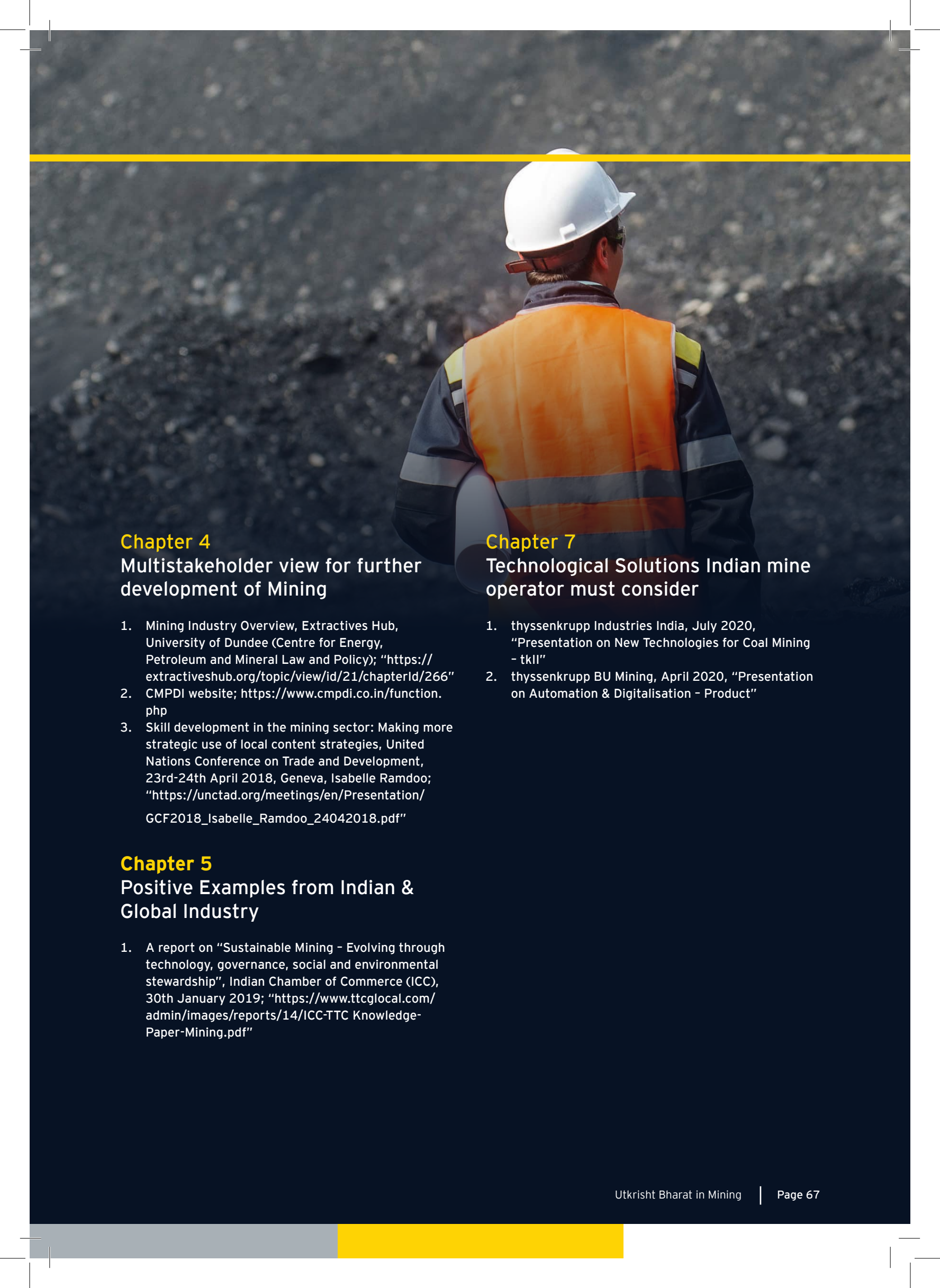
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# OFFICES

EY

## Ahmedabad

22nd Floor, B  
Wing, Privilon  
Ambli BRT Road,  
Behind Iskcon  
Temple, Off SG Highway  
Ahmedabad - 380 059  
Tel: + 91 79 6608 3800

## Bengaluru

12th & 13th floor  
"UB City", Canberra Block  
No. 24, Vittal Mallya Road  
Bengaluru - 560 001  
Tel: + 91 80 6727 5000

Ground Floor, 'A' wing  
Divyasree Chambers  
# 11, Langford Gardens  
Bengaluru - 560 025  
Tel: + 91 80 6727 5000

## Chandigarh

Elante offices, Unit  
No. B-613 & 614  
6th Floor, Plot  
No- 178-178A  
Industrial & Business  
Park, Phase-I  
Chandigarh - 160 002  
Tel: + 91 172 6717800

## Chennai

Tidel Park, 6th & 7th Floor  
A Block, No.4, Rajiv  
Gandhi Salai  
Taramani, Chennai  
- 600 113  
Tel: + 91 44 6654 8100

## Delhi NCR

67, Institutional Area  
Sector 44, Gurugram  
Haryana - 122 002, India  
Tel: +91 124 443 4000

3rd & 6th Floor,  
Worldmark-1  
IGI Airport Hospitality  
District  
Aerocity, New  
Delhi - 110 037  
Tel: + 91 11 4731 8000

4th & 5th Floor,  
Plot No 2B  
Tower 2, Sector 126  
Gautam Budh Nagar, U.P.  
Noida - 201 304  
Tel: + 91 120 671 7000

## Hyderabad

THE SKYVIEW 10  
18th Floor, "SOUTH  
LOBBY"  
Survey No 83/1,  
Raidurgam  
Hyderabad - 500 032  
Tel: + 91 40 6736 2000

## Jamshedpur

1st Floor, Shantiniketan  
Building  
Holding No. 1, SB  
Shop Area  
Bistupur, Jamshedpur  
- 831 001  
Tel: + 91 657 663 1000

## Kochi

9th Floor, ABAD Nucleus  
NH-49, Maradu PO  
Kochi - 682 304  
Tel: + 91 484 433 4000

## Kolkata

22 Camac Street  
3rd Floor, Block 'C'  
Kolkata - 700 016  
Tel: + 91 33 6615 3400

## Mumbai

14th Floor, The Ruby  
29 Senapati Bapat Marg  
Dadar (W), Mumbai  
- 400 028  
Tel: + 91 22 6192 0000

5th Floor, Block B-2  
Nirlon Knowledge Park  
Off. Western Express  
Highway  
Goregaon (E)  
Mumbai - 400 063  
Tel: + 91 22 6192 0000

## Pune

C-401, 4th floor  
Panchshil Tech  
Park, Yerwada  
(Near Don Bosco School)  
Pune - 411 006  
Tel: + 91 20 4912 6000

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## Confederation of Indian Industry

**The Mantosh Sondhi Centre**  
23, Institutional Area, Lodi Road, New  
Delhi - 110 003 (India) T: 91 11 45771000  
/ 24629994-7 \* F: 91 11 24626149

---

## thyssenkrupp Industries India Pvt. Ltd.

**Corporate office**  
Pimpri, Pune 411  
018, India  
Telephone : +91 20  
2742 5461 - 64  
Fax : +91 20 2742 5350  
E-mail : contactus.tkii@  
thyssenkrupp.com

**Mining office**  
Eco-Space, Premises  
No.701, Block-A7th Floor,  
New Town, Rajarhat,  
Kolkata - 700 156. India  
Telephone : +91 33  
6605 5200 / 01  
Fax : +91 33 6605 5218  
[www.thyssenkrupp-  
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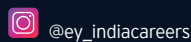
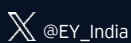
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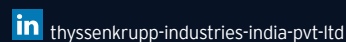
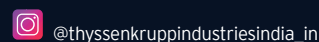
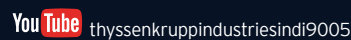
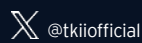
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