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CHAPTER 18

Malaysia's rare Earth gamble: A critical examination of its high-risk REE future

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Abstract: This paper critically examines Malaysia's ambitions and advancements in the rare earth elements (REE) industry, highlighting key national and state-level initiatives. It briefly evaluates the environmental repercussions of REE extraction alongside the disproportionate impacts on Indigenous Peoples and Local Communities (IPLCs) whose lands overlap 70% of reserves. It questions whether short-term economic gains, projected at RM747 billion (Aziz 2025), is worth jeopardising sustainable legacies for future generations through insufficient safeguards. This paper also offers recommendations urging the Malaysian government to thoroughly evaluate its options before fully committing to the development of the REE sector.

INTRODUCTION

Overview of critical minerals

Numerous countries designate certain minerals as critical or strategic minerals through official lists or policies, driven by economic security, clean energy transitions, and supply chain vulnerabilities. There is no one standard definition to which mineral is critical and it varies across nations. The terminology varies across different countries: while Malaysia and China commonly refer to these as 'strategic minerals', other nations use terms such as 'strategic and critical minerals' or 'energy transition minerals' to describe resources essential for technological advancement and the energy transition.

For example, according to the US Energy Act of 2020, the US Secretary of State defines any non-fuel mineral, element, substance or material as critical if it meets three key criteria: it is vital to economic or national security; its supply chain is susceptible to disruption, and; it serves as an essential function in one or more energy technologies (U.S. Department of Energy, n.d.), the absence of which would have serious consequences. The list becomes critical depending on geopolitics and changes in technology. The US has a list of 60 critical minerals, with 10 classified as new critical minerals and 15 rare earth elements (USGS 2025).

These minerals are essential resources that underpin the development and functioning of sectors such as technology, defense, energy, and manufacturing. Their importance stems from serving as foundational components in advanced technologies, including renewable energy infrastructure and defense systems. Key examples of critical, strategic, or energy transition minerals include rare earth elements (REE), copper, manganese, lithium, cobalt, and nickel. Malaysia has classified five strategic minerals in its New Industrial Master Plan 2030 and they include REE, tin ore, silica, kaolin and bauxite (MITI 2023).

Global drivers for rare earth elements (REE)

In relation to rare earths, China is said to have the highest reserves with 44 million metric tons with Brazil second with 21 million metric tons and India third with 6.9 million metric tons (Pistilli 2025). According to the International Energy Agency (IEA), China dominates 60% of the global production of rare earths and about 90% of the processing and refining

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(White 2023). It is a paradoxical cycle that in the effort to transition away from fossil fuels due to climate change, countries are increasingly mining critical or strategic minerals for renewable energy. This process in itself causes comparable environmental harm.

From consumer electronics to electric vehicles, military equipment, artificial intelligence, nanoelectronics, information and communication technologies, and medical biotechnology, the relentless demand against the monopolised REE supply chain has created geopolitical tension. This is especially so since China announced its export ban of technology to make rare earth magnets in addition to the bank of technology to extract and separate REE in 2023 (Liu and Patton 2023).

Even before China's move to protect its dominance in the supply with its domino-effect on the dependent industries, countries had shifted their focus to frenetically diversify and secure the supply chain to protect their own national industries and interests. Malaysia intends to leverage on this by attracting investments and collaboration with countries that vie for entry into the Malaysian REE industry (Reuters 2025a).

What is Rare Earth Element?

Rare earth elements (REEs) are a group of 17 chemically similar elements, including the 15 lanthanides plus scandium and yttrium (Hoatson *et al.* 2011). While common in the Earth's crust, their extraction is complex and often environmentally challenging. REEs are classified into light (LREE) and heavy (HREE) categories, with LREEs like neodymium used in magnets for wind turbines and data storage, and HREEs, which are rarer and more valuable, used in hybrid cars, fibre optics, and medical devices. Scandium is unique and not part of either category.

REEs do not exist on their own as native metals. They are found in low concentrations in a number of minerals including silicates, carbonates, oxides, phosphates and halides. Separating these elements from other elements is typically hard.

THE MALAYSIAN MINING & REE CONTEXT

History of mining and legacy of waste

Malaysia's mining history dates back to the early 19th century with small scale mining of minerals by local communities to the operation of large tin mines in Perak to the extraction of rare earth element (yttrium) from monazite by Asian Rare Earth Sdn Bhd (ARE) in 1979 in Bukit Merah, Perak and now the processing of lanthanide concentrate (a partially processed mineral product that contains REE) imported from Mount Weld, Australia at the Lynas Advanced Materials Plant (LAMP) (Lynas Malaysia) in Kuantan, Pahang (Consumer's Association of Penang 1993, 2011; Badd 2019).

Mining in Malaysia has also left a legacy of waste behind with little lessons learnt especially in relation to the Bukit Merah ARE case. In the Bukit Merah case, many residents from the town of Papan, Perak, suffered the effects of cancer as a result of radioactive pollution within a few years from the start of the operations by ARE (Bradsher 2011). A representative action was filed by the 10,000 strong residents of Bukit Merah in 1985 against ARE and others. They won at the Ipoh High Court in 1992 and in 1993, the then Supreme Court overturned the decision of the High Court. Despite this loss, it was public pressure that forced the shutdown of the ARE plant in 1994 (Badd 2019). Today, the radioactive waste—thorium hydroxide, which is the property of the Perak state government—is permanently buried in a long-term storage facility somewhere in the Kledang Range, behind Papan town in Perak, entombed under more than 20 feet of clay and granite (Yong 2011).

Apart from the Bukit Merah case, Malaysians will also need to contend with more radioactive waste generated from the LAMP facility in Gebeng, Kuantan, Pahang, for generations to come. The water leach purification (WLP) residue—one of two types of waste generated during the processing of the lanthanide concentrate—contains radioactive wastes of thorium radionuclides among others, which will remain radioactive for another 14 billion years due to its long half-life.

A total of 1.6 million tonnes of this radioactive waste will be permanently disposed off in a facility in Gebeng, Pahang right next to the LAMP. Unlike the thorium hydroxide waste in the Kledang Range, which was buried deep in the hill, the WLP residue will be kept in "near surface repositories with limited regulatory control" according to the 2021 Environmental Impact Assessment Report (DOE 2021).

The Ministry of Science, Technology and Innovation (MOSTI) has recently approved a 10-year licence (Lo 2026) for Lynas Malaysia signalling the government's continued willingness to host rare earth processing operations despite persistent public concerns. In granting this long-term approval, MOSTI effectively provides regulatory certainty for the company's investment and operations, including downstream activities tied to Malaysia's broader ambition to participate in the rare earth value chain. This decision raises questions about the adequacy and robustness of existing environmental and radiological safeguards, as well as the extent to which community feedback and independent scientific assessments were integrated into the licensing process.

In spite of Malaysia's challenging history with mining-related environmental damage and hazardous waste, the government is resolute in its pursuit of the economic benefits offered by rare earth mining. To reassure the public, several sustainability measures have been introduced, such as communication, education, and public awareness (CEPA) programmes, the engagement of Canadian technical expertise, and the proposed implementation of sustainability certification schemes. Nonetheless, these efforts do not fundamentally address the underlying issue: Do the environmental risks and harms associated with rare earth mining outweigh its financial gains?

MALAYSIA'S POLICY FRAMEWORK AND INITIATIVES FOR RARE EARTH ELEMENT (REE) INDUSTRY DEVELOPMENT

Malaysia has established a comprehensive set of policies, plans, and regulatory frameworks to support and advance mineral development, including REE mining. Among the principal policies is the Second Mineral Policy (*Dasar Mineral Negara 2* – DMN2), which has been in force since 2009 and prioritises sustainable mineral development. Additionally, the Framework for the National Mineral Industry Transformation Plan 2021 – 2030 or *Kerangka Pelan Transformasi Industri Mineral Negara 2021 – 2030* (TIM 2021 – 2030) sets out transformation objectives for the mineral sector. Both the National Mineral Industry Transformation Plan and the New Industrial Master Plan 2030 further reinforce the integration of REE into downstream processing strategies.

While the DMN2 is still the main policy in force, the Third Mineral Policy (*Dasar Mineral Negara 3* – DMN3) is still underway after the 3rd National Mineral Council Meeting approved the framework in July 2024 (Ajos 2023). The government held stakeholder consultations in developing the action plans under this third framework. The time frame for this policy will be until 2030. The core objectives of this policy include legislative enhancements with the strengthening of coordination between federal and state governments and emphasis on environmental social governance (ESG) standards. DMN3 will be aligned with the 13th Malaysia Plan 2026 – 2030 or *Rancangan Malaysia Ke-13 2026 – 2030* (RMK13).

The RMK13 will focus on: building local capacity in REE mining, purification and separation; develop talent, infrastructure and incentives; enhance REE resource mapping, and; federal-state governance and cooperation. The TIM 2021 – 2030 has identified five strategic minerals which are: 'non-radioactive' rare earth elements (NR-REE), bauxite, tin ore, silica sand, and kaolin (KeTSA 2021).

The term 'non-radioactive' is used to define REE although these minerals all contain naturally occurring radioactive materials (NORM). The current focus of Malaysia is to extract REE from ion-adsorption clay (IAC) deposits using an In-Situ Leaching (ISL) method where rare earth carbonate (REC) would be the final product.

According to the TIM 2021 – 2030 framework, Malaysia possesses approximately RM4.11 trillion in mineral resources, encompassing both metallic and non-metallic minerals. Of this total, metallic minerals account for around RM1.03 trillion, while non-metallic minerals are valued at approximately RM2.96 trillion. The country is estimated to hold 16.2 million tonnes of rare earth oxides, with about 70% of these deposits located in the states of Terengganu, Kelantan, Kedah, and Perlis (Aziz 2025). The majority of rare earth reserves remain underground, often situated in permanent reserved forests, environmentally sensitive areas, hills, and mountainous regions. Malaysia aims to capitalise on these substantial resources by advancing the development of IAC rare earth elements. Recognising Malaysia's promising potential in the REE sector, numerous states across the country have expressed keen interest in advancing the development of this industry, as one would see below.

During a recent Parliamentary session, the Minister of Natural Resources and Environmental Sustainability (NRES), Arthur Joseph Kurup, announced on 20 January 2026 that the Department of Minerals and Geoscience, undertook a study under the 12th Malaysia Plan and has estimated the presence of 274,144 metric tonnes of REE within a surveyed area of 103.9 km^2 across nine states: Terengganu, Perak, Kedah, Sarawak, Negeri Sembilan, Pahang, Kelantan, Selangor, and Johor (Dewan Rakyat Hansard 2026). The Minister also mentioned that the government will ensure that the industry is developed responsibly and sustainably taking into account economic prosperity and the well-being of the people.

Policy ban on export of REE raw materials

In September 2023, the Malaysian Prime Minister, Dato' Seri Anwar Ibrahim announced the development of a policy to ban exports of REE raw materials to avoid exploitation and loss of resources (Anathalakshmi and Nguyen 2023). The moratorium came into effect on 1 January 2024 following its endorsement at the Cabinet Meeting held on 27 October 2023 and it is subject to review every six months (NRES 2024).

As it follows, a critical aspect of the moratorium on exports of REE raw materials was to develop the value-adding midstream (Bernama 2025a) and downstream industries as opposed to solely mining. In January 2025, the Prime Minister also confirmed that Malaysia would be seeking the assistance of Japan to develop a REE processing plant in Malaysia (Mahari 2025). This follows through the announcement by the former Minister of NRES, Nik Nazmi Nik Ahmad in Parliament in November 2024 that Malaysia had great potential to develop the REE downstream industry as a super magnet producing country to support the electric vehicles (EVs) manufacturing sector (Bernama 2024c).

In 2025, Malaysia announced a RM600 million neodymium-iron-boron super magnet plant in Kuantan, Pahang. Led by Malaysia's Lynas Rare Earths Ltd. and South Korea's JS Link Co., the facility aims to produce 3,000 tonnes of high-performance magnets yearly for EVs and electronics. With land secured and investments confirmed, the project is set for groundbreaking under the MOSTI's oversight (Reuters 2025c).

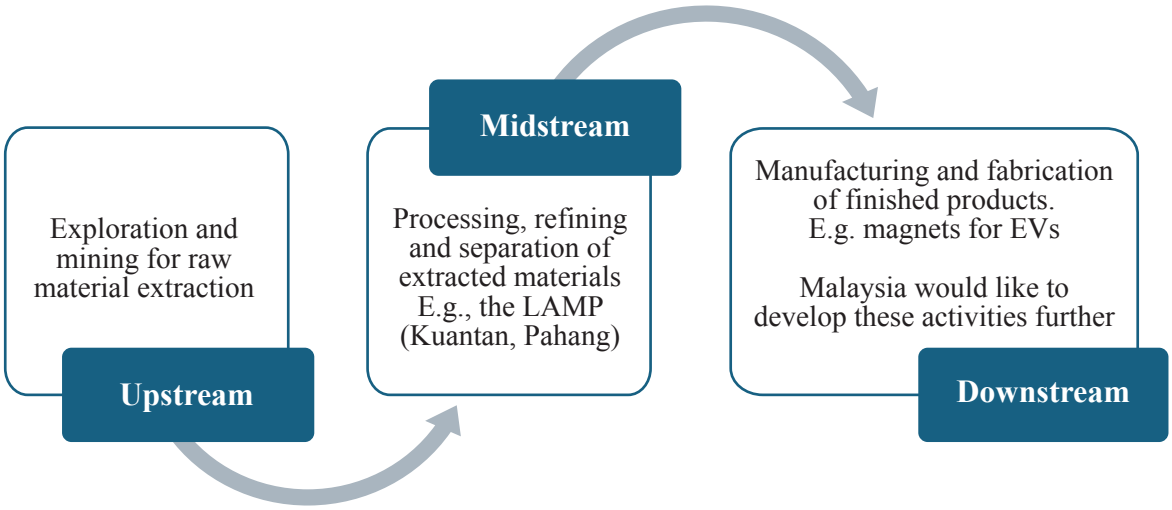

Figure 1. Value chain of the REE industry (Source: MOSTI 2023).

The US Malaysia Agreement on Reciprocal Trade (ART)

On 26 October 2025, Malaysia signed the Agreement on Reciprocal Trade (ART) and a Memorandum of Understanding (MOU) on Critical Minerals Cooperation (The White House Washington 2025a) with the United States during President Donald Trump's visit to Malaysia. This pact promotes collaboration across the critical minerals supply chain, including exploration, extraction, processing, refining, manufacturing, recycling, and recovery of rare earth elements and other key materials vital for technology and green energy transitions. One of the key terms of the ART, in Annex III, Section 6 (in particular Article 6.2) is as follows,

> "Malaysia has committed to refrain from banning, or imposing quotas on, exports to the United States of critical minerals or rare earth elements. Malaysia has committed to the expedient development of its critical minerals and rare earths sectors in partnership with U.S. companies, including granting extended operating licenses to create certainty for businesses to increase production capacity. Malaysia has committed to ensure no restrictions are imposed on the sale of rare earth magnets to U.S. companies" (The White House Washington 2025b).

Although Malaysia has pledged not to impose export bans or quotas on critical minerals destined for the United States, the export ban is still in force at the time of writing (Reuters 2025a). However, on 20 February 2026, in a 6 – 3 majority decision, the US Supreme Court ruled against President Trump's tariffs imposed under the International Emergency Economic Powers Act (IEEPA) (Library of Congress 2026). Following this ruling, the minister of Ministry of Investment, Trade and Industry (MITI), Johari Ghani confirmed that the ART has been nullified (FMT 2026). However, this remains to be seen as there is no formal proof that Washington has confirmed the same and a group of PKR lawmakers has requested for a formal communication between both countries (Malay Mail 2026).

Legal framework related to the mining and mineral industry

The governance of Malaysia's mining and mineral industry is overseen by the Department of Mineral and Geoscience Malaysia (JMG) under the NRES ministry, with significant contributions from other key agencies such as MOSTI, MITI, and the Department of Atomic Energy Malaysia (ATOM) (Reuters 2025b). The legal foundation rests on core statutes like

the Mineral Development Act 1994 (MDA 1994), which governs licensing and state mineral rights, and the Environmental Quality Act 1974 (EQA 1974), which ensures environmental protection through mandatory Environmental Impact Assessments (EIAs) reports. Importantly, mining falls under state jurisdiction, granting state governments primary authority over mineral licensing, local regulations, and the enforcement of environmental and safety standards, thereby playing a central role in regulating and shaping sustainable mining practices in Malaysia.

The following is a list of key policies and legislation that are related to the mining industry in Malaysia (Table 1). The laws also include their corresponding regulations, guidelines and circulars that regulate the mining and mineral industry.

Table 1. Relevant policies and laws applicable to the mining and mineral industry in Malaysia.

Policies	**Laws**
Second National Mineral Policy (DMN2)	Mineral Development Act 1994 and State Mineral Enactments
National Industrial Master Plan 2030	National Forestry Act 1984 & State Forestry Enactments
Framework Plan for the Transformation of the Malaysian Mineral Industry 2021 – 2030 (TIM 2021 – 2030)	Environmental Quality Act 1974
National Advanced Materials Technology Roadmap 2021 – 2030	Town and Country Planning Act 1976
Green Technology Master Plan Malaysia (GTMP)	Natural Resources and Environment Ordinance 1993 (Cap. 84) (1958 Ed.) (Sarawak)
National Green Technology Policy	Environment Protection Enactment 2002 (Sabah)
Standard Operating Procedure (SOP) of Non-Radioactive Rare Earth Elements (NR-REE) Mining Malaysia	Geologists Act 2008
4th National Physical Plan	Geological Survey Act 1974
Development plans for each state in Peninsular Malaysia (local, structure and special area plans)	Occupational Safety and Health Act 1994

On 10 March 2023, the government approved the Standard Operating Procedure (SOP) for Non-Radioactive REE Mining (NR-REE) (JMG 2023) to regulate the emerging REE mining sector through standardised guidelines across the various federal and state agencies on the pretext of promoting sustainable mining. The SOP purports to address feasibility studies and licensing during pre-mining exploration, licensing for mining operations, environmental impact assessments, safety protocols and rehabilitation plans during the operational phases, and post-mining export controls and royalties to prevent resource loss and promote downstream processing.

To date, only Perak, Pahang, and Negeri Sembilan have formally adopted the SOP. As mining falls under state jurisdiction, it is ultimately the responsibility of each state government to formally adopt the SOP, making any necessary modifications to suit their specific requirements.

Standard Operating Procedures (SOP) – A critical examination

The SOP provides guidance on development, operation, environmental management, safety, and mine closure, specifically for mining 'non-radioactive' rare earth elements using the ISL method and processing of IAC deposits. Notably, it does not require a Radiological Impact Assessment (RIA) for ISL mining of IAC deposits, unlike open-pit mining.

The SOP attributes the term 'non-radioactive' to REE mining solely based on the consideration that activity concentration of radioactive elements such as thorium (Th) and uranium (U) is usually below 1 Bq/g in IAC deposits, meeting the clearance level required by Atomic Energy Licensing (Radioactive Waste Management) Regulations 2011. However, this may not always hold true, as concentrations can vary by location, and tailings produced could result in 'technologically enhanced naturally occurring radioactive materials' (TENORM) that might exceed safe limits (Findeis and Schaeffer 2017). The omission of RIA requirements is therefore questioned.

While the SOP covers technical, environmental, socioeconomic, and governance aspects, its focus seems more on reassuring and attracting investors than on robustly protecting the environment or affected communities. Environmental protections are largely superficial, lacking comprehensive measures for long-term hazardous waste management, monitoring, or remediation.

The SOP claims to prohibit mining in conservation areas, but there are no strong safeguards to enforce this. Jurisdictional friction between federal and state authorities further complicates effective implementation, as land and mineral resources fall under state control, allowing states to amend or adapt the SOP as they see fit. There is no clear moratorium preventing states from exploiting conservation or environmentally sensitive areas, rendering the SOP primarily a guide for investors rather than a strict regulatory framework.

State plans on REE

In recent years, several states have taken proactive steps to capitalise on their significant REE deposits (Table 2). Among the frontrunners is Perak, which made headlines as the first state to approve *in situ* mining and beneficiation of lanthanide-rich ion-adsorption clays (Sahabat Alam Malaysia 2022), followed by ambitious plans in Negeri Sembilan and a strong policy stance in Sarawak (Sarawak Department of Premier 2025). These initiatives, while poised to boost economic growth and technological advancement, have also raised important questions about environmental impacts, regulatory compliance, and the equitable sharing of benefits. The evolving REE mining sector in Malaysia teeters on a fine line: unlocking high-value resources concentrated in biodiverse forest reserves, while confronting profound environmental risks like habitat destruction, toxic tailings, and irreversible harm to indigenous peoples and local communities and ecosystems.

RISKS AND IMPACTS OF REE MINING ON THE ENVIRONMENT AND PUBLIC HEALTH

Illegal REE mining

In addition to the rapid push by various state governments to explore and mine REE, the issue of illegal mining also persists. Over the past few years, there have been several documented cases of illegal REE mining in the Bukit Enggang Forest Reserve in Sik (Ikhsan and Abdul Rahman 2023), Kuala Pilah, Negeri Sembilan in 2023 (New Strait Times 2023), in Perak in 2023 (Reuters 2023) and in Selangor and Kelantan in 2024 (Azmi 2024). These incidents represent a small fraction of the broader and more complex challenges associated with REE mining. Since REE deposits are typically located deep within forest reserves and other environmentally sensitive areas, it is likely that further unreported illegal mining activities may be occurring undetected.

Table 2. Development or proposed development of the REE industry by states in Malaysia.

States	Key initiatives / plans	Scale and/or location	Economic focus	Environmental/social issues
Perak – Kenering pilot project	First state to approve an *in situ* mining and beneficiation of lanthanide rich ion adsorption clays in the Kenering district. The federal government allowed for an exemption to the nationwide moratorium, permitting the export of raw materials. [1]	The project site is located along Federal Route 4 (East-West Highway) segment of Jalan Baling-Gerik. It is on 2,161 ha in ESA Rank 1 within the Central Forest Spine Primary Linkage 8, overlapping several forest reserves (Kenderong Forest Reserve, Bintang Hijau (Hulu Perak) Forest Reserve and Belukar Semang Forest Reserve).	The state claims to have collected RM 71.5 million in royalties from rare earth carbonate exports since February 2023. [2]	Mining activities were suspended in November 2025 after reports of discolouration in the Perak River was reported. This prompted investigations by DOE. The cause for the discolouration remains undisclosed, but authorities have committed to releasing the findings. [3]
Perak – future plans	Three additional districts (Kuala Kangsar, Kinta, Larut Matang & Selama) with large REE reserves have been identified. [4]	Estimated 1.7 million metric tonnes of REE, mainly in forest reserves.	The government intends to collaborate with South Korea (downstream) and France (midstream) to build higher value industry. [5,6]	Further expansion would likely intensify land-use and conservation conflicts and long term governance of the waste.
SG4 (Kedah, Terengganu, Kelantan, Perlis)	A joint statement on REE governance and benefit sharing under Ninth Schedule powers (Federal Constitution) was issued by the SG4 states in October 2025. [7]	*Data not yet available given that this is only a joint-statement on REE governance as of writing.*	The states support the full value chain ecosystem but with transparent revenue sharing and avoidance of past oil royalty inequities.	Further expansion would likely intensify land-use and conservation conflicts and long term governance of waste.
Pahang	In April 2025, the state approved 220 hectares in Sungai Wang, Hulu Jelai sub-district, Lipis as a pioneer mining site for REE, with other areas identified in Raub and Bentong.	The state claims that there is an estimated 1.4 million metric tonnes of REE worth RM37.4 billion. [8] About 70% of this resource is in forest reserves and ESAs. The approved project is in Sungai Wang, Hulu Jelai district, Pahang. [9]	This was an early-stage project announcement with limited follow up.	The Orang Asli of Pos Lanai from the Semai tribe, living in close proximity to this proposed project site will be most impacted if this project takes off. They have been opposing this project since 2020 when the government had

				proposed the same project on a larger area (about 660 hectares). In 2021, this community filed a civil suit at the High Court in Pahang amongst others, seeking recognition of their native customary rights. Their legal suit is still pending in court. [10]
Negeri Sembilan	Two Jelebu sites have been identified with pilot projects planned to start in 2026 and revenue expected in 2027. [11]	One of the proposed mining sites is in Ulu Klawang in Mukim Ulu Triang. The site overlaps the Gapau Permanent Reserved Forest and is also on an ESA Rank 2 with high value biodiversity.	The projects target future REE revenues for the state and positions the state within the national REE development timeline.	The recent EIA report for the Ulu Klawang project published in December 2025 was rejected. However, there is no legal barrier to repeated EIA report resubmissions by the project proponent. [12]
Sarawak	In October 2025, the state government explicitly prohibited the export of REE raw materials. They are retaining them as strategic assets essential for domestic high-value industries. A new mining policy will be rolled out in 2026. [13]	The state has indicated they have national REE reserves valued at about RM809.6 billion.	Sarawak aims to emulate China's protectionist model, promoting domestic technology manufacturing and full upstream midstream downstream integration with digitised, transparent operations.	The state has tightened mineral export rules in December 2025 to prevent extraction only operations with emphasis on sustainable development. [14] There may be a possibility of land-use and conservation conflicts on the ground including issues surrounding the rights of indigenous communities.

References: [1] Lawrence 2025; [2] Arif 2025; [3] Khairi 2025; [4] Ahmad 2025; [5] Bernama 2024a; [6] Goh and Ng 2026; [7] FMT 2025; [8] Bernama 2025c; [9] Bernama 2024b ; [10] Bernama 2023; [11] Singh 2025; [12] EIA; [13] Bernama 2025b; [14] Bong 2025.

REE mining within permanent reserve forests contravenes the National Forestry Act 1984
The risks of mining for REE be it in Permanent Reserved Forests (PRFs) or Environmentally Sensitive Areas (ESAs) are real. REE is not a forest produce within the meaning of Section 2 of the National Forestry Act (NFA 1984). Hence, mining or extraction of REE within any PRFs will contravene Section 2 of the said Act. Having said this, nothing prevents the authorities from amending the NFA 1984 to include a new definition or degazetting PRFs in the pursuit of REE.

Further, as seen in the Kenering pilot project above, the approving of such mining activity in an ESA Rank 1 ecosystem is clearly in violation of the federal government's own planning policy and can in no way be viewed as a sustainable activity. In fact, Section 12 of the NFA 1984 also provides for the land excised from a PRF to be replaced with an equal or bigger area of land. However, according to the 2022 amendment to the 1984 Act (National Forestry Act 1984, Section 11), an excision of the PRF has to take place subject to the conduct of a public inquiry (*siasatan awam*), in accordance with the rules which are to be drawn up subsequently by each state. So far, this amendment has only come into force in Perlis on 1 April 2023 and the Federal Territories of Kuala Lumpur, Putrajaya and Labuan on 1 February 2025. Not all states have adopted this amendment and until they do so, PRFs remain at risk of being degazetted for REE extraction without any public consultation or scrutiny.

No clear moratorium prohibiting mining of minerals in ESAs and PRFs
There is no clear moratorium prohibiting mining of any minerals in ESAs and PRFs apart from what is stated in the SOP. The SOP only serves as a guideline for states, allowing each state the flexibility to adopt it fully, partially, or to modify and supplement it according to their own legal framework and practices.

The federal-state jurisdictional divides
The Federal Constitution has assigned lands, mines, and forests as sources of revenue to states (Federal Constitution, Article 110). Further, 10% of the revenues collected by the federal government from export duties on tin, iron, and minerals ores will also be allocated to the producing states (Abdul Jalil and Karim 2009). Currently, there is no real and adequate financial incentive for state governments to protect their forests. Dependence on land and forests as the main source of revenue means state governments would be less inclined to gazette land and forests for conservation purposes as totally protected areas. This has resulted in misaligned economic incentives for the states to exploit natural resources instead of protecting high conservation value (HCV) areas. This situation will continue unless clear, lasting, and enforceable mechanisms are established to enable states to effectively conserve their forests. Without permanent solutions—such as robust legal frameworks, consistent funding streams, and strong regulatory safeguards—states may continue to face pressure to exploit forest resources for economic gain.

Environmental and public health concerns of REE Mining
REE mining poses significant environmental and public health risks, including radioactivity and pollution from intensive energy use and waste generation throughout all stages of production. The process uses large amounts of water, acids, and solvents, resulting in substantial waste byproducts that can contaminate groundwater with acids, heavy metals, and radioactive elements like thorium and uranium. It is estimated that processing one tonne of REE can produce up to 1.4 tonnes of radioactive waste (Findeis and Schaeffer 2017).

Disturbances to geomorphology can lead to landslides
Besides risks of eutrophication, ISL could also lead to mine collapse and landslides when the RE mining is done at a geologically unsuitable site. If the chosen site for ISL does not have the suitable levels of permeability or positioned over a solid bedrock without fissures,

the disturbance caused to the geomorphology (i.e., soil structure, stability, etc.,) by the direct injection of the leachate into the IAC ore body could very well destabilise the landscape. ISL also carries the risk of the capillary forces (such that exist between liquid and solid surface that moves liquid in narrow spaces without external force) surrounding the narrow leaching holes to attract the leaching solution back to the topsoil layer, destroy the vegetation and plants on the surface, all of which can make rehabilitation even more difficult. In the Ganzhou region in China, over 100 reported landslides are already attributed to ISL practices. It is imperative therefore for proper caution to be exercised and best practices followed to prevent destabilisation of the geomorphology at the mining site (Yang *et al.* 2013).

CASE STUDIES ON IMPACTS OF MINING ON LOCAL COMMUNITIES AND MINING

Case study 1: Consumption of heavy metal polluted water by Indigenous Community

One of the ways iron ore is mined through the process of washing iron ore rich soils, where water is mixed with the soil to break apart the clumps; afterwards the slurry is passed through either a washing trough or magnetised drum, where the iron particles and nuggets are separated from the slurry for further processing. The slurry flows into a series of tailing ponds, where the sediment and other particulate matter settle to the bottom of the ponds, while the water is reutilised as washing liquid. This occurs in a closed-circuit iron ore mining setup.

In some cases, the iron ore rich soils also bear other metallic elements, such as aluminium, chromium, and manganese, henceforth referred to as heavy metals, that can be detrimental to human health. When exposed to water, oxygen, and in suitable conditions, these heavy metals are dissolved and mobilised, enabling them to move with the water flow and increasing the risk it being consumed, absorbed, or adsorbed by living things and the natural environment. Heavy metals are highly toxic, and its effects are dependent on the exposure period and dosage received. Its effects include organ damage, degenerative diseases, cancer, and in serious cases, death. Examples historical occurrences of mass heavy metal poisoning include the Minamata disease, Itai-Itai disease, Grassy Narrows First Nation mercury pollution, and the Zamfara State lead pollution.

Kampung Kelaik, Kelantan and its surrounding forests and rivers are home to about 200 Indigenous Peoples of the Temiar ethnic subgroup. Over the years, especially after the opening of the Gua Musang – Cameron Highlands highway, the community had to contend with increasing landscape changes and encroachment into their territories, way of live, and agency. Mines and plantations appeared in the landscape, followed by deforestation, loss of access to forest products, and adverse changes to the environment, including decreased river water quality.

In 2024, it came to light that tailing and effluent from nearby iron ore mines have entered into the nearby natural environment. At the discharge point where the slurry escapes into the environment, it was found that the concentrations for aluminium, arsenic, chromium, iron, and manganese have exceeded the Department of Environment's limit for Class III river, by multiple magnitudes (Table 3). Blood sample of one villager shows elevated levels of chromium, aluminium, arsenic, and iron.

Table 3. Heavy metals in water samples from mining effluent release points, August 2024.

Heavy Metals (mg/L)	Aqua Orion	Redstar Capital	DOE Limit (Class III River)*
Aluminium	87.1	4.44	0.06
Arsenic	0.002	<0.001	0.4
Chromium**	2.6	0.183	2.5 (Chromium-3) 1.4 (Chromium-6)
Iron	47.4	5.86	1
Manganese	9.93	0.41	0.1

* DOE Class III River: River that can be used for livestock and fisheries, extensive treatment needed to be used for water supply.
** Testing was for total chromium.

(Reports on the plight of Kampung Kelaik were authored by Vinothaa and Razak, and accessed through the Pulitzer Center; Razak and Vinothaa 2024; Vinothaa 2024).

Case study 2: Mamut Copper Mine and its Legacy

The Mamut Copper Mine (MCM) is located in Sabah, where it sits at the east-southeast border of the Kinabalu Park. MCM was in operation for 24 years (1975 – 1999), where the leased area of 1,942 hectares was mined for copper and gold. Throughout the operation of the MCM, 250 million tonnes of overburden and waste rock and 150 million tonnes of tailings were produced, which were deposited in Lohan Valley and Lohan tailings facility, respectively (van der Ent and Edraki 2016).

The weathering of the overburden and tailing, as well as heavy metal leaching from rain resulting in heavy metal contamination of the surrounding environment, as well as the Mamut River. A study compared the concentration of 10 selected heavy metals in the soil adjacent to the Mamut River and a control river (Kipungit River); it found that the level of heavy metals in the soils from Mamut River were 10 – 100 times higher than the heavy metal level in Kipungit River (Ali *et al.* 2004). A study focused on the concentration of heavy metals in the liver of the River Toad [*Bufo juxtasper* (Inger)] collected from the Mamut River, Laganan River, Tabin Wildlife Reserve, and Crocker Range. It found that copper, cadmium, and nickel concentrations are relatively higher in the River Toads from the Mamut River, compared to the three other sites (Lee and Stuebing 1990).

The rehabilitation of MCM is possible, but it faces challenges such as the large volume of waste materials and high levels of rainfall (van der Ent and Edraki 2016). It was estimated that the rehabilitation of MCM will cost up to RM500 million (Santos 2022). At the present, MCM and its facilities remain an environmental risk should structural failure occurs, and still continue to leach heavy metals and other environmental contaminants into its surroundings.

RECOMMENDATIONS

As the government continues to proceed with developing the REE industry, it is crucial that this is approached with utmost care. The government must prioritise the well-being of people and the protection of the environment above profit and carefully consider the following recommendations to guide responsible and sustainable decision-making.

No-go zones

It is strongly recommended that NRES recognises PRFs, ESAs and indigenous customary territories as no-go zones for REE mining, and that their status (whether through laws or policies) must not be altered in any way to circumvent this rule.

This is aligned with the recent UN Secretary-General's Panel on Critical Energy Transition Minerals report (UN 2024) that recommends "governments to consider declaring other protected and conserved areas as 'no-go areas' for activities related to critical energy transition mineral value chains, taking into account national legal contexts". Hence, the government must proactively identify and officially designate specific regions as 'no-go zones or areas' and therefore strictly prohibit REE mining in these areas.

Recognition of indigenous peoples' customary territories and FPIC

While the ESAs are defined by the National Physical Plan, the complexity surrounding the indigenous customary land rights must also be acknowledged too. This complexity is linked to how such territories are often unilaterally determined by the state, without proper consultation, transparency and information access for the people. Compounding the matter, state authorities have also been known to erroneously interpret that indigenous customary land rights do not exist in gazetted forests and conservation areas, when neither their rights were properly extinguished nor adequate compensation was ever paid to the affected communities.

What is urgently needed in this country, is the formal recognition of Indigenous Peoples as right-holders. Without such safeguards in place, as is the status quo now, rights of project proponents as registered land owners or licensees will always supersede the rights of Indigenous Peoples who are associated with the land for decades or centuries before project proponents, simply because they do not possess the documentary evidence of their land rights. As Indigenous Peoples, most often than not, have their territories overlap with PRFs and ESAs, recognising their rights as such would at least keep mining or any other environmentally destructive projects from encroaching into their areas (Sahabat Alam Malaysia 2011). Indigenous Peoples are the primary guardian of our forests after all.

Meaningful public consultations

Meaningful public consultation and participation following the FPIC principles is also key. Oftentimes when public consultations are carried out, they are done in a manner that exaggerates the project benefits to the affected community, and conceal the adverse impacts of the projects to elicit positive response to the project by the communities on ground prior to project approval. A meaningful consultation here means, the communities are told in unambiguous and unequivocal terms, what exactly the project purports to carry out, how that will affect them as right-holders, and the project's adverse impacts to their health and environment. They must be given an option to say "no" to the project, and have their choice respected.

No biodiversity offsets

Biodiversity offsets cannot be considered as a mitigating measure in the ESG standard. Incorporating offset requirements into mining project approvals or biodiversity offset is a false solution and also a form of greenwashing. Offset is based on the problematic assumption (Mariet *et al.* 2024) that the ecological damage caused by the project can be cancelled out or offset by restoring biodiversity elsewhere other than the proposed project area. ESAs and other ecosystems cannot simply be replaced elsewhere, especially when measures should be in place to increase such areas instead of eliminating or reducing them.

There should also be a meaningful participatory process for civil society organisations, community-based organisations, and any concerned citizen to provide feedback/input to the standard, and there should be a response from the government on how they have considered the feedback in the process.

Any claim of ESG-compliance, responsible and/or sustainable mining are just forms of greenwashing, if the government, mining companies, and financial institutions are **not** able to forgo these mineral-rich ESAs or lands of Indigenous Peoples involving their customary rights.

Comply with transparency and open data policies

The government must also abide by its commitments to transparency and open data policies. The government should not simply make such announcements in the media and stop there, but instead, take active steps in implementing these policies. This means making technical reports of impugned projects ready available to affected communities and not to give them a run around under the guise that such technical reports are not made mandatory to be published into the public domain or that they are the intellectual property of the project proponent.

Remove the misleading classification of IAC REE as non-radioactive

The government should rectify the blanket mislabelling of all IAC deposits in Malaysia as a "non-radioactive" source of REE within the SOP. Currently, the SOP relies on a single preliminary radioactivity analysis at a proposed REE mine, which concluded that the Naturally Occurring Radioactive Materials (NORM) present were below the 1 Bq/g clearance threshold set by the Atomic Energy Licensing (Radioactive Waste Management) Regulations 2011. However, there is no guarantee that other IAC deposits across Malaysia, or the tailings generated from In-Situ Leaching (ISL), will consistently meet this threshold.

It is highly concerning that the SOP uses this isolated preliminary study to justify exempting all future ISL projects from the requirement to conduct a Radiological Impact Assessment (RIA). Without a mandated RIA process, there is no reliable way to determine the potential radiological impacts of an ISL project on the surrounding environment and local communities. Therefore, it is vital that an RIA framework is given the same regulatory force as the Environmental Impact Assessment (EIA) framework, especially since the government is actively encouraging the expansion of the REE industry to capitalise on its economic benefits.

Incentives for states to safeguard our forests

The international agreements that Malaysia has signed onto (i.e., the Paris Agreement and Convention on Biological Diversity), provide financial support for developing countries to pursue forest and biodiversity conservation efforts. Malaysia is a developing country and is entitled to receive financial resources to meet our international commitments. The international funds available are the Green Climate Fund, Adaptation Fund, Global Environment Facility, and Special Climate Change Fund.

Federal-state jurisdictional divisions have been highlighted by many as the key challenge when addressing conservation issues in Malaysia. Given the federal-state jurisdiction dichotomy, international climate funds is one of the first steps that we need to take to address some of the drivers of deforestation. The federal government needs to help diversify state revenue streams. The Ecological Fiscal Transfer (EFT) is one of the finance mechanisms to encourage the gazetting of protected areas by state governments. At a minimum, these will alleviate the pressure faced by state governments that are dependent on the exploitation of forests and other natural resources for their income generation.

Seeking international climate funds is also consistent with the call in 12th Malaysia Plan 2021–2025 to diversify conservation funds. Together with the various financial instruments planned and created in Malaysia to incentivise forest and biodiversity conservation efforts, international climate funds can add to the pool of funding and diversify the funding sources

for conservation efforts in Malaysia, while acknowledging that there are other systemic causes/root causes in deforestation and violation of the rights of indigenous peoples and local communities.

Compliance, monitoring and waste management

If the government continues to proceed with building the REE sector, the authorities must enforce strict compliance with laws, rules, and regulations for managing radioactive and toxic waste from REE mining, whether using traditional or ISL methods. Waste management including site selection for waste and pollution control should be a top priority and strictly implemented. There must also be continued independent monitoring of the status of the waste and the critical health markers of the surrounding environment by the relevant authorities.

In relation to extraction, while ISL is theoretically less destructive than open pit mining, comprehensive geological and technical surveys are crucial to accurately assess ore quantities and ensure minimal environmental impact. Failure to properly conduct these studies can result in low resource recovery (as low as 5%) and unnecessary environmental harm and risk to public health.

CONCLUSION

Malaysia should not risk repeating mistakes of the past by hastily pursuing the REE industry purely for immediate gains while disregarding long-term sustainability. Our history with mining has already left a legacy of environmental harm and significant radioactive waste in Perak and, more recently, in Pahang. Unless a thorough and transparent cost-benefit analysis is conducted and a permanent, effective waste management solution is put in place for both radioactive and non-radioactive by-products, we risk further eroding our remaining biodiversity and the territories of indigenous peoples. We should not rush into this sector at the expense of our environment and indigenous peoples and local communities.

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