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IMPACT OF GREEN PATENT IN MINING INDUSTRY: DISCUSSION PERTAINING TO POLLUTION CONTROL

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Abstract

The mining industry is one of the most significant industries. It serves as a source for all other industries. With wind, electric energy and other renewable energies are being accelerated as the future of the planet's energy needs, the role played by mining industry has increased further. The mining industry cater to increasing demand for rare earth elements which are employed in a variety of technologies to produce green energy. In turn this makes mining a necessary activity for the transition to a greener world. As a result, it's critical to keep the environmental risks associated with mining under control. Doing so will ensure that the advantage associated with rare earth metals is not negated by the operation itself. Therefore, switching to greener technology entails switching to greener mining as well. Innovation plays a central role in solving the environmental risks associated with the mining sector. It is essential for creating methods for discovering new mineral deposits, making it possible for us to economically collect larger quantities of minerals from the earth, and making sure that this is done in an ecologically friendly manner. This research paper deals with current patenting trends in the mining industries and how green patent can influence the development of Climate Change Mitigation technologies, and positively analyses the impact of green patents at various stages of mining, from mine discovery to metal production.

Keywords: Green Patent, greener technology, patent, mining technology, climate change

1)Introduction

“When the well is dry, we know the worth of water”- Benjamin Franklin

As we stand on the precipice of a climate crisis, this quote takes on a profound new meaning, transcending its original context. In an era defined by rapidly changing climate patterns, extreme weather events, and escalating environmental challenges, we have come to appreciate the value of our ecosystem and the importance of preserving it. The mining industry has long served as a supplier to the industrial sector. In today's terms, it has come to prominence due to a growth in demand not only in general, but especially in the green energy transition process, which has boosted demand for rare earth metals. As a result, greener mining has become inevitable.

The author begins this paper by providing an overview of green patents by tracing their history and conceptualising them. The author highlights the relevance of the mining industry and how green patent might solve the environmental effect connected with mining production lifecycle and value chain in the second section. Finally, the research investigates global and Indian patterns.

2)A Brief History of Green Patent

Necessity is the mother of invention. Necessity arises when there is a threat to the existing practice or process, thus leading to inventions. Innovations aid in technology change or technology transfer. Technology change can be defined as an acquiring process whereby each innovation builds on the corpus of prior knowledge and serves as a springboard for further developments. Moving to greener technology has become a necessity in every aspect of our life with the deteriorating conditions of the environment¹. The history of Green Patents can be traced in parallel to the History of Environmental Jurisprudence.

The concept of "green patents" and specific provisions for environmentally friendly inventions in patent law can vary by country, and it's challenging to pinpoint a single country as the absolute first to introduce such provisions. However, Japan was one of the early pioneers in recognizing and incentivising green patents. It introduced provisions related to green patents in its patent law as early as the 1970s. These provisions were aimed at encouraging and

¹ Qamar, M.Z., Ali, W., Qamar, M.O. and Noor, M., 2021. Green technology and its implications worldwide. *The Inquisitive Meridian*, 3, pp.1-11.

protecting inventions related to pollution control and environmental conservation. Japan's recognition of the importance of environmental innovation and its efforts to incorporate it into patent law served as an early model for other countries to follow.

Germany offered reduced fees and fast-track examination for green patent applications in the 1990s. The United States launched the Green Technology Pilot Program² in 2009 to accelerate the examination of patent applications for green technologies, including renewable energy and pollution control inventions³. In 2013, the European Union introduced the Eco-Patent Commons, a voluntary initiative encouraging the sharing of environmentally beneficial patented technologies. India's Patent Office launched the Green Channel initiative to expedite the examination of patent applications for green technologies.⁴

The Paris Agreement (United Nations Framework Convention on Climate Change - UNFCCC), which came into force in 2016, is a global accord aimed at addressing climate change⁵. While it does not directly mention "green patents," it emphasizes the importance of technology transfer and cooperation in the context of climate-friendly technologies⁶. The agreement encourages the development and dissemination of environmentally sound technologies to combat climate change. Similar provisions are also contained in WIPO.

The TRIPS Agreement sets international standards for the protection of intellectual property, including patents.⁷ While it does not specifically categorize patents as "green," it provides a framework for the protection of innovations related to environmental technologies and sustainable development. The IP standards for the green innovations are to be found in Section 5 and Section 7 of the TRIPS Agreement⁸. Article 7 contains the following:

“The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of

² Dechezleprêtre, A., 2013. Fast-tracking 'green' patent applications: an empirical analysis. *ICTSD Programme on Innovation, Technology and Intellectual Property*.

³ Gattari, P., 2012. The role of patent law in incentivizing green technology. *Nw. J. Tech. & Intell. Prop.*, 11, p.41.

⁴ Lu, B., 2013. Expedited patent examination for green inventions: developing countries' policy choices. *Energy Policy*, 61, pp.1529-1538.

⁵ Robbins, A., 2016. How to understand the results of the climate change summit: Conference of Parties21 (COP21) Paris 2015. *Journal of public health policy*, 37(2), pp.129-132.

⁶ Azam, M.M., 2011. Climate change resilience and technology transfer: The role of intellectual property. *Nordic Journal of International Law*, 80(4), pp.485-505.

⁷ Doane, M.L., 1993. TRIPS and international intellectual property protection in an age of advancing technology. *Am. UJ Int'l L. & Pol'y*, 9, p.465.

⁸ Peter, K.Y., 2017. The objectives and principles of the TRIPS agreement. In *The Regulation of Services and Intellectual Property* (pp. 255-322). Routledge.

technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations."

3. Concept and Meaning of Green Patent

Patenting green technology is referred to as "green patenting." A patent is an exclusive ownership right along with the right of commercial exploitation of the patent holder. It is given to a patent holder for any novel, innovative, and useful device, substance, technique, or procedure. For a limited period of time, patent right gives the owner of patented product an exclusive right to stop the public from economically exploiting his or her innovation. The Patent applicants are required to publish and detailly describe the innovation in exchange for his or her exclusive rights. As a result, the volume of literature serve as important source of scientific and technological advances. In addition, patent data contains a wealth of non-technological information, such as historical, geographic, and bibliographical data. It is feasible to quantify features of invention through the of data related with patents filed, and many scholars have been utilising number of patents filed as an indicator of an activity disseminating knowledge.

Green patents refer to patents that have been granted for green technology. Green technology means application of innovative solutions, and products which aim to minimize their impact on the environment and promote sustainability. Green technology is designed to address environmental challenges, conserve natural resources, reduce pollution, and mitigate the effects of climate change. It encompasses a wide range of sectors and technologies, including green energy sources (such as, wind, sun, geothermal, water, tidal, etc.), energy-efficient appliances and buildings, waste reduction and recycling systems, sustainable agriculture practices, and clean transportation solutions (such as electric and hybrid vehicles). A green patent could be one issued for a device that actively prevents environmental deterioration or one that does not affect the environment. Overall Green patent is a patent which protects an invention or innovation which directly or indirectly confers environmental benefit.⁹

Accordingly, it may be concluded that a "green patent" is a kind of patent that relates to an

⁹Bronwyn H. Hall & Christian Helmers, *Innovation and diffusion of clean/green technology: Can patent commons help?*, 66 Journal of Environmental Economics and Management 33, XXXX (2013), <https://doi.org/10.1016/j.jeem.2012.12.008> (last visited Sept. 20, 2023).

invention, innovation, or technology created to address environmental or sustainability concerns, lessen environmental impact, or encourage the conservation of natural resources. These patents are often given to individuals, groups, or businesses for cutting-edge and practical ideas that support environmental sustainability and protection.

4. Green Patent in Mining Industry

4.1) Significance of Green Patents in Mining

Mining sector products are an important element of our daily life. We require them to meet our daily demands. The mining industries have played always and will play a significant part in human civilization's advancement. This industry's goods, which are wide in range including rare earth metals, are critical in the construction of buildings, automobiles, and batteries, solar panels other infrastructures. The expanding global population will definitely increase the demand for minerals. This sector confronts ongoing hurdles in meeting such demand while also meeting policymaker's sustainability criteria.

The use of rare earth elements in a multitude of green technologies has raised demand for them. Consequently, mining has become a crucial activity for the transition to a greener planet. In the United Kingdom, Internal combustion engine vehicles (ICEVs) which are considered as the most significant sources of carbon emissions. To reach its "net zero" target the ICETVs must be converted to Battery Electric Vehicle (BEVs). The conversion requires 207,900 tonnes cobalt, 264,600 tonnes lithium carbonate, 7,200 tonnes neodymium and dysprosium, and 2,362,500.¹⁰ This quantity is equivalent to twice the present annual global cobalt output, a whole year's global neodymium production, and three-quarters of global lithium production. Likewise, the green energy transitions i.e., wind, sun, nuclear, as well as the recently created delivery infrastructure, rely greatly on mineral-based technology.¹¹

Innovation is a critical tool for addressing these challenges. A study suggests that there will not be scarcity of mineral resources in the future, however effective expedition of mineral deposits will encounter hurdles due to the UN's Sustainable Development Goals.¹² Here comes the idea of green mining which will ensure that the advantage associated with the mining is not negated by the operation itself.

¹⁰Mining our green future - *Nature Reviews Materials*, Nature, <https://www.nature.com/articles/s41578-021-00325-9> (last visited Sept. 20, 2023).

¹¹ Olivier Vidal et al., *Metals for a low-carbon society*, 6 *Nature Geoscience* 894, XXXX (2013), <https://doi.org/10.1038/ngeo1993> (last visited Sept. 20, 2023).

¹²Simon M. Jowitt et al., *Future availability of non-renewable metal resources and the influence of environmental, social, and governance conflicts on metal production*, 1 *Communications Earth & Environment*, XXXX (2020), <https://doi.org/10.1038/s43247-020-0011-0> (last visited Sept. 20, 2023).

4.2) Innovation in Mining Sector

Mining sectors, like any other industry, innovate in their goods, manufacturing methods, and organisational practises. Mining enterprises undertake following efforts as inputs for these innovative outputs,

- Research and development (R&D) efforts
- Purchase of ready-made technologies
- Acquire disembodied technologies

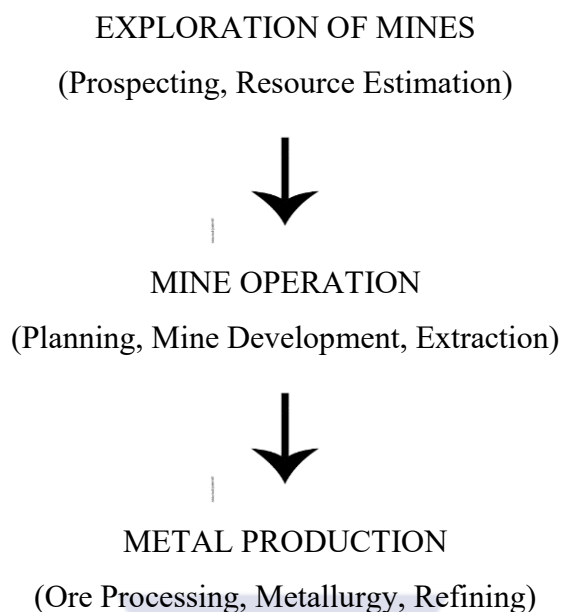
In terms of product innovation, the mining industry deviates greatly from the usual trend. The probability of finding a completely new goods is relatively rare, which implies that the potential for innovation with respect to product in this sector is highly restricted. But the discovery of new deposits of old product which are of great commercial value is an essential aspect of mining. Thus, making R&D expense a part of company's investment on expedition, even if such an investment is not technically recognised as its Research and Development.¹³

Furthermore, process and organisational innovation are crucial in the mining business, with the goal of cost reduction. The distinction between process innovation and organisational innovation is frequently blurred in many sectors. This is unquestionably true in the mining business. Process innovation is often defined as any enhancement to the manufacturing process within an industrial facility. It includes layout changes, improvement in machinery, and any process used to generate an item or provides services. Organisational innovation encompasses everything that occurs outside of the manufacturing facility. These include logistical, managerial, financial, and other related advancements. In order to analyse the impact of green innovation in mining industry it is important to comprehend the various stages of mining.

4.3) Stages of Mining and their Environmental Implications

The basic input for any mining enterprise is the land containing the ore bodies to be mined. The principal result is purified metal or coal, which are then used as primary inputs in a wide range of industrial businesses. Converting ore bodies to refined mineral or metal creates value. Each step of the lifecycle might involve technological innovation contributions from numerous sources. The mining lifecycle consists of numerous separate processes, beginning with the locating of an ore body and ending with the derivation of minerals and the restoration of the land to its natural form. Stages of mining can be represented as follows:

¹³ Alica Daly et al., *Mining patent data: Measuring innovation in the mining industry with patents*, WIPO Economic Research Working Paper No. 56 (May 2019), https://www.wipo.int/edocs/pubdocs/en/wipo_pub_econstat_wp_56.pdf (last visited Sept. 20, 2023).



The primary environmental issue linked with the operation of mining is the shift in the use of land. Mining infrastructure built in distant, unspoilt environments can increase access to these areas, thereby causing more human-nature conflict disrupting ecology.

Many phases of mining and mineral processing necessitate the use of water, resulting in large water footprints. Dust reduction, soluble particle removal, screening and separation techniques, and waste management tailings dams are some examples. High water usage in mining activities can restrict local people's access to uncontaminated freshwater supplies, resulting in water stress in the region.

Environmental pollution is induced by mining tailings leaks which are radioactive, poisonous, or acidic. Clearing of land leads to deforestation contributing to significant increase in atmospheric carbon dioxide and greenhouse gases. Yet another essential factor to consider is the amount of greenhouse gases emitted per unit mass of mined material. Since, the creation of products from mined materials uses high amounts of energy which is sourced from fossil fuel also contributes significantly to emission of greenhouse gases.¹⁴

4.4) Green Mining Strategies

Sustainable mining contains the following components:

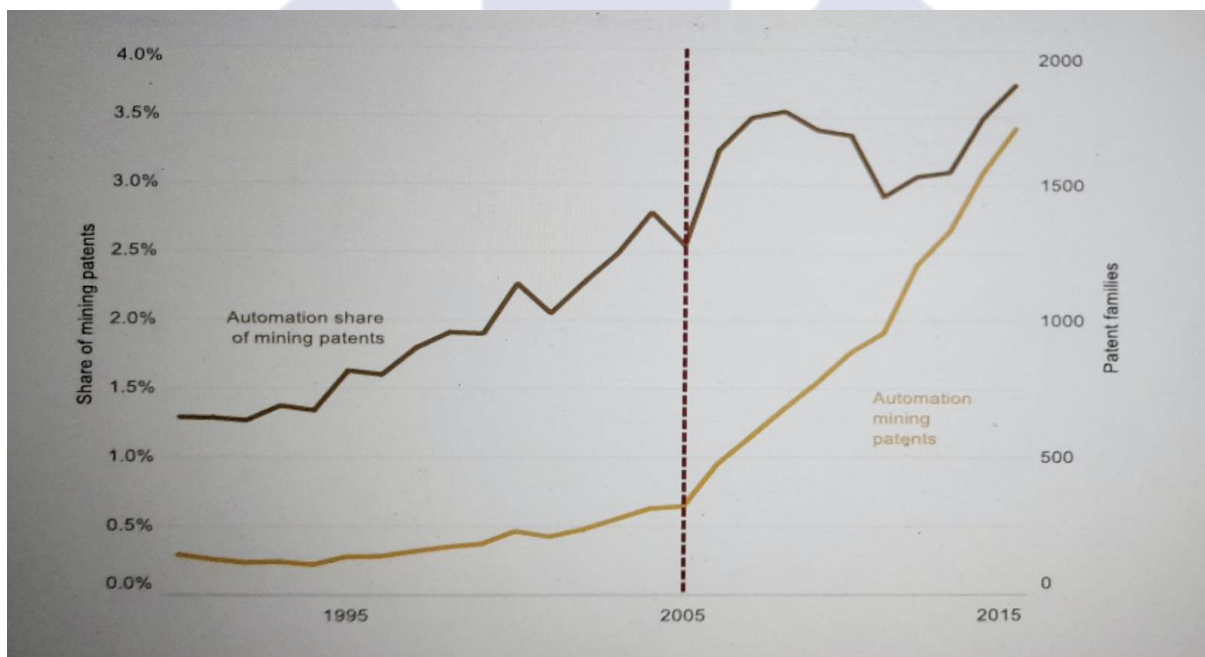
- ecological sustainability
- economic vitality
- social equality

¹⁴ Sammy Witchalls, *The Environmental Problems Caused by Mining* | *Earth.Org*, Earth.Org (Apr. 3, 2022), <https://earth.org/environmental-problems-caused-by-mining/> (last visited Sept. 20, 2023).

Green mining was used in Finland in order to eliminate any consequences. Green mining minimised the environmental effect of mining at all phases of operation. To achieve this it is important to provide proper training to the miners, create awareness about the use of green technology, effective management systems with respect to environment and the establishment of partnerships.

Following are some bright areas in mining where there is a greater scope for deployment of green technologies:

- Genetically engineered microorganisms to dispose of mining wastes by breaking down its components
- Carbon capture storages
- Innovations aiding in reuse of byproducts
- Boost energy efficiency by electrification and using green energy grid to reduce and eliminate the dependency on fossil fuels
- Utilising the digitalisation process in automating various stages of mining¹⁵



Source: WIPO Mining Database (technology subset)

4.5) Advantages Associated with Green Patent In Mining Industry

Following benefits are associated with green patents,

- Acts as an incentive to innovate in the field of green technology

¹⁵ Alica Daly et al., *Mining patent data: Measuring innovation in the mining industry with patents*, WIPO Economic Research Working Paper No. 56 (May 2019), https://www.wipo.int/edocs/pubdocs/en/wipo_pub_econstat_wp_56.pdf (last visited Sept. 20, 2023).

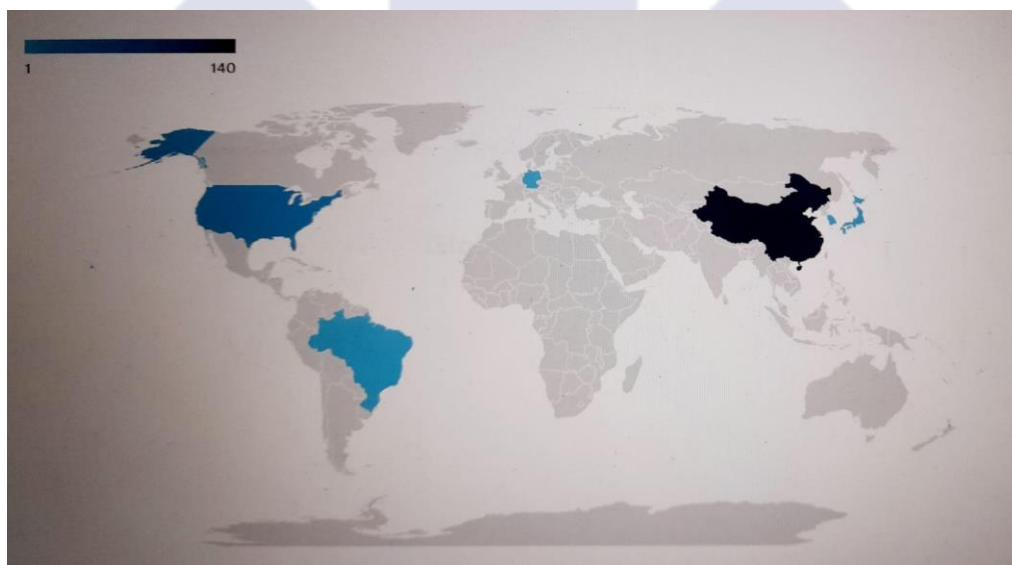
- Fast tracking of patent as an added incentive to innovate
- Facilitate distribution and transfer of green technologies globally through various collaborations involving different stakeholders including companies, individuals, research centers and universities.

Following are a few recent projects aimed at improving green patent:

- WIPO Green¹⁶
- IPC green inventory¹⁷
- Green Technology Pilot program¹⁸
- Eco Patents Commons¹⁹

5. Trends in Various Countries

In Q2 2023, China had the highest percentage of green patents filed in the mining sector (74%), followed by the United States (21%), and Japan (5%). China's share was 34% greater than its 40% share in the first quarter of 2023.²⁰



Source: GlobalData Patent Analytics

¹⁶ *WIPO GREEN: Supporting Green Innovation and Technology Transfer*, WIPO - World Intellectual Property Organization, https://www.wipo.int/wipo_magazine/en/2020/01/article_0003.html (last visited Sept. 20, 2023).

¹⁷ *IPC GREEN INVENTORY*, WIPO - World Intellectual Property Organization, <https://www.wipo.int/classifications/ipc/green-inventory/home> (last visited Sept. 20, 2023).

¹⁸ *Green Technology Pilot Program - CLOSED*, United States Patent and Trademark Office, <https://www.uspto.gov/patents/initiatives/green-technology-pilot-program-closed> (last visited Sept. 20, 2023).

¹⁹ *The Eco-Patent Commons: Caring through sharing*, WIPO - World Intellectual Property Organization, https://www.wipo.int/wipo_magazine/en/2009/03/article_0004.html (last visited Sept. 20, 2023).

²⁰ *Environmental sustainability related patent filings decreased in the mining industry in Q2 2023*, Mining Technology, <https://www.mining-technology.com/dashboards/patents/patent-activity-environmentalsustainability-mining-industry/> (last visited Sept. 20, 2023).

Research that looked at the mining sector in different nations and regions including China, the United States, South Africa, etc. The countries that were analysed were selected in such a manner that some had significant patent offices and some were large mining locations that have discovered several fascinating patterns. The said study has arrived at following findings:²¹

- The increase in total mining patents and green patents in mining across the board has shown various trends, the rate and pattern of those developments varies depending on whether a nation consumes or produces resources. In reaction to increase in price of rare earth metals and oil, resource-producing areas saw greater shifts in R&D priorities.
- The development of green patents in some countries were aided by a proportional growth in R&D sector of mining technology. While some other countries have expanded their focus on R&D for mining and associated green technologies while decreasing their total R&D scale. Some countries including China on the other hand, have grown the scale of their R&D which in turn has resulted in the development of more invention in the field of green technology.
- The Paris Agreement has also contributed to a comprehensive growth in green mining technologies.
- Rise in metal price has led to an increase in the number of patents obtained in the sector.

Further the research highlighted the following global trends²²:

“In general, Only China and the United States of America outperform in terms of both mining production and innovation. Australia, Canada, and Norway are likewise pretty balanced in terms of mining production and innovation. Other typical mining economies struggle to be seen in the limelight of innovation. The Russian Federation, Brazil, and Chile are most likely the finest of these, with the others producing extremely limited innovation outputs. Indeed, mining innovation is more likely to stimulate the development of effective innovation systems that are not necessarily located in mining operating nations. Many developed economies that are not especially relevant in mining output contribute significantly to global mining innovation. The leading

²¹Andre S. Yamashita & Hidemichi Fujii, *Trend and priority change of climate change mitigation technology in the global mining sector*, 78 Resources Policy 102870, XXXX (2022), <https://doi.org/10.1016/j.resourpol.2022.102870> (last visited Sept. 20, 2023).

²² Alica Daly et al., *Mining patent data: Measuring innovation in the mining industry with patents*, WIPO Economic Research Working Paper No. 56 (May 2019), https://www.wipo.int/edocs/pubdocs/en/wipo_pub_econstat_wp_56.pdf (last visited Sept. 20, 2023).

economies include Japan, the Republic of Korea, and numerous European countries. Increased mining relative specialisation in a country will contribute more to the global mining innovation intensity boom. On the Exploration subsector, Australia, Chile, and the Republic of Korea have grown their relative specialisation in this subsector and are likely among the major contributors to the exploration boom in comparison to other sectors. Chile and Australia were the only countries who improved their mining transport specialisation. When compared to lower- and upper-middle-income countries, the United States, Canada, and Australia are more specialised in automation. The chosen economies have a relatively low level of environmental specialisation. Only Chile, the Republic of Korea, and the United States of America have a positive RSI (Relative Specialization Index) for environmental technology.”

6. Position in India

The mining sector in India produces around 4% of the country's GDP and is one of the major employers in the country, employing over one million people, or roughly 4% of the Indian workforce. The mining industry in India is plagued by a number of environmental issues.

Existence of Pollution Havens in India pose a serious threat to the Indian Ecology. Pollution Havens, in the context of the mining industry, refer to regions or countries with less stringent environmental regulations and enforcement compared to other areas. Transnational Companies (TNCs) in the mining industry may choose to operate in these pollution havens to take advantage of lax environmental standards, lower operational costs, and fewer restrictions on pollution emissions. This practice can have negative environmental and social consequences. In various Indian states, mining TNCs have been seen to be damaging the environment through their operations. TNCs in the bauxite sector have displaced tribals (adivasis) in Orissa.

Advanced mining technology, automation, and globalisation have transformed the mining industry across the world. Many significant mining corporations in India have implemented environmentally friendly practises. The National Mineral Development Corporation is building a 0.3-million-ton pig iron facility to use tailings. The Kudremukh Iron Ore Company has proposed reclaiming 117 million tonnes of tailings in order to recover 21 million tonnes of concentrates.

An extract from Times of India runs as follows²³:

“Every second patent granted in India between 2016 and 2021 is related to green technology, with a quarter relating to alternative energy production, coinciding with the center's efforts on increased use of green technology for boosting the economy and encouraging consumers to use products produced using such technology.”

Green Patent will have a big impact on encouraging more and more mining businesses to embrace environmentally friendly practises and technology.

7. Conclusion

Greener mining is an unavoidable component of the sustainable development process. Greener mining would be difficult to envision without green patent. Green patents serve an irreplaceable and vital part in making mining more environmentally friendly. The increased use of environmental technology is most likely related to a greater societal and industrial awareness of the environmental effect of mining activities. As a result, a growth in green patents is directly related to increased societal and industrial awareness.

The recent scientific developments in field of machine learning and digitalisation provides great potential in revolutionizing the knowledge-based tasks such as mine exploration, waste disposal and transportation aspects of mining. Electrification of equipment's, operating on a green grid will have significant impact in reducing the dependency on fossil fuels.

A countries R&D strategies act as a starting point and backbone for aforementioned activities. Therefore, it is crucial for a country to enumerate country specific framework for R&D sector with respect to mining that can combat the climate change by a balance focus on both efficiency and R&D investment scale.

Last but not least, it is critical to build an environment of responsible and accountable stakeholders for an effective manifestation of the advantages connected with green patents. The mining innovation boom is the responsibility of companies and other stakeholders. Thus, increasing the contribution of green technology from private businesses will have significant impact in increasing green patent fillings.

²³ Every 2nd patent granted since 2016 relates to Green tech; most linked to waste, alternative energy | India News - Times of India, The Times of India, <https://timesofindia.indiatimes.com/india/every-2nd-patent-granted-since-2016-relates-to-green-tech-most-linked-to-waste-alternative-energy/articleshow/89420047.cms> (last visited Sept. 20, 2023).