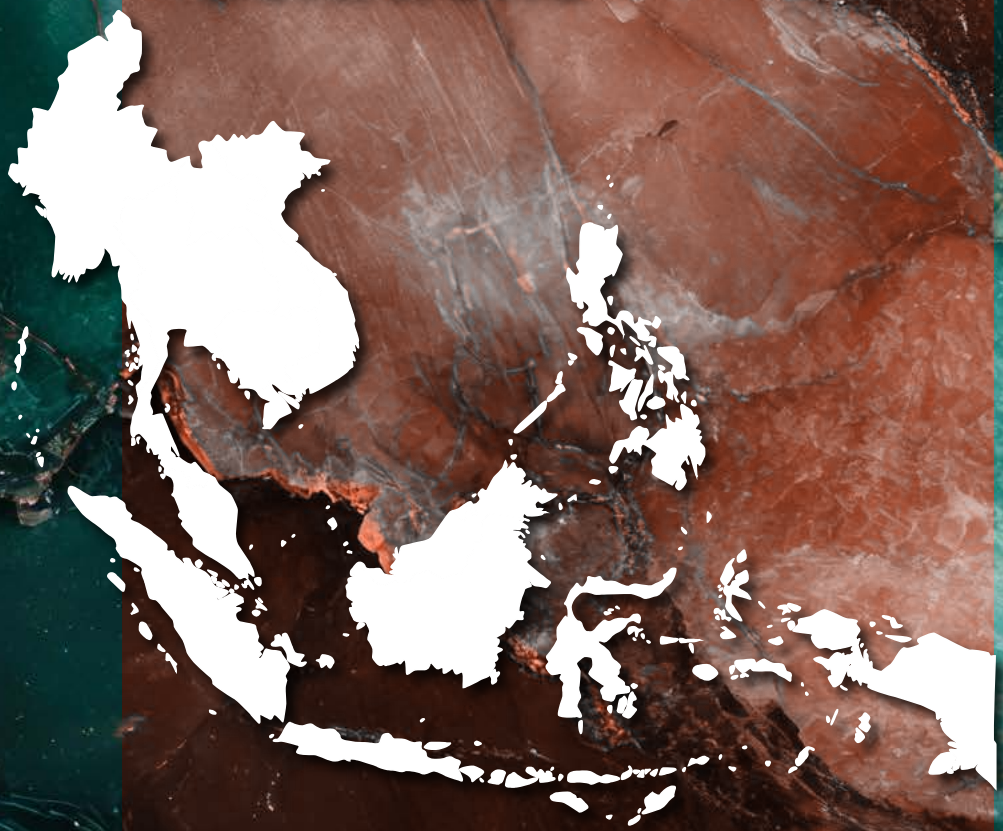
Crimes Associated with Critical Minerals in Southeast Asia: Trends, Challenges and Solutions



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Acknowledgements

This report was written by Lorenzo Colantoni, UNICRI consultant, under the overall guidance of Matthew Burnett-Stuart (Associate Expert, UNICRI). Special appreciation is extended to Kieran Jones, Maëlle Délen and Maria Zamorano for their editorial support and contributions.

UNICRI acknowledges the valuable input provided by the following Experts: Anrike Visser, Claudia Carpanese, David Aled Williams, Flaviano Bianchini, Luca Maiotti, Lynn Schlingemann, Nicole Byrd, Peter Bishop, Pierre Vaud, and Rezki Syahrir.

Suggested citation: UNICRI, *Crimes Associated with Critical Minerals in Southeast Asia: Trends, Challenges and Solutions* (United Nations publication, 2025).

Foreword

The global transition to clean energy and digital technologies has significantly heightened the demand for critical minerals, positioning Southeast Asia as a key player in an increasingly complex geopolitical and economic landscape. The region's rich deposits of nickel, rare earth elements, tin, and cobalt hold immense potential to drive sustainable development and economic prosperity. Yet, this growing demand also brings with it profound governance, security, and environmental challenges. Criminal activities such as illegal mining, smuggling, corruption, and environmental degradation pose serious threats to the long-term benefits of responsible resource management in Southeast Asia.

This report, *Crimes Associated with Critical Minerals in Southeast Asia: Trends, Challenges and Solutions,* aims to shed light on the risks and vulnerabilities confronting the region's critical minerals sector. It offers a comprehensive analysis of evolving criminal dynamics, gaps in regulatory and enforcement frameworks, and the socio-economic impacts of illicit activities. Furthermore, the report explores how legal, technological, and policy interventions can enhance transparency, accountability, and sustainability across the sector.

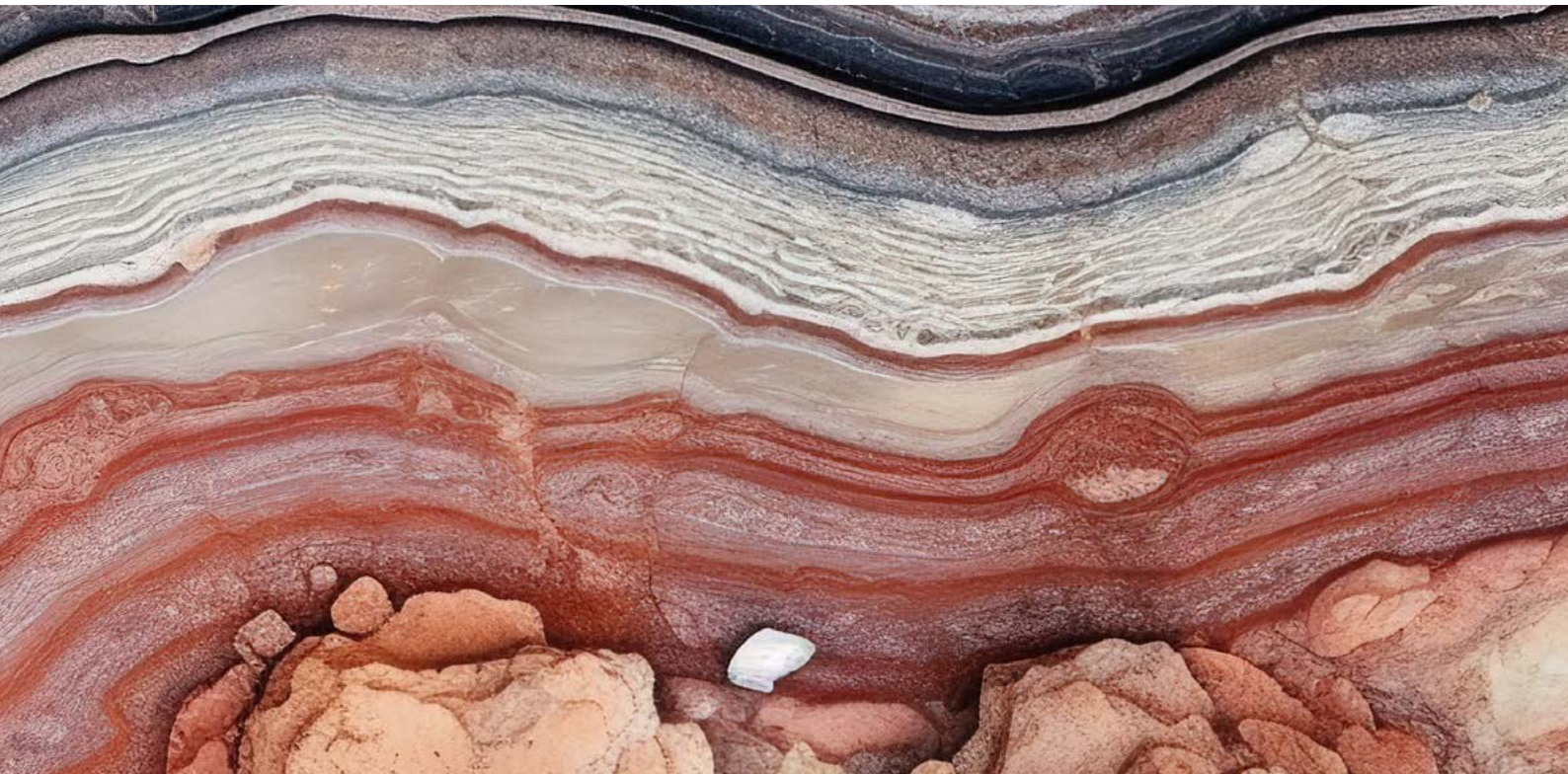
Addressing these challenges demands a collaborative, multi-stakeholder approach. Governments, international organizations, civil society, and private sector actors must work

together to ensure that the extraction and trade of critical minerals contribute to sustainable development rather than exacerbating crime, conflict, and environmental harm. By adopting innovative tools such as traceability systems, supply chain monitoring, and robust legal frameworks, stakeholders can mitigate criminal risks while promoting ethical and responsible sourcing practices.

UNICRI remains steadfast in its commitment to supporting evidence-based policymaking and capacity-building initiatives that strengthen the resilience of Southeast Asia's mineral supply chains. It is our hope that this report will serve as a valuable resource for policymakers, law enforcement agencies, researchers, and industry leaders as they navigate the intricate challenges of critical mineral governance in the region.

We extend our deepest gratitude to the researchers, experts, and stakeholders who contributed their knowledge and insights to this study. Their dedication to addressing the intersection of crime, governance, and natural resource management is vital to shaping a more secure, sustainable, and equitable future for Southeast Asia and beyond.

Leif Villadsen,
UNICRI, Acting Director



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Executive Summary

Overview

Critical minerals are becoming some of the most strategic resources on the global stage due to their use in the majority of the technologies essential for the energy and digital transition. As international demand for these elements rises, so do exploration, extraction and trading activities worldwide, triggering what many are already calling a "critical minerals rush".

Southeast Asia could play a crucial role in this process, and to some extent, it already does. The region has a significant endowment of critical minerals (section 2.1.3) and established production of some of these key resources. Indonesia and the Philippines are the world's first and second largest producers of nickel,[1] respectively, while Myanmar is the fourth-largest producer of Rare Earth Elements (REEs).[2] Nevertheless, the region is still considered largely unexplored, and investments in mining (both for exploration and production) have declined across countries for years—although the increasing focus on critical minerals may soon reverse this trend.

These and other factors may increase the vulnerability of Southeast Asia's critical minerals sector to criminal infiltration (section 2.3). Several countries in the region have historically struggled with issues such as corruption, political instability, and lack of transparency in their mining industries. The rapid expansion of critical minerals extraction could lead to a spike in illegal activities across the entire supply chain. This has already occurred in some countries, such as Malaysia, where the Minister of Natural Resources and Environmental Sustainability recently declared that approximately 84 per cent of its REE exports were illegal.[3] Similar challenges exist in Indonesia and Myanmar (section 3). In several cases, most notably in Malaysia, Viet Nam, and Indonesia, authorities have responded by launching investigations and formulating policies to address the illegal extraction of critical minerals in anticipation of the sector's growth (section 3.2). If these efforts are combined with traceability mechanisms (section 3.3.1), stronger legislative and enforcement measures (section 3.3.2), and social initiatives (section 3.3.3), they could prove effective in preventing a new wave of illegal

1 (U.S. Geological Survey 2024b)
2 (U.S. Geological Survey 2024c)
3 (The Star 2024a)

mining in Southeast Asia. This would enable countries in the region to fully benefit from their mineral resources while mitigating the environmental and social impact of mining.

Context

Despite the significant endowment of most countries in the region, the distribution of critical minerals across Southeast Asia is uneven in both type and quantity (section 2.1.3). However, as exploration activities expand, this picture could soon change. Currently, Indonesia and the Philippines hold some of the world's largest nickel reserves, while several other countries in the region have little to none. Indonesia also possesses substantial tin reserves and production capacity, as does Myanmar and, to a lesser extent, Malaysia. Myanmar plays a key role in REE production, alongside Viet Nam, which holds similar reserves but produces significantly less. Malaysia could soon catch up if ongoing exploration confirms its resource potential.

Some of these countries have enacted a series of policies to increase critical mineral production and trade, particularly to enhance government control over these resources (section 2.1.4). The most common measure is export bans, the most notable being the nickel export ban imposed by Indonesia in 2020. Other countries such as Malaysia have adopted similar restrictions, while the Philippines is considering similar measures.

Criminal exposure of the critical minerals sector in Southeast Asia

This complex landscape creates significant opportunities for criminal infiltration in Southeast Asia's critical minerals sector (section 2.3.3). The urgency to rapidly develop the sector may result in weak environmental or anti-corruption assessments, making it easier for criminal networks to operate. Additionally, the frequent price volatility of many critical minerals creates incentives for illicit activities. As competition intensifies, criminal actors may step in to offer low-cost but illegal solutions for waste disposal or tailings management. Export bans also offer an opportunity to criminal actors for

smuggling, particularly for resources and minerals whose distribution is concentrated in only a few countries—as in the case of nickel.

Southeast Asia also faces challenges in combating illegal mining due to a lack of focused investigation (section 2.2.1). Since the illegal mining of critical minerals is a relatively new concern, criminal methodologies and actors are less understood compared to regions with a long history of illegal mining, such as the Amazon. Limited expertise among regional enforcement agencies and civil society further exacerbates this issue. Additionally, Southeast Asia's complex geography and political diversity (section 2.3.1) make coordinated efforts even more difficult.

The structure of the mining sector further complicates enforcement (section 2.3.1). Unlike in other regions, illegal mining activities in Southeast Asia are often carried out through large-scale operations that maintain a façade of legality, rather than through entirely illicit or artisanal mining. This is also due to features inherent to most critical minerals, which are traded in large quantities and require advanced refining processes. As a result, illegal activity is not confined to the extraction stage—although this phase remains central due to its environmental and human rights impact—but extends throughout the supply chain (section 2.3.3). Shipping is a particularly relevant entry point for criminal players, particularly in countries where export bans are in place.

Obstacles to effective action

Enforcement efforts against illegal critical mineral mining in Southeast Asia are hampered by several challenges affecting both the sector's supply chain and national operational and legislative frameworks (section 3.1). Chief among these challenges is the lack of traceability mechanisms for critical minerals, both globally and within the region. This lack of oversight makes it nearly impossible—or prohibitively expensive—to verify the true origin of resources, complicating investigations and creating significant opportunities for the laundering of illegally mined minerals (section 3.3.1). To address this, Indonesia has expanded its Sistem Informasi Mineral dan Batubara Antar Kementerian/Lembaga (SIMBARA) to include

tin and nickel, following its initial launch for coal and gold in 2022. Additionally, some private sector initiatives, such as the Global Battery Alliance's (GBA) "Battery Passports", aim to enhance supply chain transparency (section 2.1.2). However, implementing such systems across the entire industry poses significant logistical and financial challenges, as most traceability mechanisms would need to be developed from the ground up to accommodate complex supply chains.

In many cases, national legislations also require updating, while enforcement agencies will need to enhance their technical expertise and, to some extent, adapt their strategies to effectively address the challenges posed by this emerging wave of illegal mining (section 2.1.3).

Three primary factors act as key enablers for illegal activities: corruption (section 3.2.1), political instability (section 3.2.2) and insufficient protection of local and Indigenous communities (section 3.2.3). Corruption permeates all levels of the mining industry, from low-level officials overlooking environmental and health violations, to high-ranking politicians issuing illegal permits for small and major operations. Although political instability is not a widespread issue across the region, it is particularly relevant in Myanmar, where governance challenges create opportunities for illicit mining operations (section 3.2.2). Meanwhile, issues affecting local and Indigenous communities are more common and involve countries such as Indonesia and the Philippines, where unclear land tenure or insufficient protection of indigenous rights pave the way for illegal operations.

Solutions

Despite these challenges, Southeast Asian countries can adopt several solutions to counteract illegal mining for critical minerals, focusing on the technological traceability component (section 3.3.1), strengthening legal and operational frameworks (section 3.3.2), and empowering local and Indigenous communities (section 3.3.3).

Traceability is essential for effective enforcement. Recent technological advancements can help simplify the implementation of these complex systems. New apps and software are now supporting the collection of chain of custody informa-

tion, using a source-forward traceability approach (i.e. each player along the supply chain is responsible for supplying data, rather than leaving data collection to the final operator). Satellite imagery allows for a quick identification of the origin of minerals when GPS coordinates are provided, while geochemical fingerprinting allows for a rapid identification of the source through unique chemical or isotopic patterns. However, all these new technologies need to be matched by complementary measures to facilitate their implementation, such as raising public awareness or integrating their use into broader initiatives (section 3.3.1).

Strengthening legislative and operational frameworks is equally critical (section 2.3.2). This requires not only introducing new measures, such as stricter sanctions and specialized training for enforcement agencies, but also a fundamental shift in the approach of national institutions. Current frameworks remain primarily designed around a smaller-scale mining sector compared to industries like timber and palm oil, with a focus on conventional minerals such as gold and coal. Revised legislation and enforcement strategies should instead reflect the unique characteristics of the rapidly evolving critical minerals sector and incorporate emerging concerns related to environmental crime, particularly the phenomenon of crime convergence.

Finally, empowering local and Indigenous communities can be a highly effective strategy for both improving enforcement and preventing illegal mining at its source. These communities are often the first and most severely affected by illegal mining, facing health, social, and economic impacts. At the same time, they are frequently the most effective at detecting and exposing such activities, as seen in the Philippines. Key measures to strengthen their ability to prevent and respond to illegal mining include providing economic alternatives, improving land tenure security, increasing their monitoring capacity and negotiating power, as well as increasing the transparency and accountability of Free, Prior, and Informed Consent (FPIC) processes (section 3.3.3).

By implementing these solutions, Southeast Asian countries can mitigate the risks posed by illegal mining while ensuring the long-term sustainability of their critical minerals sector.

LIST OF ACRONYMS

AI: Artificial intelligence

APMC: Altai Philippines Mining Corporation

ASEAN: Association of Southeast Asian Nations

ASM: Artisanal and small-scale mining

DRC: Democratic Republic of the Congo

EU: European Union

EUDR: EU Deforestation-Free Regulation

EV: Electric vehicle

FPIC: Free, Prior and Informed Consent

GBA: Global Battery Alliance

IEA: International Energy Agency

IRA: Inflation Reduction Act

KPK: Indonesian Corruption Eradication Commission

LSM: Large-scale mining

MPSA: Mineral Production Sharing Agreement

NGO: Non-governmental organization

OCG: Organized crime groups

REE: Rare earth element

SIMBARA: Sistem Informasi Mineral dan Batubara Antar Kementerian/Lembaga

UNICRI: United Nations Interregional Crime and Justice Research Institute

UNODC: United Nations Office on Drugs and Crime

1. Introduction

1.1 Objectives and scope of the report

The demand for critical minerals, essential for high-tech products and green energy technologies, is surging globally. Southeast Asia, rich in mineral resources, plays a crucial role in meeting this demand. However, the region faces significant challenges from illegal mining and trafficking of these minerals, posing threats to environmental integrity and sustainable development.

This report aims to analyse the state of illegal mining and associated crimes in Southeast Asia's critical minerals sector, with a particular focus on minerals essential for the energy and digital transitions. By identifying gaps in awareness, legislation, and enforcement, the report seeks to support Southeast Asian member states in enhancing their capacity to combat illegal mining and trafficking effectively.

This report is part of the United Nations Interregional Crime and Justice Research Institute's (UNICRI) Critical Minerals Initiative, which addresses urgent vulnerabilities in the supply chains of critical minerals such as cobalt, nickel, and rare earth elements (REEs). Environmental crimes associated with illegal mining, including deforestation, soil degradation, and water contamination, threaten ecosystems and biodiversity while violating human rights and destabilizing governance systems. UNICRI's work supports stakeholders in securing supply chains, combating environmental degradation, and protecting human rights.

BOX 1: DEFINING CRITICAL MINERALS

There is no universally agreed definition of critical minerals. However, this report follows UNICRI's Strategic Response Framework, which defines critical minerals as those that *are essential to technology, economic stability, and national security while being vulnerable to supply chain disruptions and security risks.*

For the purposes of this study, critical minerals refer specifically to those vital for the global energy transition and digital transformation. This includes nickel, tin, copper, cobalt, and REEs—key materials used in renewable energy technologies, battery production, and high-tech industries.

1.2 Illegal mining and associated crimes

Crimes linked to mining encompass a broad spectrum of offences, ranging from violations of administrative regulations to serious criminal activities involving organized crime. Due to the absence of universally accepted definitions across countries and institutions, these crimes often operate within a legal grey area, with blurred boundaries between regulatory breaches and criminal conduct. This report focuses on offences that affect the entire supply chain, from exploration and extraction activities to refining and trading. While some international actors incorporate trafficking within the broader concept of illegal mining,[4] this report distinguishes between offences occurring at the extraction stage and those further along the supply chain. Nonetheless, it acknowledges that the illicit mineral trade is an integral part of illegal mining operations, as it facilitates financial gains and enables further criminal activities.

BOX 2: DEFINING ILLEGAL MINING

There is no universally accepted definition of illegal mining. For the purpose of this publication, illegal mining refers to mining activity that is: (a) carried out by a person, natural or legal, or a group of people without complying with the requirements of applicable laws or administrative regulations that govern these activities; or (b) carried out in areas where the exercise of such activities is prohibited or using prohibited equipment, devices or chemicals.[5]

Illegal mining is a highly lucrative and widespread offence, deeply entrenched in regions where weak governance, resource abundance, and economic vulnerabilities create fertile ground for illicit extraction. It is particularly pervasive in parts of Africa and Latin America.[6]

However, the nature of illegal mining is evolving due to:

4 (Interpol 2022)

5 Adapted from UNODC, Global Analysis on Crimes that Affect the Environment – Part 2b: Illegal Mining (United Nations publication, 2025).

6 (Cortinhas Ferreira Neto et al. 2024)

- **Rising global demand for minerals**, including those historically considered less lucrative, such as REEs, lithium, and nickel.
- **The rapid advancement of digitalization and the energy transition**, driving demand for critical raw materials.
- **Volatility in commodity prices**, which creates opportunities for illicit operators with low regulatory constraints.

Between 2017 and 2022, the price of nickel rose by 3.1 times, REEs by 2.5 times, and lithium by 6.7 times.[7] This surge, however, was followed by sharp price drops (e.g. lithium prices have declined significantly in the past two years), benefiting illicit actors who can operate with lower costs, greater flexibility, and fewer regulatory burdens compared to legal enterprises. Illegal mining operations bypass environmental, labour, and safety standards, making them highly profitable but also socially and environmentally destructive.

Illegal mining takes various forms, but in terms of extraction activities, it generally falls into the same two broad categories as legal mining: artisanal and small-scale mining and large-scale mining.

- **Artisanal and Small-Scale Mining (ASM):** ASM refers to legal or illegal mining operations that primarily use simplified forms of exploration, extraction, processing, and transportation. ASM activities can be legal, informal, or illicit, depending on the regulatory framework of the country in which they take place. Informal ASM occurs when miners operate without official permits or outside the regulatory framework but do not explicitly violate criminal law. Such violations may result in administrative sanctions rather than criminal prosecution. Illegal ASM refers to activities that explicitly contravene national, regional, or international laws, such as mining in protected areas, failing to comply with labour, tax, or environmental regulations, or using banned chemicals like mercury. ASM is often associated with unsafe working conditions, environmental degradation, child and forced labour, and social conflicts. In some cases, artisanal miners operate within or near LSM concessions, sometimes with tacit approval or informal agreements with LSM operators. Criminal or armed groups may also exploit ASM operations, using them for money laundering, illicit financing, or territorial control.

7 (IEA 2023a)

* **Large-Scale Mining (LSM)**: LSM refers to highly mechanized, capital-intensive mining operations that are typically legally sanctioned and conducted by large corporations or state-owned enterprises. However, LSM operators may engage in illegal practices such as exceeding the limits of their concessions, violating environmental and labour standards, or obtaining permits through corruption. In some cases, entire large-scale operations function outside the law, particularly in regions with weak government oversight or high levels of corruption. These illicit large-scale mines often cause severe environmental destruction, social unrest, and human rights violations, contributing to deforestation, pollution, and conflicts with local communities.

A range of ancillary offences often accompany these crimes, such as participation in an organized criminal group (when organized crime is involved), terrorism (when illegal mining is used as a source of financing for terrorist organizations) and money laundering, with tax evasion also being a frequent occurrence. Corruption is a cross-cutting issue in all violations, serving as a key enabler of illegal mining at every stage, from high-level corruption in granting concessions to local corruption that conceals illegal discharges and other forms of pollution.

The international community has expressed concern about the growing involvement of organized crime groups in illegal mining and trafficking of mining products. These concerns have been reflected in UN resolutions like **ECOSOC Resolution 2019/23**, which emphasizes the need to combat transnational organized crime linked to illicit trafficking of precious metals and illegal mining. In 2020, in its resolution 75/196, the UN General Assembly highlighted the substantial increase in the volume and range of criminal offences related to trafficking of precious metals and minerals, acknowledging their potential role in funding organized crime and terrorism. It called for appropriate and effective measures to prevent and combat trafficking in precious metals by organized criminal groups, including by adopting necessary legislation. These and other high-level discussions highlight the need for effective measures to prevent and combat illegal mining and the trafficking of metals and minerals. They also emphasize that these crimes have become a priority on the international agenda, requiring the immediate attention of the global community.

1.3 Structure of the report

This report examines the demand and production of critical minerals globally. It then analyses the criminal risks within Southeast Asia's critical minerals supply chain, along with the primary methods used by organized crime groups (OCGs) and other criminal actors. Additionally, it analyses obstacles to effective action and provides recommendations applicable to Southeast Asia and other regions.

The structure of the report is the following:

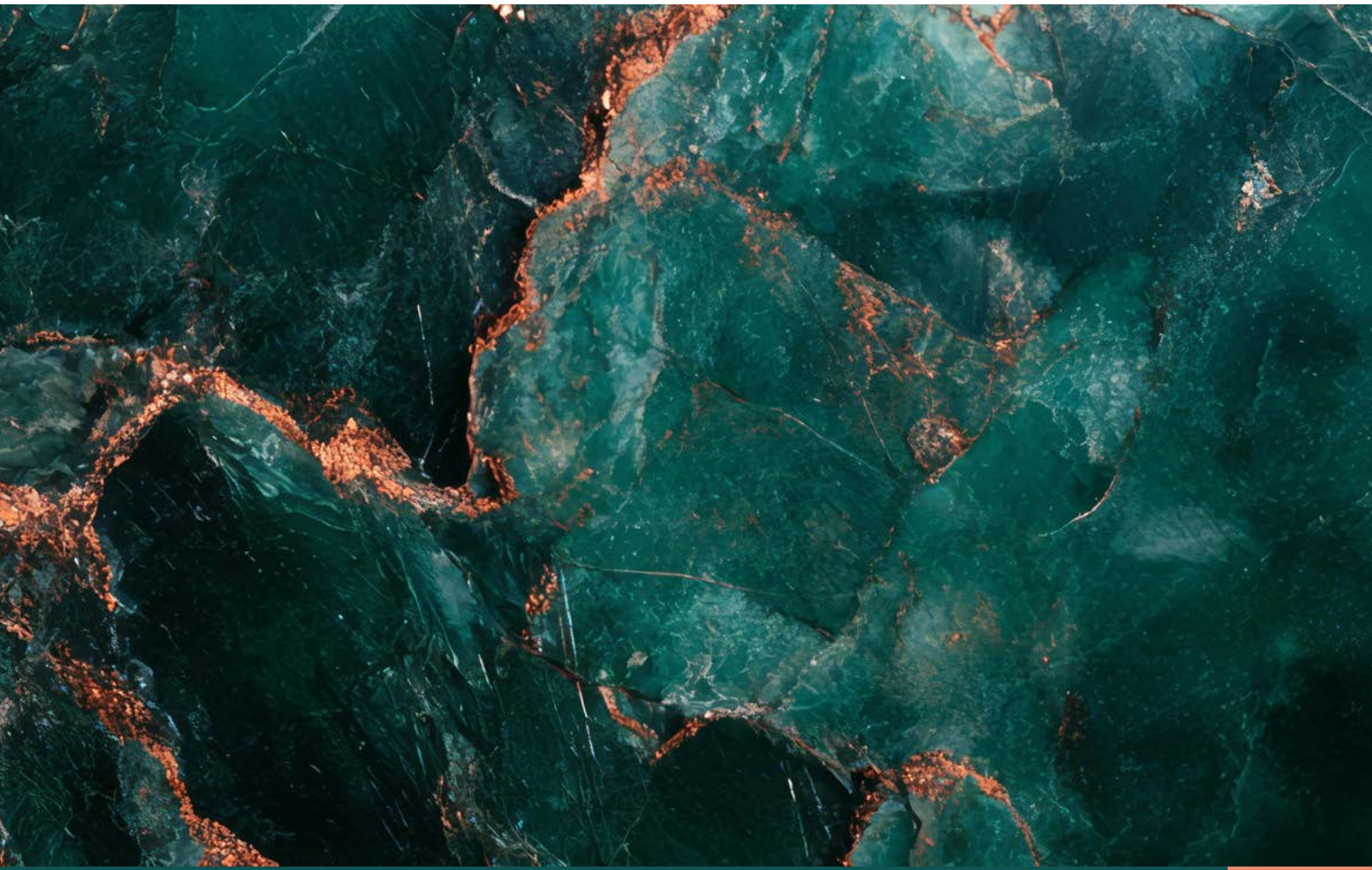
* **Context:** This section provides an overview of global demand and Southeast Asian production of critical minerals, including the national strategies and policies of key players. It further examines the policies adopted by Southeast Asian countries and analyses vulnerabilities where criminal actors can infiltrate supply chains. Additionally, it explores common methodologies used by criminals and structural weaknesses within the sector.
* **Obstacles and solutions:** This section begins with a detailed analysis of the key barriers to effective action, such as the absence of robust traceability mechanisms and inadequacies in both operational and legislative frameworks. It then identifies three major enablers of criminal activity: corruption, political instability, and insufficient protection of local and Indigenous communities. Case studies from Southeast Asia illustrate these challenges. The section concludes with proposed solutions that align with the identified obstacles, emphasizing the importance of traceability technologies, legislative reforms, and the empowerment of local and Indigenous communities.

1.4 Methodology

This report was developed through desk research and interviews with experts in the sector and region; an expert group review; and finally through a validation workshop. Interviews included various stakeholders, such as enforcement agencies, civil society, researchers, academia, and international organizations, totalling 13 interviews. A complete list of the organizations involved in the project is available in the references section of this report.

The expert group, composed of eight members, provided key insights and guidance for the project. Their contributions were gathered through interviews, knowledge exchanges, and additional specialist consultations.

A validation workshop was conducted by UNICRI in collaboration with the Government of Cambodia. The Regional Expert-Level Workshop, titled “Combating Organized Crime and Illicit Trafficking Related to Critical Minerals in Southeast Asia”, took place on 4–5 December 2024 in Phnom Penh, Cambodia. The workshop brought together 30 participants from 11 countries, including Brunei Darussalam, Cambodia, Indonesia, Italy, Lao PDR, Malaysia, Myanmar, Pakistan, the Philippines, South Africa, and Viet Nam. Attendees represented law enforcement agencies, government bodies, international organizations, and independent experts. Participants held in-depth discussions on governance challenges, regional impacts of illegal mining and associated crimes, gaps in regulatory frameworks, organized crime involvement, and related law enforcement challenges.



2.Context

2.1 Mining for critical minerals in the world and in Southeast Asia

2.1.1 The global demand for critical minerals

Critical minerals are the backbone of modern technologies and sustainable energy systems. Their rising demand is reshaping the mining sector globally, including in Southeast Asia, where rich reserves coexist with significant governance and sustainability challenges.

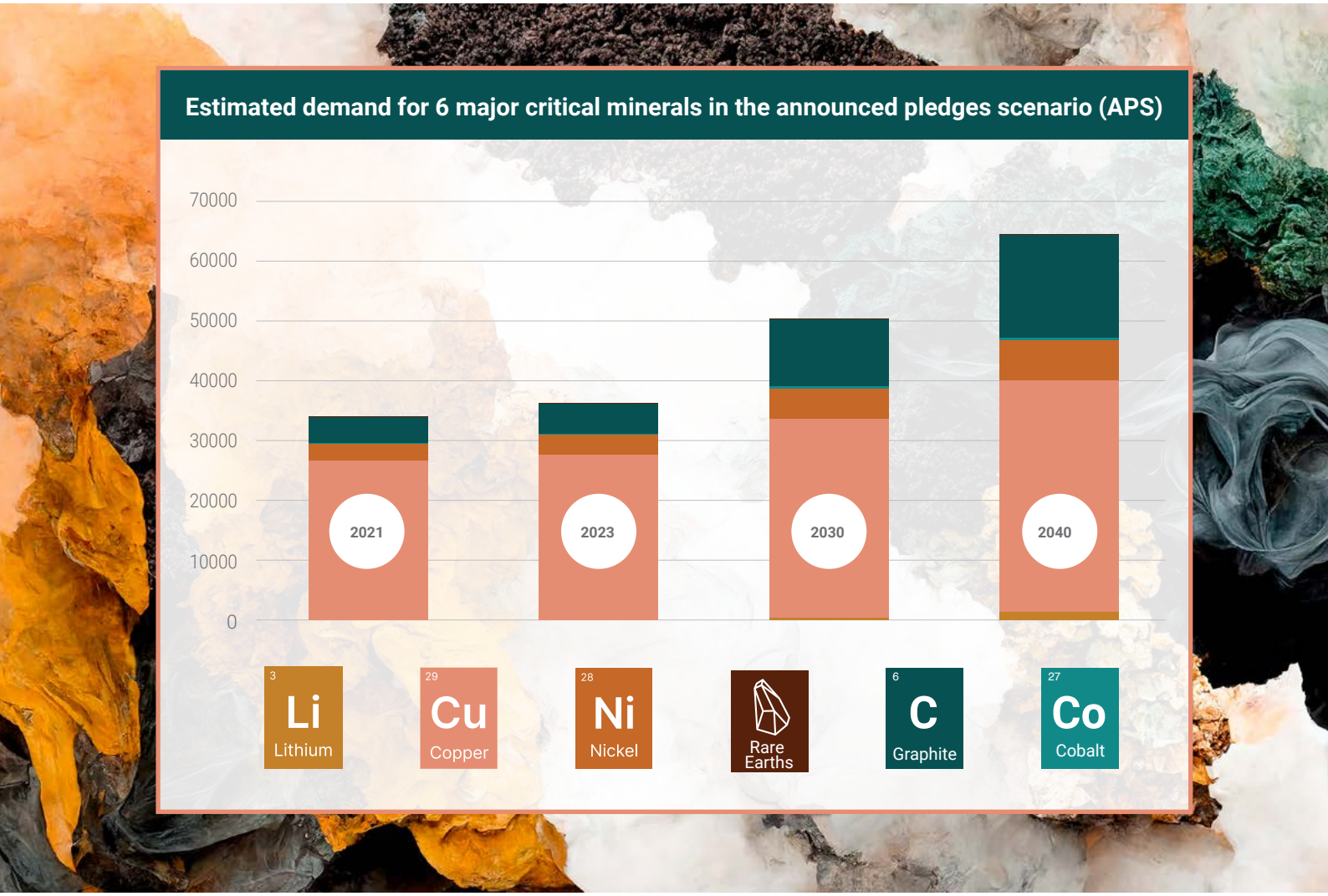
Globally, mining activity has surged, with the industry growing by 6.1 per cent from 2022 to 2023.[8] Key minerals, such as **nickel** and **lithium**, have experienced exceptional growth rates, with nickel production increasing by **10 per cent** and lithium by **23 per cent**. While the situation varies by mineral, region and even individual countries, the overall growth trend is clear, driven by strong demand. This demand is influenced by the expanding role of minerals in the modern global economy. Sectors such as transport, energy production, and manufacturing are witnessing a spike in the use of minerals like graphite, cobalt and copper, which is impacting prices and trade patterns, and they are pushing for further exploration and production.

The energy transition and digitalization are the two key drivers behind this increase. Renewable energy technologies require significantly more mineral inputs than fossil fuel-based systems; for instance, an onshore wind plant uses nine times more minerals than a natural gas plant.[9] The same applies to electric vehicles (EVs) compared to internal combustion engine cars: EVs require over 200kg of critical minerals, six times the amount needed for conventional cars.[10]

The energy transition influences mineral demand in various ways. For example, renewable energy requires an expanded grid to balance the intermittency of solar and wind power, driving increased demand for copper and aluminium. The need for energy storage is also boosting the demand for lithium and nickel, among other elements.

8 (Brunel 2023)
9 (IEA 2022b)
10 (UNEP 2024)

Digitalization plays a slightly smaller role than energy transition, but the expansion of consumer electronics and the digitalization of household appliances is equally pushing for more REEs, cobalt and other minerals—often far beyond current production levels. Forecasts from the International Energy Agency (IEA) predict that lithium demand will grow by 13 to 42 times in 2040 compared to 2020 levels, while demand for REEs is expected to rise by 3 to 7 times, and nickel demand by 6 to 19 times.[11] Such outlooks still show a significant degree of variation because of the uncertainty over global climate policies, but it is clear that the magnitude of the increase will be particularly relevant.



Source: IEA, Global Critical Minerals Outlook 2024

11 (IEA 2022b)

2.1.2 The strategic role for security, competitiveness, and national strategies

Beyond their fundamental role in addressing climate change and other challenges, the energy transition and digitalization processes are widely regarded by countries and companies as major current and future industrial opportunities, with strong implications for economic competitiveness and security. As a result, critical minerals have become strategically important, driving a global race for these commodities and prompting several key international players to enact ambitious policies ensuring a stable and diversified supply.

China holds a leading position in the critical minerals sector as the largest producer of REEs, accounting for approximately 60 per cent of global production.[12] Despite relatively limited domestic reserves of some minerals, such as lithium, China maintains significant influence over production through Chinese-owned operations abroad. It also plays a dominant role in mineral refining, handling smelting for around 59 per cent of lithium, 68 per cent of nickel, 40 per cent of copper, and 73 per cent of cobalt globally. This supports China's manufacturing industries, especially in sectors like battery production, solar panels, and wind turbines. However, this concentration has raised concerns among other global economies, particularly the United States and the European Union (EU), which seek to reduce dependency, mitigate supply disruptions, and manage price fluctuations by diversifying supply chains.

The United States is working to secure a diversified supply of critical minerals through various policies and investments, the most relevant being the 2022 Inflation Reduction Act (IRA).[13] The plan allocates US$370 billion to accelerate the energy transition and increase energy security, including strict requirements for the procurement of critical minerals. For instance, an EV battery must contain at least 80 per cent of the market value of its critical minerals sourced either from the United States or a country with a Free Trade Agreement (FTA) with Washington. This has, in turn, spurred initiatives to strengthen the supply chains with FTA partners and boost domestic production, such as the case of the $675 million Critical Minerals Research Program.[14]

12 (IEA 2023c)
13 (The White House 2023)
14 (IEA 2023b)

The European Union is equally involved in this process. following a 2008 Raw Materials Initiative,[15]which aimed to assess technological developments, supply, and demand, it introduced its first list of Critical Raw Materials in a 2011 Communication[16] As the list expanded from 14 materials to 34 by 2023, the EU launched the European Raw Materials Alliance through the 2020 Communication on Critical Raw Materials.[17]

European action in the sector further evolved through various policies aimed at consolidating and diversifying its supply, most of which fell under the umbrella of the Green Deal Industrial Plan, the European response to the IRA.[18] The key element of this strategy is the Critical Raw Materials Act, which received final approval from the European Council in March 2024.[19] Among its other objectives, the regulation introduced targets for local extraction and domestic processing and recycling, while also requiring mandatory risk assessments of the supply chain for companies producing key transition technologies, such as wind turbines and batteries. This has been followed by extensive diplomatic efforts, resulting in the signing of 13 trade partnerships with third countries on critical minerals.[20]

Other players also have a significant role in the sector. Australia is a leading producer of several critical minerals—it became the world's top lithium producer in 2018, surpassing Chile,[21] and has a solid production of cobalt, copper and REEs, among others. However, it is also trying to increase its control over production and refining beyond its borders. Given its geographical position and strong ties with Association of Southeast Asian Nations (ASEAN) countries, Australia is increasing its influence in the sector through its Critical Minerals Facility,[22] the main financial tool behind its Critical Minerals Strategy.[23] This approach has, to some extent, been replicated by other producing countries like Canada, which introduced its own strategy in 2023.[24] Notably, an increasing number of countries are adopting similar policies, proving

15 (European Commission 2008)
16 (European Commission 2011)
17 (European Commission 2020)
18 (European Commission 2023a)
19 (European Council 2024)
20 (Marta Pacheco 2024)
21 (Cecilia Jamasmie 2018)
22 (Australian Government 2023a)
23 (Australian Government 2023b)
24 (Canadian Government 2022)

the growing global interest in securing the supply of critical minerals—Saudi Arabia, in particular, has been highly active in this area.[25],[26]

2.1.3 Critical minerals in Southeast Asia

Southeast Asia is part of this critical mineral rush. The region has a significant endowment of critical minerals, although their distribution varies significantly across countries:

Nickel: 22 per cent of known global reserves are located in Indonesia and 5 per cent in the Philippines.[27]

Tin: Primarily located in Indonesia (16 per cent), Myanmar (14 per cent) and Malaysia (2 per cent).

REEs: Equally divided between Myanmar and Viet Nam (both holding 18 per cent of global reserves).

Bauxite (the main source of aluminium and gallium): Found in Viet Nam (18 per cent) and Indonesia (4 per cent).

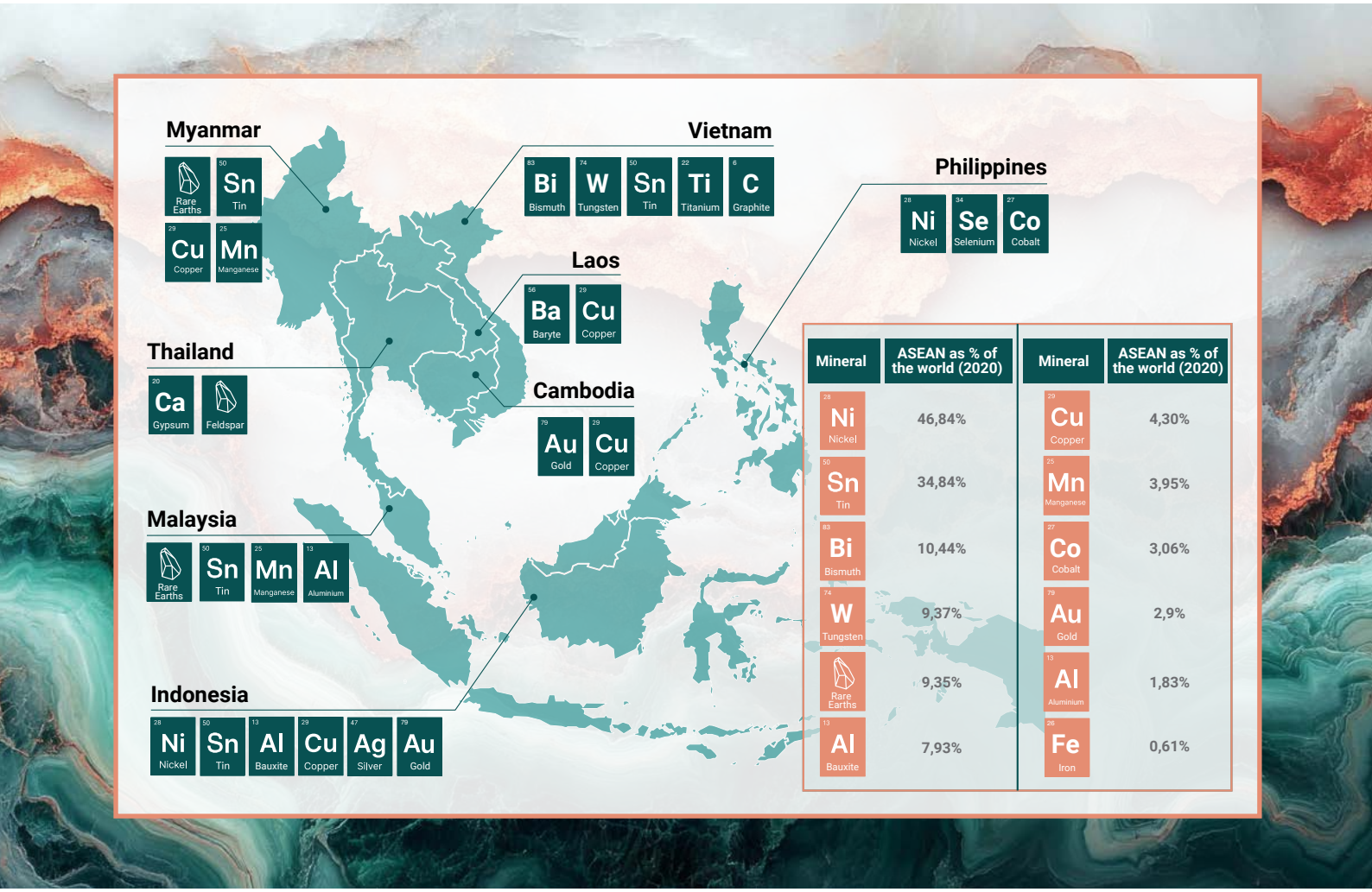
Cobalt is also present in the Philippines and especially in Indonesia, which has jumped from minimal production to representing 5 per cent of the global share in 2023.[28] This development makes the country the world's third-largest producer of the resource, although the Democratic Republic of the Congo (DRC), the top producer, accounts for a much larger 73 per cent of total production.

The dramatic shift in cobalt production highlights the complexities surrounding the exploration and production of critical minerals in Southeast Asia. The region has witnessed a significant decline in mining investments, which in 2022 were roughly half of what they were in 2012.[29] As a result, reserves are likely underestimated, and the situation described above could change rapidly in the future. For instance, only about 5 per cent of the Philippines' mineral resources have been explored.[30] This underdevelopment is reflected in production

25 The IEA is monitoring such developments with a dedicated tracker: https://www.iea.org/data-and-statistics/data-tools/critical-minerals-policy-tracker
26 (Schulze and Schrolle 2024)
27 (Bilqis, Febriyanti, and Trishana Munardy 2024)
28 (Reuters 2023a)
29 (IEA 2022a)
30 (Australian Government 2023c)

levels, which remain far below their full potential. For example, despite holding an estimated 22 per cent of global bauxite reserves, Southeast Asia accounts for only 6 per cent of the world's production.[31] Myanmar, Malaysia and Viet Nam are notable manganese producers, ranking 10th, 12th, and 16th globally, though estimates of their reserves are unreliable.[32]

Copper production is slightly more established, with Myanmar, Indonesia, and the Philippines contributing approximately 4 per cent of global production.[33] Additionally, knowledge on reserves is improving, particularly in Viet Nam and other countries.[34] If fully developed, these resources could generate substantial economic benefits: according to the IEA, Southeast Asia's critical minerals could be worth as much as $800 billion by 2050.[35]



31 Ibid.
32 (U.S. Geological Survey 2024a)
33 (IEA 2022a)
34 (Le et al. 2024)
35 (IEA 2022b)

While this growth could benefit the region's economies, concerns are rising over the environmental and social impacts of this new wave of extraction. This applies both to new mines, such as the PT Weda Bay nickel mine in Indonesia, and to the expansion of existing operations, such as the Rio Tuba mine in the Philippines.[36]

2.1.4 The policies and strategies of Southeast Asia

Southeast Asia's policies and strategies regarding critical minerals are evolving in response to rising global demand, though progress has been uneven across the region. In April 2024, the ASEAN Energy Centre referred to critical minerals as the "New Gold",[37] highlighting the growing interest of many countries to participate in this new global mineral rush. ASEAN has become quite active in the sector, launching initiatives[38] and declarations[39] aimed at fostering cooperation and attracting investment. However, this focus on critical minerals is relatively recent, as they were barely mentioned in the 2021–2025 ASEAN Minerals Cooperation Action Plan,[40] formulated in 2021. The renewed attention reflects a series of strategic moves and policy shifts by most countries in the region.

The section below outlines the key national and regional policies influencing the exploration and production of critical minerals while highlighting both successes and ongoing challenges.

2.1.5 Export bans and industrial strategies

Considering its significant nickel reserves, Indonesia has implemented a ban on nickel ore exports since 2020 through a series of policies[41] aimed at increasing the value of the whole supply chain, including refining and, eventually, the use

36 (Fair Finance Asia 2024)

37 (Bilqis, Febriyanti, and Trishana Munardy 2024)

38 See https://asean.org/asean-rok-launches-project-on-critical-minerals-management-and-strategy-for-sustainable-environment/ and https://asean.org/book/asean-igf-minerals-cooperation-scoping-study-on-critical-minerals-supply-chains-in-asean/

39 (ASEAN 2023)

40 (ASEAN 2021)

41 This has been summarised by the IEA here: https://www.iea.org/policies/16084-prohibition-of-the-export-of-nickel-ore

of nickel in manufacturing. The country is currently exploring a potential FTA with the United States, which could facilitate controlled sectoral growth while ensuring compliance with the United States IRA. It is not the first time Indonesia has adopted such a strategy. In the past, similar policies met with limited success—a bauxite ban in 2014 and copper export restrictions in 2009[42] both led to sharp declines in foreign investments and production, with bauxite production plummeting by 95 per cent shortly after the ban. However, there are indications that the nickel export ban has had a more positive impact, attracting significant Chinese investment into Indonesian smelters and driving a substantial increase in production.[43]

Export bans have also been implemented elsewhere in the region. For instance, Myanmar prohibited REE exports in 2018.[44] The ban was lifted in 2019, but export disruptions have been frequent in recent years, the latest occurring in November 2024 due to the conflict between the Kachin Ethnic Armed Organisation and the junta.[45] Challenges in enforcement and governance continue to affect the sector, particularly given Myanmar's complex political landscape and the role of unregulated extraction.

Malaysia initially took a different approach, offering investment incentives and tax breaks through the Malaysian Investment Development Authority to attract foreign capital.[46] These measures aimed not only to expand extraction but, and perhaps more importantly, to boost the production of advanced materials, such as rare earth magnets. This approach continued until September 2023, when Malaysian Prime Minister Anwar Ibrahim proposed a ban on REEs exports to increase domestic refining. This shift aligns with broader efforts to enhance resource control, manage illegal exports, and reduce dependence on foreign processing infrastructure—a key focus of Malaysia's Minister of Science, Technology and Innovation Chang Lih Kang's April 2024 visit to China.[47]

42 (Baskaran 2024a)
43 Ibid.
44 (Tradium.com 2023)
45 (Business & Human Rights Resource Centre 2024)
46 (Yean 2023)
47 (Asia News 2024)

Similarly, Viet Nam has faced challenges in developing its critical minerals industry, particularly in the REE sector, where reserves may be larger than previously estimated—potentially the second largest in the world after China, according to the U.S. Geological Survey.[48] While national strategies have sought to advance the sector since 2010, progress has been slow. The launch of the "Geological, Mineral, and Mining Industry Development Strategy for 2030 (with a 2045 vision)" in 2023 marks a renewed effort to attract investment and integrate critical minerals into broader industrial policies.[49] This strategy has been accompanied by a series of diplomatic interactions with key partners, sparking further interest in Vietnamese resources, particularly from South Korea[50] and Australia.[51] Notably, Viet Nam and Malaysia, as the third- and second-largest manufacturers of photovoltaic (PV) panels, respectively, have a direct incentive to boost critical mineral production to support their already thriving industries.[52]

The Philippines is actively diversifying export markets and expanding its resource base, including strengthening partnerships with the United States and Japan.[53],[54] A potential trilateral agreement on critical minerals is under discussion, reflecting a shift in trade relationships.[55] The partnership with the United States has already translated into several initiatives, such as a $5 million technical assistance programme. Additionally, the Philippines has benefitted from Indonesia's export ban, becoming the largest exporter of nickel ore to China.[56] Nonetheless, it is also aiming to increase its downstream activities and manufacturing sector, as highlighted in its April 2023 National EV Roadmap.[57] In this sense, the Philippines is also considering imposing restrictions on raw nickel ore exports—an idea that has been repeatedly discussed despite the success of exports to China.[58]

Other countries are still struggling with the development of

48 (Guarascio and Vu 2023)
49 (Vietnam+ 2023)
50 (Jaewon 2023)
51 (Hiep 2023)
52 (IGF 2023)
53 (The White House 2024a)
54 (The White House 2024b)
55 (Crismundo 2024)
56 (Argus Media 2023)
57 (Government of the Philippines 2023)
58 (Argus Media 2023)

these resources. Cambodia has been trying to develop its REE sector since at least 2010,[59] and while some discoveries were made in the early 2020s,[60] no dedicated national critical minerals strategy has been adopted to date.

Lao PDR introduced its "National Green Growth Strategy of the Lao PDR till 2030"[61] in 2018 which, in line with the country's significant mineral potential, included references to mining. Discussions over a dedicated mineral strategy have been ongoing for several years.[62] However, despite official recognition of the sector as key for national development, as of this writing, it remains unclear when—or if—a formal strategy will be finalised.

Thailand, on the other hand, has little-known reserves of critical minerals and a limited mining tradition. Nevertheless, its rapidly expanding automotive industry (the 11th largest in the world in 2021[63]), has driven a growing interest in the sector, particularly in EVs.[64] Singapore and Brunei have no significant reserves but may play a role in the sector through financial services and trade facilitation. Singapore's role as a global finance hub is particularly relevant, as it may influence financial flows linked to illegal activities in the sector. In November 2024, Singapore enacted the Anti-Money Laundering and Other Matters Act, introducing significant amendments to the Corruption, Drug Trafficking and Other Serious Crimes (Confiscation of Benefits) Act (CDSA).[65] A key feature of this legislation is the inclusion of serious foreign environmental crimes, such as illegal mining and deforestation, as predicate offenses for money laundering. This expansion empowers Singaporean authorities to prosecute individuals and entities involved in laundering proceeds derived from such overseas environmental offenses, even if the primary crime occurred outside Singapore's jurisdiction.

59 (Sothanarith 2010)
60 (Khmer Times 2021)
61 (Secretariat for Formulation of National Green Growth Strategy of the Lao PDR 2018)
62 (LAO NEWS AGENCY 2023) and (Xinhuanet 2024)
63 (IGF 2023)
64 (Thailand Automotive Institute 2022)
65 (Ministry of Home Affairs Singapore, *Phased Commencement of the Anti-Money Laundering and Other Matters Act*, 1 November 2024)

2.2 Criminal exposure of the Southeast Asian mining sector

The factors outlined in section 2.1 directly influence Southeast Asia's vulnerability to illegal mining. This is further compounded by the region's unique geography, political landscape, and the distribution and availability of its resources.

The rapidly growing global demand for critical minerals and their strategic importance (section 2.1.1) are accelerating resource extraction. However, this urgency often conflicts with the implementation of comprehensive environmental and anti-corruption measures. Governments have strong incentives to expand national production quickly, which can hinder efforts to detect illegal activities and create opportunities for criminal groups to infiltrate the supply chain.

Price volatility presents an additional challenge. Critical minerals—particularly nickel and lithium—experienced sharp price fluctuations in 2021 and 2022,[66] with values surging in the first half of 2021 before plummeting. This instability has deterred legal investment in the mining sector[67] while simultaneously increased the likelihood for illegal financing and money laundering.

The increasing prevalence of critical minerals policies across countries (section 2.1.4) plays a key role in improving the industry's contribution to national economies throughout the value chain. However, these policies also create opportunities for criminal activities. For instance, OCGs can circumvent the export bans imposed by countries like Indonesia and Malaysia, profiting either from producers seeking to avoid export taxes or buyers looking to expand their supply. Additionally, as environmental regulations tighten across the region, criminal groups can exploit the situation by offering illegal, low-cost waste disposal and tailings management. This may incentivize companies to engage in environmental violations to cut costs and remain competitive.

While illegal mining in other regions, such as Ibero-America and Central Africa, has historically created significant challenges, two distinctive factors set Southeast Asia apart in this area:

66 (IEA 2023a)
67 (Baskaran 2024b)

* The limited research on the issue in Southeast Asia (section 2.2.1).
* The region's complex geography and political landscape (section 2.2.2).

2.2.1 An underinvestigated region

As discussed in section 2.1.3, Southeast Asia remains comparatively less explored and exploited than other mineral-rich regions, especially concerning critical minerals. While the production of gold, iron, coal, nickel and copper has historically been prominent, both production and exploration of critical minerals have lagged behind those of other resource-rich countries such as Australia, Russia, South Africa and China. Consequently, illegal mining in the region has been less visible and, more importantly, far less investigated. By contrast, illegal mining in regions like the Amazon have been the subject of extensive analysis by civil society and national authorities, leading to numerous investigations and operations.[68] Similarly, illicit cobalt extraction in the DRC is also well documented,[69] despite ongoing challenges faced by the government and international institutions in addressing the issue.

Southeast Asia lacks a comprehensive analysis of the risk associated with illegal mining. Research has primarily focused on the impact of mining on Indigenous communities[70] and on specific cases, such as illegal gold mining[71] and other minerals.[72] Additionally, critical minerals, due to their relative novelty, have received even less attention. The main exception is Myanmar, where illegal REE extraction is already widespread and closely linked to the country's political instability. This issue has been the subject of extensive analysis, particularly by civil society organizations.[73]

This lack of knowledge has clear consequences: criminal methodologies and actors are less well known, and efforts

68 See for instance the WWF-Acto report at https://www.wwf.org.br/?86681/Amazon-has-more-than-4000-illegal-mining-sites-shows-ACTO-study-with-WWF-Brazil
69 (Ojewale 2024)
70 (Huang and Ge 2024a)
71 (Afrimen 2022)
72 (Jong 2024)
73 Interview WWF Myanmar, Global Earth rights

to counteract them are less coordinated. Unlike countries such as Brazil and South Africa, several Southeast Asian nations lack dedicated task forces against illegal mining, and enforcement agencies often do not have specialized expertise, resulting in weak legislation. This is particularly true for critical minerals. While illegal gold mining has long-standing roots in the region, illicit extraction of critical minerals is relatively new, with limited dedicated legislation. Local and national non-governmental organizations (NGOs) play a significant role in addressing issues like poaching, deforestation, and forest fires, as well as traditional illegal mining (e.g. gold and coal). However, their engagement with critical minerals has been less prominent, though this is rapidly changing as more NGOs begin focusing on the issue.[74] Since civil society often provides crucial information for investigations, the lack of such data exacerbates the sector's vulnerability to criminal activity.

2.2.2 Geographical and political complexity

Compared to other mineral-rich regions, Southeast Asia also presents a high degree of geographical and political heterogeneity, as well as various resource endowments. The region is divided into mainland Southeast Asia (Viet Nam, Cambodia, Myanmar, Thailand and Lao PDR) and maritime Southeast Asia (Singapore, Indonesia, the Philippines, Brunei and Malaysia), each with distinct characteristics and accessibility challenges.

Mainland Southeast Asia features easily accessible plains and numerous rivers, which are threatened by mining pollution and heavily impacted by illegal sand mining.[75] However, it also features remote mountain ranges, including the Golden Triangle between Thailand, Lao PDR, and Myanmar—a notorious hotspot for illegal mineral trade. This area has become near lawless due to complex historical and political dynamics.[76] Additionally, its proximity to the Chinese border, combined with Myanmar's jade and REE mines, further makes it a key hub for smuggling operations.

74 Interview Greenpeace, Indonesia

75 See https://dialogue.earth/en/nature/sandmining-asia/

76 (Lintner 2022)

In contrast, maritime Southeast Asia contains a remarkable number of islands—Indonesia alone has more than 17,000—ranging from major landmasses such as Borneo and Sumatra to smaller, often uninhabited islets. This geographical complexity presents significant monitoring challenges. The abundance of sea routes and ports across these islands and archipelagos facilitates the smuggling and laundering of illegally mined minerals, making enforcement particularly difficult.[77]

Territorial disputes and domestic conflicts further weaken government control over these areas. While ASEAN countries have managed to settle some disputes over the years—such as the Pedra Blanca[78] dispute between Singapore and Malaysia—several remain active. These include the Sabah claim in Northern Borneo by the Philippines,[79] which led Manila to file a request at the UN in 2024, as well as the increasingly contentious situation in the South China Sea.[80] Rebel groups also play a role in the region; in the case of Myanmar (discussed in detail in section 3.2.2), political fragmentation has fuelled a surge in illegal mining. Similarly, separatist movements in Indonesia, particularly in West Papua, continue to pose security challenges.[81]

This combination of geographical complexity, territorial disputes, and internal conflicts makes it challenging for authorities to exercise effective control over their territories, thereby providing opportunities for illegal mining activities to flourish.

77 Interview Greenpeace Indonesia
78 (International Court of Justice 2008)
79 (Robles 2024)
80 (The Economist 2024)
81 (Al Jazeera 2023)

2.3 Main criminal methodologies and supply chain exposure

2.3.1 Structure of mining in Southeast Asia and in relation to critical minerals

Illegal mining is a complex and multi-layered crime involving various actors operating at different levels of the supply chain. Globally, four broad categories of actors can be identified in connection with illegal mining activities:

* **Individual Miners**. Artisanal and small-scale miners often operate informally, sometimes without the required permits. While many are not engaged in criminal activity per se, some may be exploited by or collaborate with criminal networks—particularly in regions where governance is weak and regulatory frameworks are poorly enforced.
* **Politically Motivated Organized Crime Groups**. Armed groups that use mining to fund operations, control territories, and challenge state authority. In some contexts, these groups establish de facto governance structures in mining areas.
* **Organized Crime Groups**. Transnational or local criminal groups involved in bribery, smuggling, money laundering, and illicit mineral trading. They may be present at various levels of the metals and mineral supply chain, each playing different roles.
* **Corporations (Legitimate & Illicit)**. While the majority of companies involved in mining operate legally, some engage in illegal conduct, including fraudulent licensing, environmental violations, illegal waste disposal, or trading of illicitly sourced minerals. These actors may appear compliant on paper but operate through complex arrangements that conceal illegal practices.

Although mining structures and criminal dynamics vary across regions, this typology is also applicable to Southeast Asia, where similar patterns of illicit involvement in the extraction and trade of critical minerals have been observed.

Table 1. Actors of upstream and downstream activities

UPSTREAM ACTIVITIES		DOWNSTREAM ACTIVITIES
ASM	LSM	
Individual miners or loosely organized individuals Politically motivated Organized Crime Groups Organized Crime Groups	Corporations Organized Crime Groups	Corporations Transnational Organized Crime Groups (national and international traders)

While this global typology provides a useful analytical framework, the mining sector in Southeast Asia presents a number of distinctive features that shape the nature and extent of illegal activities. These include the relatively recent growth of the critical minerals industry, varied regulatory environments, differing levels of governance and enforcement capacity, and the specific roles played by both state and non-state actors within national and cross-border supply chains.

Illegal ASM exists in the region, particularly in the Philippines and Indonesia, mainly in relation to gold mining.[82] However, as in most parts of the world, ASM in Southeast Asia is largely informal rather than entirely illegal. Miners often operate without official permits but may not necessarily violate criminal laws. Instead, such activity often arises in contexts of limited economic opportunity, weak enforcement, or unclear land and resource rights.

In Myanmar, REE production is mostly associated with small mines,[83] but overall, the issue is less pronounced than in other regions, such as Central Africa. This is partly because mining activities in Southeast Asia have expanded relatively recently, with new operations predominantly managed by large, often international companies, sometimes in collaboration with national authorities.[84] Unlike gold or diamonds, which yield high earnings from small quantities and can be easily traded through various channels, critical minerals typically

82 (Meutia, Lumowa, and Sakakibara 2022)
83 Interview WWF Myanmar
84 (McKinsey & Company 2023)

require extraction and refinement in larger volumes. [85] These processes are complex and require specialized infrastructure, which limits the number of potential buyers and deters small-scale illegal operations. For example, lithium mining involves intricate refinery processes and typically engages buyers operating at an industrial scale.

As a result, illegal activities in the mining sector are more likely to occur within otherwise legal operations rather than through fully illegal mines. This issue is further compounded by weak regulatory enforcement and, in some cases, collusion between national authorities and businesses. Unclear or overly broad regulations create legal grey areas that often disadvantage vulnerable groups, such as Indigenous communities.

For instance, while Indigenous peoples in countries like Indonesia and the Philippines are afforded legal protection, these are often vaguely defined and inconsistently enforced, leaving these communities particularly exposed to exploitation by illegal mining operations.[86] In particular, laws regarding Free, Prior and Informed Consent (FPIC) are often too general, allowing for ambiguous interpretations of consultation requirements. Weak enforcement further enables FPIC procedures to be conducted with only with a small part of local and Indigenous communities—usually those who agree with the proposed project—while most of the population remains unaware of the plans and their potential impact. Additionally, the process of obtaining legal recognition of ancestral land rights is often lengthy, complicated by extensive bureaucracy, and expensive. For instance, in the Philippines, such procedures can take up to 20 years to complete, rendering these measures insufficient to prevent destructive activities.[87]

While it is usually easier to implement standards and enforce regulations for LSM operations than on a multitude of small ones, larger businesses also have greater resources to conceal violations and engage in corruption at both local and national levels.[88]

85 Interview Pierre Viaud
86 Interview Asia Indigenous Peoples Network on Extractive Industries and Energy
87 (Global Witness 2024)
88 (Beevers 2015)

2.3.2 Main criminal methodologies

This report identifies four main methodologies through which illegal mining activities are usually perpetrated in Southeast Asia:

* **Fully or partially illegal ASM activities.** In this case, illegal mining is done by artisanal miners who use basic techniques such as gravity processing, with limited access to mechanised equipment. While this is common in non-critical mineral extraction, particularly for gold, coal, and quarry operations, it is also observed in parts of tin and REE production in Myanmar[89] and Malaysia.[90] In some cases, production is coordinated by OCGs or, in Myanmar,[91] by local militias, acting as intermediaries for foreign buyers. Although ASM is not always illegal, and its scale is often smaller than LSM (and less technologically advanced), the lack of coordination and oversight in these extraction activities significantly increases its social and environmental impact.
* **Fully illegal LSM activities.** This is the least common form of illegal mining across Southeast Asia, as most LSM production in the region maintains a façade of legality. However, certain activities—initiated autonomously by local crime groups or militias—may employ mechanized equipment while completely disregarding legal and environmental standards. These operations tend to have severe environmental consequences.
* **Partially illegal LSM activities.** This is the most prevalent form of illegal mining in Southeast Asia, involving ostensibly legal businesses that engage in various illegal practices. The extent of these violations varies: some may involve minor infractions, such as exceeding concession limits or causing limited pollution; in more egregious cases, illegality underpins the entire mining operation. For example, in the tin mines of Bangka and Belitung islands in Indonesia,[92] extraction activities with unsustainable environmental and human health impacts have been authorized only through extensive corruption. Political and influential figures often protect these illegal operations, making their identification and prosecution particularly difficult.

89 (McFarlane and Villalobos 2019) and interview WWF Myanmar
90 Interview Greenpeace Indonesia
91 Interview with an international NGO representative, anonymity requested.
92 (Jong 2024)

* **Illegal activities across the supply chain.** This category encompasses offences beyond mining itself; trafficking to bypass export bans; and illicit activities related to smelting and refining**.** While these crimes are less common than other forms of illegal mining, their impact is significant. In some cases, this is due to the fact that refining still occurs outside Southeast Asia (particularly in China or Australia).[93] The main issue, however, is the lack of detection and almost non-existent tracing (section 3.3.1), which makes discovering document fraud and other ancillary crimes particularly complicated. The few refining activities inside the region also have very little visibility and enjoy significant protection by authorities, since reshoring downstream activities is a key priority for several Southeast Asian governments (discussed in section 2.1.4).

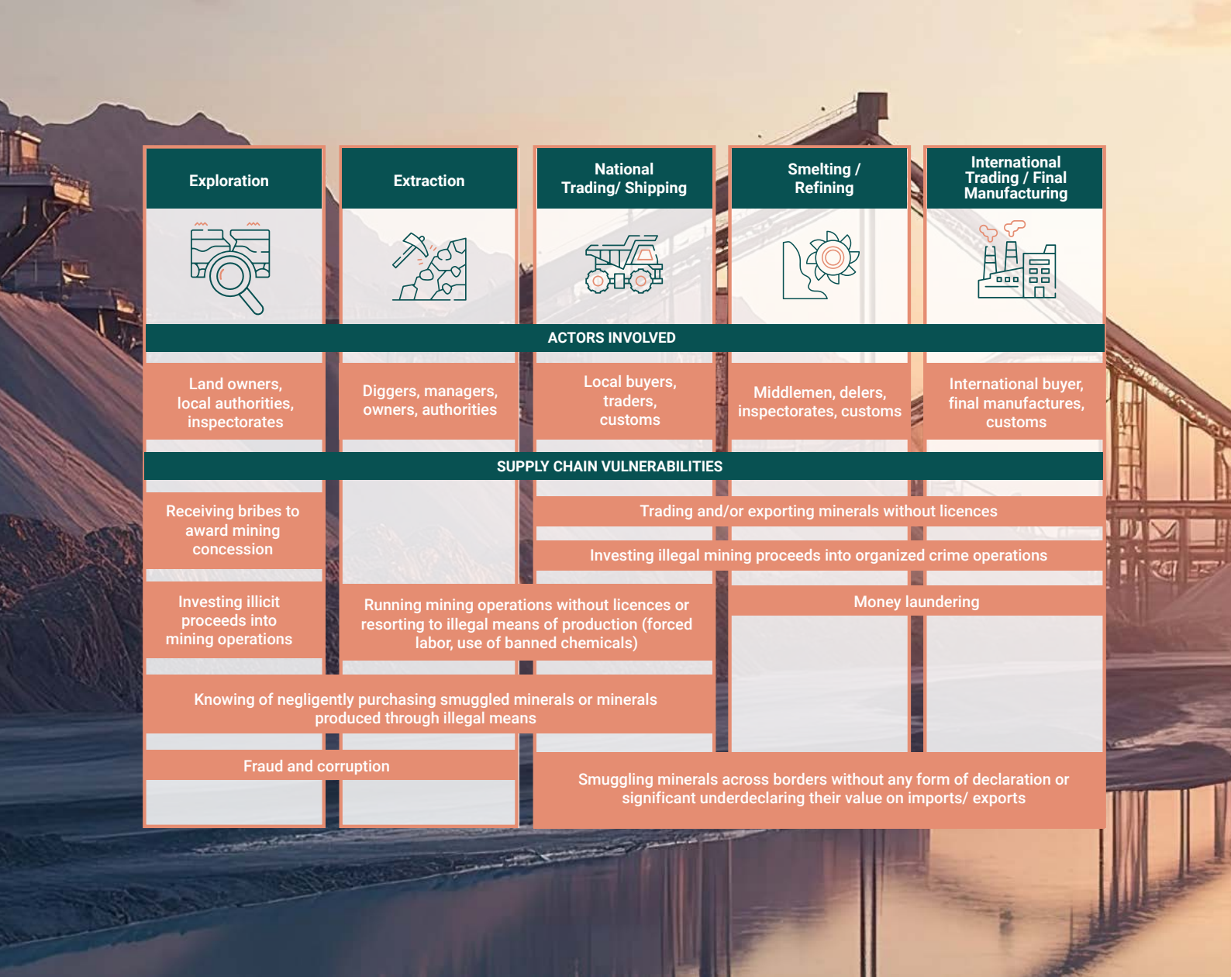
It is worth noting however that there is limited data available on criminal players, particularly regarding OCGs involved in critical minerals in the region, mostly due to the novelty and limited transparency of the sector.

2.3.3 Criminal exposure across supply chains

Specific vulnerabilities exist across the different supply chains of critical minerals in Southeast Asia, largely dependent on the structure of the production process, market for the commodity, and national production.

Critical minerals represent, first of all, a variety of commodities whose supply chains can significantly differ both among elements and depending on extraction methods and on the final use of the mineral. In most cases, the supply chain is divided as follows:

93 (IEA 2022b)



However, there are differences in how these supply chains are structured for different minerals. For those currently produced in Southeast Asia:

* Nickel is first concentrated to produce ore with a larger percentage of the element (from 1–1.7 per cent to 10–20 per cent)[94] at the mining site,[95] and then it generally undergoes smelting and refining processes, which are performed in large facilities.
* Tin also undergoes a two-step refinery process, in both cases carried out in large facilities, but it does not require concentration as cassiterite, the main tin ore, usually contains 78.6 per cent of the element.[96]

94 (Emew Clean Technologies 2017)
95 (Talon Metals Corporation 2016)
96 (Bowles 2021)

- REEs differ, as the first processing typically occurs at the mining site, followed by more complex refining conducted in large facilities. The first part usually consists of milling, cracking and separation to obtain REE oxides that can then be refined.[97]
- Cobalt, like REEs, often undergoes an initial stage of ore concentration near the mining site, followed by final refining in large industrial facilities. This has not been the case in Southeast Asia yet, perhaps due to the currently low extraction rates of the resource. However, in some cases in the DRC, artisanal miners send their ore to deposits through intermediaries (called *négociants*) where it is processed, since miners either cannot afford processing or lack the necessary expertise.[98]

Different stages of the supply chain present different risks for criminal infiltration. Exploration activities pose a limited risk of criminal involvement and present little environmental or social impact. However, in some cases, companies have been involved in the illegal construction of infrastructure (particularly roads) and other violations even at the exploratory stage.[99]

Extraction activities serve as the primary entry points for criminals and represent the highest risk of violations. These violations vary, but the main offences occurring in Southeast Asia include:

- **Permitting violations:** Activities that have not been authorized or extend beyond their authorization, or where concessions have been obtained unlawfully.
- **Environmental violations:** Health and environmental impacts of production or refining, such as the use of prohibited equipment or methods (e.g. discharging tailings into the sea where it is prohibited) or violations of regulations (e.g. regarding the safe use of mercury).
- **Labour law violations:** Poor working conditions, forced or child labour, human trafficking and offences related to human rights violations.

97 (Mischo, Barakos, and Gutzmer 2016)

98 (Ritchie 2023)

99 This is the case of the nickel mine in Sibuyan Island in the Philippines. See https://news.mongabay.com/2023/12/nickel-mine-threatens-philippines-biodiversity-hotspot-on-sibuyan-island-analysis/

* **Violations concerning Indigenous land or protected areas:** OCGs, illegal miners or other bad actors exploiting ambiguous land tenure laws or loopholes to gain access to resources on Indigenous land or in protected zones.

Such violations may also occur during initial processing when conducted at mining sites or smaller facilities. In contrast, illegal activities in secondary and more advanced processing appear to be rarer in Southeast Asia, or at least no major cases have been reported as of the time of writing.[100]

Across these violations, corruption and document fraud are frequent occurrences, with corruption likely being the main enabler of illegal mining (as discussed in section 3.2.1). While forged or misappropriated permits are frequently used to justify operations or falsely demonstrate compliance with environmental regulations, corrupt practices often go much further. These may include bribing inspectors to manipulate environmental or safety records, disguising payments to traditional chiefs as corporate social responsibility spending to secure community or Indigenous consent, leveraging political patronage to facilitate project approval, and awarding contracts to politically exposed persons (PEPs) or their associates. Influence peddling and the manipulation of permit and approval processes are also common, further undermining regulatory control and accountability.

Shipping constitutes another key entry point for criminals, especially as a means to launder illegally produced minerals or bypass export bans. This is particularly relevant for critical minerals (and, to some extent, other minerals), as these commodities must ultimately enter the legal market to be traded. As a result, the criminal dynamics resemble those associated with agricultural commodities like palm oil or timber, rather than those of entirely illegal or heavily controlled goods like drugs or weapons.

Minerals are laundered by batch-mixing the illegal loads with legal ones. This may occur before shipping—when illegal and legal batches are mixed at a deposit or loading site and then transported together—or afterward. In the latter case, illegal minerals are shipped directly to the refinery and then

100 The only case regards REEs from the Lynas refinery in Malaysia, which has been subject to heavy protests from NGOs and local communities over its alleged pollution, but which has not been under any investigation so far: https://www.greenpeace.org/malaysia/story/1243/looking-back-at-our-first-campaign-in-malaysia-stopping-lynas-radioactive-threat/

mixed with legal ones on-site, with or without the refining company's knowledge of their illicit origins. Generally, the more intermediaries present in the supply chain, the higher the risk of laundering and batch mixing, especially when these intermediaries are small buyers. Due to the absence of tracing mechanisms (section 3.1.1), it is very complicated (and in most cases impossible) to uncover illegal batches once they have been mixed with legal ones. As a result, enforcement agencies must detect illegal shipments before they reach their final destination. Although difficult, this has proven successful in some cases; for instance, a recent investiga-tion in Indonesia led authorities to intercept the smuggling of approximately 11,000 tons of nickel ore that lacked the proper documentation.[101]

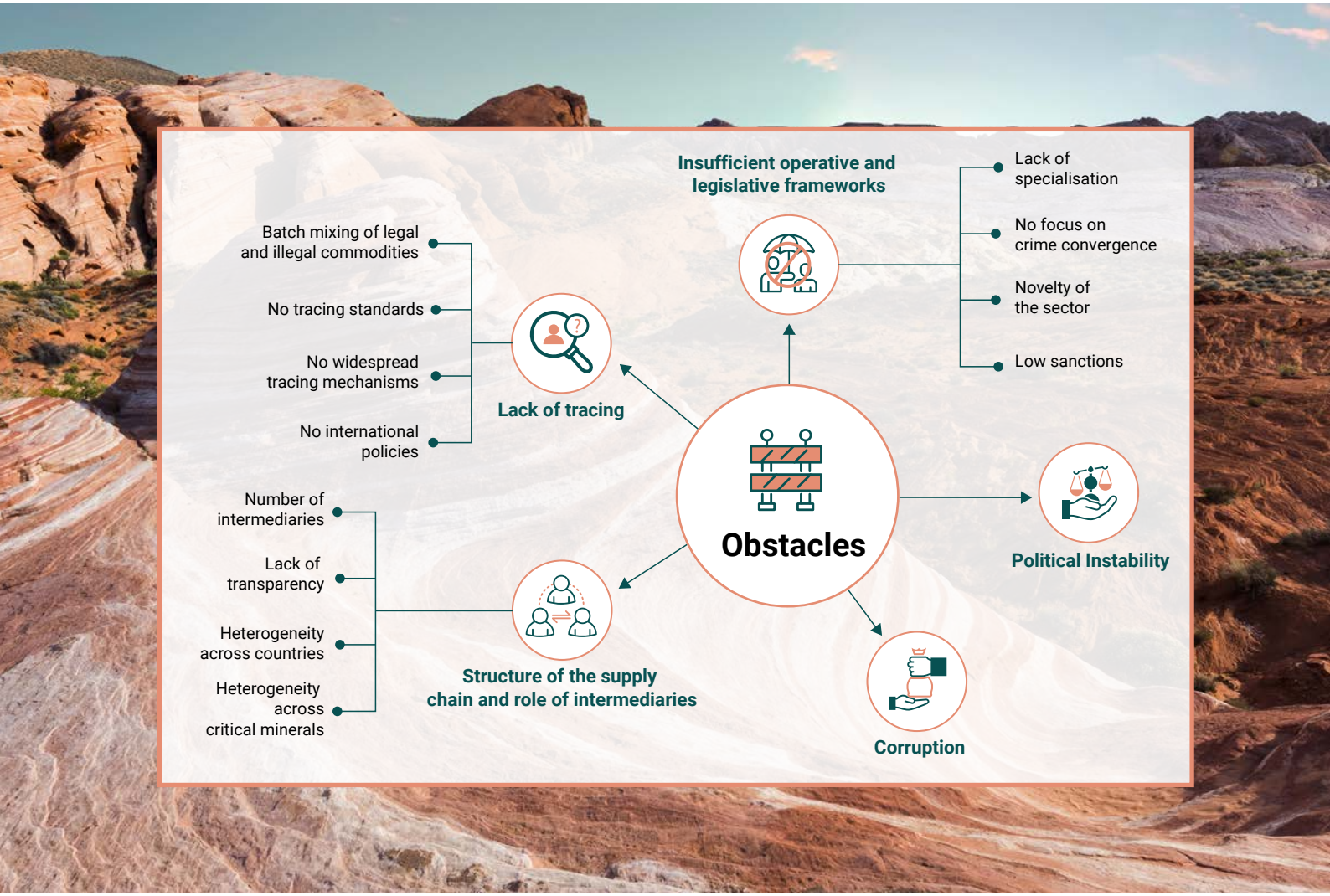
In this sense, the main element of exposure lies in the lack of effective traceability across the supply chain. In most cases, once minerals reach the refining stage, it becomes extremely difficult, or impossible, to trace them back to a potentially unlawful origin. This gap arises from two core issues: the reliability of information and the integrity of the systems used to capture and transmit it. Information on origin, volume, or permits is often unreliable, as it may be self-reported, incomplete, or based on forged or misused documents. Moreover, tracking systems themselves are frequently fragmented, lack standardization, and are vulnerable to tampering, making it easier for false or manipulated data to enter and circulate within the supply chain. This creates opportunities for various illegal actors: buyers can claim that the illegal batch they purchased is legal, as proving otherwise is highly complex. Meanwhile, enforcement agencies face lengthy and costly investigations to reconstruct trade routes, particularly since traders and importers are not obligated to collect information about a mineral's chain of custody. Furthermore, intermediaries and shipping companies are less exposed to scrutiny, as they can claim that the batch they are transporting is legitimate, especially since document fraud is significantly easier in a supply chain that lacks full traceability and certification mechanisms. Currently, the easiest stage at which to detect criminal activities is the extraction phase, since the environmental and social impact is often—but not always—visible.

101 (Asia Today 2024)

3. Obstacles and solutions

Effective measures to combat offences related to illegal mining are hindered by a range of technical, political, social, and economic challenges at both regional and global levels. Indeed, while Southeast Asia has specific vulnerabilities to illegal mining for critical minerals, the sector is still generally prone to unlawful practices due to a lack of transparency and regulation across the supply chain. This report outlines the primary categories of obstacles, emphasizing three key enablers of illegal activities in Southeast Asia: corruption, political instability, and inadequate protection of community and Indigenous rights.

3.1 General obstacles



3.1.1 Tracing and lack of distinction between legal and illegal commodities

One of the central challenges undermining efforts to combat illegal mining is the lack of effective traceability mechanisms, a problem affecting critical minerals globally and within Southeast Asia. While traceability does not in itself guarantee legal or ethical sourcing - a mineral can be fully traceable yet still linked to exploitative labour practices, corruption, or sanctioned actors—it is a key tool for transparency. Without it, identifying links to unlawful or high-risk origins becomes extremely difficult or prohibitively expensive. This lack of visibility enables criminal actors to move illicitly sourced materials through the supply chain with limited risk of detection. Common examples include producers who sell illegal ores to legal traders or smelters after mixing them with legal batches, and traders who buy from both legal and illegal producers, thereby laundering the commodities themselves. As a result, tracing is the key to understanding the impacts of the different steps in the supply chain. It was one of the main recommendations in 2024 report by the UN Secretary-General's Panel on Critical Energy Transition Minerals.[102] The document advised launching "a multi-stakeholder expert process to develop a global traceability, transparency and accountability framework along the entire mineral value chain—from mining to recycling."

Traceability is particularly relevant for Southeast Asia and critical minerals. The complexity of mining in the region (see section 2.3.1) stems from its diverse resource endowment, varying regulations across countries, and lack of coordination. This has made it easier to hide illegal activities when proper tracing is not implemented. Legal and illegal minerals are also often hard to distinguish due to unclear regulations, lack of transparency and corruption, so mixing and laundering unlawful batches is generally easier than in regions where production is more streamlined.

Implementing traceability remains a complex undertaking. While a number of schemes have been developed and are being applied across different geographies and segments of mineral supply chains, they vary significantly in scope, coverage, and enforcement. In Southeast Asia, as in many

102 (UN Secretary-General's Panel on Critical Energy Transition Minerals 2024)

regions, traceability systems are still at an early stage of development and are not yet applied in a consistent or comprehensive manner. Efforts to improve methodologies and expand their application are ongoing (see section 2.3.1). There are technical, economic, and political obstacles behind this. First, tracing requires developing a system to collect the chain-of-custody data, that is, information documenting the different players who produced, handled, bought, and sold the batch. This data should not only be complete but also reliable and verifiable by third parties (something that can be achieved, for instance, through blockchain, GPS data, apps and other measures, as described in section 3.3.1). Developing such a system is a complex process that, in most cases, would need to be started from scratch and require significant time and financial resources. At the same time, some standards are being promoted for commodities like gold and platinum, as in the case of the Responsible Jewellery Council's Chain-of-Custody standard,[103] but an equivalent framework is still missing for critical minerals.

There is also a lack of policies obliging operators to gather this data and develop these frameworks, likely because despite growing global demand for such schemes, the issue has received limited attention in the past. This contrasts with other batch-traded commodities, such as timber or cocoa, which have been the focus of significant efforts, particularly in recent years. For instance, in 2023 the EU enacted the Deforestation-Free Regulation (EUDR), which requires companies importing key agricultural commodities into the EU to provide full traceability for each batch and demonstrate that production did not contribute to deforestation.[104] However, the implementation of this regulation has been delayed by one year following protests by EU trading partners, highlighting the challenges of introducing traceability even in more established sectors.[105]

Several legislative instruments now address supply chain risks through due diligence obligations, including the 2024 EU Corporate Sustainability Due Diligence Directive,[106] This Directive draws on the OECD Guidelines for Responsible

103 (Responsible Jewellery Council 2023)
104 (European Commission 2023b)
105 (European Commission 2024a)
106 (European Commission 2024b)

Business Conduct, which define due diligence as the process by which companies identify, prevent, mitigate, and account for how they address actual and potential adverse impacts in their operations, supply chains, and business relationships. However, the Directive does not directly address mining and remains broad in its scope, similar to other regulatory frameworks like the German Supply Chain Due Diligence Act.[107] In the minerals sector, more targeted frameworks include the EU Conflict Minerals Regulation and the EU Batteries Regulation, both of which are based on the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas.[108] Originally developed as a soft law instrument, the OECD Guidance has increasingly been integrated into binding national and regional regulations (e.g. Switzerland's legislation, the ICGLR Regional Certification Mechanism in the DRC, Rwanda, and Tanzania) and market-based standards (such as the UAE's due diligence requirements for gold). However, the EU Conflict Minerals Regulation remains limited in scope: by covering only tin, tungsten, tantalum, and gold (3TG), it excludes a significant share of potentially high-risk minerals, particularly rare earth elements (REEs).[109]

The OECD Guidance does not focus primarily on traceability, but rather outlines a broader risk-based due diligence framework. Traceability may be one component, depending on a company's role and risk exposure. The core emphasis is on establishing internal management systems and achieving supply chain visibility to identify, mitigate, and address adverse environmental and human rights impacts. As of early 2025, policy discussion on traceability and supply chain transparency has grown within Southeast Asia. While the 2021 report "Strengthening ASEAN Cooperation in Minerals: Development Prospects of ASEAN Minerals Cooperation" by the ASEAN secretariat[110] did not mention traceability, recent regional discussions increasingly emphasize the need for harmonized standards to reduce smuggling, mineral laundering, and associated reputational risks.[111] This growing attention reflects a recognition that fragmented national systems can

107 (German Federal Ministry for Economic Cooperation and Development, German Federal Office for Economic Affairs and Export Control, and Business & Human Rights 2023)

108 (OECD 2016)

109 (Anrike Visser 2023)

110 (ASEAN Secretariat 2022)

111 UNICRI workshop, 2024

undermine the credibility and sustainability of the region's critical minerals sector. In parallel, private sector actors, particularly those linked to electric vehicle and electronics value chains, are under rising pressure from downstream buyers, financial institutions, and compliance frameworks to demonstrate responsible sourcing and enhance the visibility of mineral origins.

3.1.2 Structure of the supply chain and role of intermediaries

Another relevant obstacle is the complex structure of the supply chain of critical minerals in Southeast Asia (detailed in section 2.3). While complex, transnational supply chains and the presence of multiple intermediaries can increase the risk of obfuscation, laundering, and regulatory evasion, these are not the only factors affecting traceability. In the Southeast Asian context, challenges are often more closely tied to high levels of informality, limited enforcement capacity, and gaps in the rule of law. Even in countries like Indonesia, where production and smelting are largely concentrated domestically, issues such as the mixing of legal and illegal feedstock and cross-border smuggling persist, highlighting that supply chain opacity can arise even without extensive cross-jurisdictional trade. In this sense, the critical minerals sector in Southeast Asia is particularly exposed as it comprises a variety of different commodities with distinct supply chains, which also vary depending on the final use of the mineral and the production technique applied (see section 2.3.1). This heterogeneity is exacerbated by variations in national supply chains, while the frequent geographical separation of extraction and refining activities adds further complexity. In this regard, the Indonesian ban on nickel exports significantly improved the tracking process, as most of the supply chain is located within the country.[112] However, there are still several minerals that have lengthy, transnational supply chains, such as tin or REEs (or even nickel in the Philippines), and thus remain particularly exposed.

112 Interview WWF Greenpeace

3.1.3 Insufficient operative and legislative frameworks

Enforcement efforts against illegal mining and mineral-related crimes in Southeast Asia continue to be hampered by insufficient specialization among enforcement agencies and outdated or fragmented legislative frameworks. This issue is both structural and institutional and remains one of the primary barriers to effective prevention, detection, and prosecution of crimes associated with critical minerals. Globally and regionally, many enforcement bodies lack dedicated environmental crime units, resulting in limited operational capacity to investigate and prosecute complex environmental offences. This has a twofold effect:

* In producer countries, authorities may struggle to identify illegal mining operations, especially where supply chains are opaque or embedded in legal production systems.
* In transit or destination countries, customs and border officials may lack the expertise to identify forged documentation, misclassified minerals, or laundering schemes, particularly when the criminal origin of commodities is concealed under layers of intermediaries.

In some Southeast Asian countries, such as Indonesia and Malaysia, there are no dedicated units for environmental crimes, whereas countries like Viet Nam and Lao PDR have established such specialized departments.[113] Additionally, only the Philippines has an environmental unit within the Customs Bureau, which is increasingly relevant given the volume of illicit mineral exports and laundering risks via maritime routes. As of early 2025, efforts are underway in some of these countries to enhance environmental law enforcement capacity within the respective Ministries of Energy and Mineral Resources, but these initiatives remain nascent.

Prosecutors often lack training in environmental crime typologies, and judges may underestimate the gravity or transnational dimensions of illegal mining, leading to limited sentencing or outright dismissal of cases. At both global and regional levels, this results in a significant enforcement gap: due to lack of specialization, officers often disregard environmental

113 (Colantoni and Sangiorgio 2024b)

offences while conducting financial or human rights investigations (and vice versa), underestimating the importance of crime convergence. In the case of the Amazon, for instance, only one third of environmental investigations are followed by a related financial crime case.[114]

Critical minerals are also a relatively new focus compared to commodities with a longer history of exposure to illegality, such as gold. Indeed, while most of these elements have been mined for decades or even centuries, the scale of production, the structure of the market, and, to some extent, extraction techniques have changed dramatically in recent years. As a result, expertise among enforcement agencies and civil society is more limited (though it is rapidly evolving). Legislative frameworks in several cases effectively criminalize illegal mining but are also often outdated, especially considering the rapid evolution the sector is undergoing in Southeast Asia. For example, the Directive on preventive measures against illegal mining in Cambodia dates back to 2004,[115] while the Vietnamese Law on Minerals was enacted in 2010.[116] On the other hand, Indonesia has one of the most recent pieces of legislation, a 2020 amendment[117] to the Law No. 4 of 2009[118] on Mineral and Coal Mining. This amendment introduced much-needed updates on licensing and environmental protection measures, but considering the sector's fast-paced evolution, it may need another update in the years to come.

The lack of specialization and outdated frameworks have several consequences. Law enforcement officers often fail to detect illegal activities due to unfamiliarity with criminal methodologies and the structure of supply chains, making them less likely to identify forged documents or unlawful practices. Similarly, judges without specialized training may not recognize the seriousness of illegal mining offences, leading to fewer prosecutions or less stringent judicial attention compared to other cases.

The situation is also aggravated by other factors, such as the heterogeneity of national legislation, as well as the lack of international laws regulating production and trade of minerals.

114 (Fact Coalition 2024)
115 (Transparency International 2021)
116 (Socialist Republic of Viet Nam 2010)
117 (IEA 2024)
118 (Republic of Indonesia 2009b)

In Southeast Asia, mining laws, licensing requirements, and permitting procedures vary significantly by country. Enforcement agencies rely on a mix of administrative regulations and criminal law measures. In Malaysia, for instance, mining is regulated by the 1994 Mineral Development Act[119], which has been updated with multiple regulations between 2007 and 2019, and by a series of "State Mineral Enactments" produced by each Malaysian state.[120] Environmental, labour, and human rights violations are, however, addressed by other legislation, such as the 1974 Environmental Protection Act[121] and the 2014 Mineral Development (Safety in Exploration and Surface Mining) Regulations.[122] This legal fragmentation complicates collaboration between countries and creates loopholes that transnational criminal organizations can exploit.

Despite criminalization, economic sanctions are also often insignificant compared to the profits generated by illegal mining. For example, unlicensed mining activities in Indonesia are sanctioned through Article 158 of the 2020 amendment of the mining law, which imposes fines up to IDR 10 billion (approximately $690,000) and a maximum imprisonment of five years.[123] Environmental violations range from IDR 500 million to IDR 5 billion (approximately $34,500 to $345,000) and carry up to three years of imprisonment under Law No. 32 of 2009.[124] While these are among the strongest regulations in the region, they remain relatively low compared to the substantial profits generated by illegal critical minerals mining.

119 (Malaysia 2013)
120 (Arman and Athsani 2016)
121 (Malaysia 1975)
122 (Ministry of Science 2018)
123 (Rohman, Hartiwiningsih, and Rustamaji 2024)
124 (Republic of Indonesia 2009a)

3.2 Main enablers

3.2.1 Corruption

Corruption is likely the main enabler of illegal mining in Southeast Asia, and it is a crucial factor at all levels of enforcement. High-level corruption can facilitate the issuance of permits and licences, even when they should not be granted due to environmental or social considerations. Corruption among local officers allows actors to avoid the detection of environmental violations (even on a large scale and especially in remote locations), smuggle illegal minerals, or forge documents for domestic or international trade. The issue can be pervasive and involve administrative authorities, enforcement agencies and customs, as well as being deeply linked to local and national politics.

While governance challenges related to corruption are not unique to Southeast Asia, several countries in the region face particular vulnerabilities. According to Transparency International's Corruption Perceptions Index, most states in the region—aside from Singapore and, to a lesser extent, Malaysia—have shown limited progress over the past decade.[125] Nonetheless, important anti-corruption initiatives have gained momentum in recent years. For example, targeted investigations in the extractive sector have brought greater public attention to governance issues and helped strengthen regulatory frameworks. The complexity of managing resource governance in Southeast Asia is amplified by overlapping legal regimes and historical ties between natural resource sectors and political or economic power structures. In some contexts, these relationships can blur the boundaries between formal and informal extractive practices, complicating enforcement and transparency.

Anti-corruption institutions in the region face significant challenges, as efforts to enhance transparency and accountability often conflict with powerful political and economic interests. The case of Indonesia illustrates this dynamic, where past initiatives to investigate corporate corruption in the forest sector faced institutional setbacks following legislative changes. The Indonesian Corruption Eradication Commission (KPK), once highly effective, has seen a decline in its efficiency and power

125 (Transparency International 2023)

in recent years it.[126] However, its activity appears to be picking up again, as evidenced by recent high-profile investigations, including cases in North Maluku and Sulawesi. Meanwhile, Viet Nam's "Blazing Furnace" anti-corruption campaign has yielded mixed results so far.[127] Across the region, governments and civil society continue to advocate for stronger transparency mechanisms and institutional safeguards.

The critical minerals sector is also particularly susceptible to corruption. The rapid expansion of this industry, driven by soaring international demand, has reduced opportunities for internal oversight and increased economic incentives for corruption. Despite recent changes affecting the mining sector, the players currently involved in critical minerals have often been active in mining for decades—a sector historically affected by deep-rooted corruption in many countries. Since critical minerals are traded in large quantities and require a formal refining process, illegal batches must be laundered at some point in the supply chain. In most cases, corruption plays a key role in this process—through the forging of documents or by enabling authorities to overlook the mixing of legal and illegal batches. Unclear regulatory frameworks, as well overlaps and loopholes across various pieces of legislation, also facilitate corruption, since such ambiguities help hide irregularities.

However, significant anti-corruption efforts have been made in the critical minerals sector in Southeast Asia in recent years, likely as an effort to clean up the supply chain and maximize the contribution to the national economy of the rising critical minerals industry. Countries like Indonesia, Viet Nam and Malaysia have successfully uncovered large corruption cases in recent years, leading to improved enforcement action and greater attention to the mining sectors (particularly critical minerals). All ASEAN member states have either ratified or acceded to the UN Convention Against Corruption, which is also being actively adopted across the region.[128] These developments reflect a broader recognition of the need to strengthen institutional resilience and ensure that the benefits of the critical minerals industry are equitably and sustainably distributed.

126 (Mulholland 2020)
127 (Pham 2024)
128 (UNODC 2024)

The case of the Bangka and Bilitung Islands, Indonesia: tin

Tin has recently been at the centre of one of the largest—if not the largest—corruption scandals in Indonesia. An investigation by the Indonesian attorney general's office[129] uncovered illegal mining activities in the Bangka and Belitung islands that have caused, according to early estimates by experts, somewhere between $12[130] and $26[131] billion dollars in environmental and human health-related damages. According to the investigation, the state-owned tin company PT Timah TBK allowed illegal mining operations on the islands and the illicit export of tin. The company allegedly even licensed machinery and acquired materials for the illegal companies without any reporting or authorisation. A portion of the profit was then channelled through a variety of methods (fake invoices, Corporate Social Responsibility funds, etc.) to the senior officials of the company who were involved in the scheme. PT Timah TBK itself also appears to engage in illicit operations, as the area it currently mines is almost double that of its concession,[132] with operations extending into protected forests and parks. The investigation has so far led to the identification of 21 suspects and the arrest of high-profile businessman Harvey Moeis, who allegedly acted as a middleman between PT Timah TBK representatives, illegal companies, and smelters, as well as working to launder the illegal tin and profits.[133] However, considering the scale of the operation and its pervasiveness across the tin supply chain, it is very likely that a much wider network of corruption is involved in the case. Not surprisingly, illegal production continues on the islands, supposedly under the protection of powerful local individuals.[134]

The impact of these activities is severe: half of the islands' territory have been at least partially converted into tin mines,[135] which are open-pit sites that require heavy machinery and landscape modifications. This has in turn caused significant loss of natural habitats and cultivated land, and in some

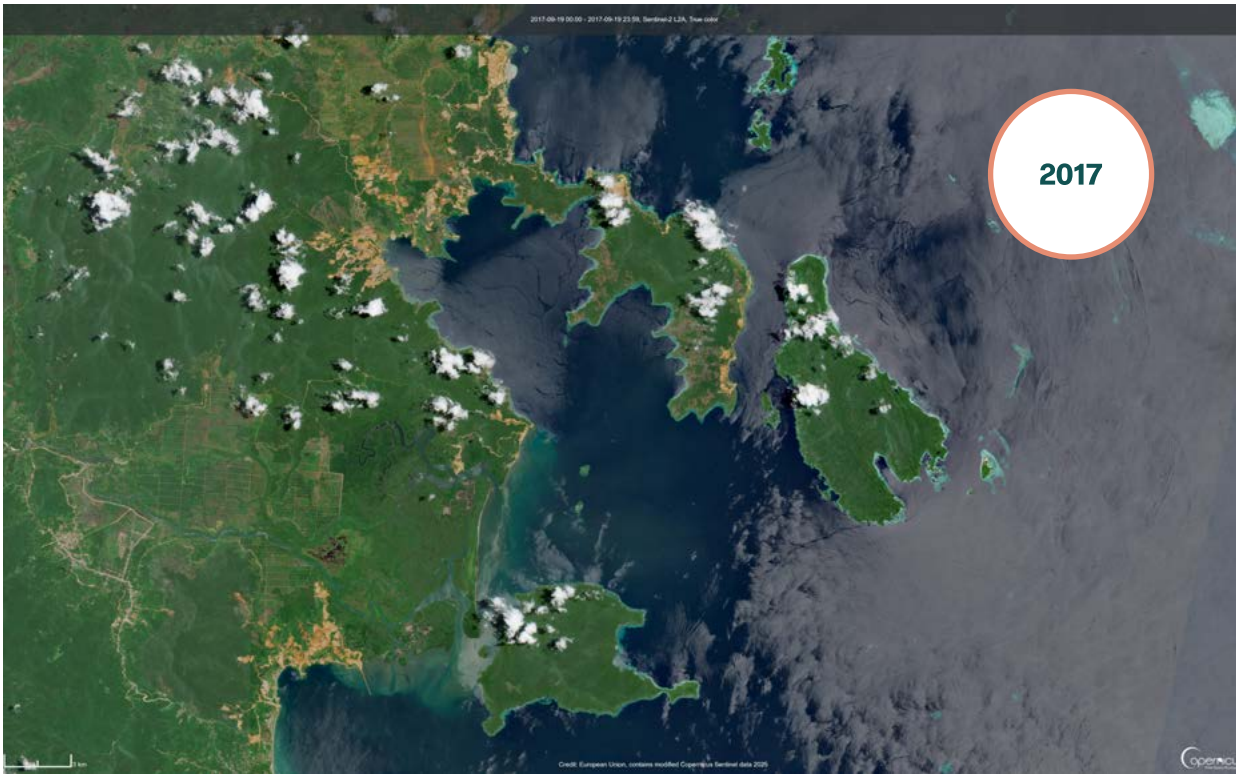
129 (Republic of Indonesia 2024)
130 (Jong 2024)
131 (Guild 2024)
132 (Jong 2024)
133 (Birtles 2024)
134 (Fajriansyah 2024)
135 (BBC News Indonesia 2024)

cases restoring these areas will be extremely difficult, if not impossible. The case has also caused extensive financial damage to the Indonesian state, with hundreds of millions of dollars in tax revenues lost due to mineral trafficking.[136]

The case of North Maluku and Sulawesi islands, Indonesia: ***nickel***

Despite the export ban, nickel is also affected by illegal mining and mineral trafficking in Indonesia, with several cases currently being uncovered. The affected areas are concentrated in the nickel-rich North Maluku and Sulawesi islands and involve both legal operations that paid bribes to build infrastructure or hide their environmental impacts, as well as fully illegal mines that participate in nickel trafficking.

The rapid boom in the nickel industry and the rapid expansion of production activities have reportedly facilitated corruption among national and regional officials, particularly in relation to granting or even reinstating previously revoked mining permits,[137] as well as land grabbing to expand production and build roads.[138] While local communities have been widely



136 (Jong 2024)
137 (Yulisman 2024)
138 (Maulia 2024)

Illegal mining for nickel in Sulawesi, Indonesia (September 2017 vs May 2024).
Credit: Contains modified Copernicus Sentinel data (2017 and 2024), processed by ESA

affected, reports suggest the involvement of village chiefs in the corruption scheme as well.[139] There are, however, several instances of completely illegal nickel mines in the area.[140] In the case of the Mandiodo Block, a nickel mine covering 16,000 hectares in Southeast Sulawesi, illegal mining has taken place inside a concession belonging to the state-owned company Aneka Tambang, which had not yet been exploited due to missing authorisations. This occurred due to corruption and protection from local individuals.[141]

Illegal activities are not limited to mining but also extend to trafficking. In order to circumvent Indonesia's ban, illegal miners must either find a way to launder nickel, or strike deals with smelters to deliver the illegal minerals. This suggests the likely existence of a strong network behind these illegal practices at different levels of the supply chain.[142] Given the extent of these illegal activities, the Indonesian Ministry of Energy and Mineral Resources has launched an investigation into the alleged illegal export of 5 million tons of nickel ore

139 Ibid.
140 (Financial Times 2023)
141 (Trianita 2023)
142 (Hermawan 2023)

in mid-2023.[143] The issue is increasingly gaining political attention due to its negative impact on Indonesian tax revenues,[144] its threat to the country's aspirations to develop a strategic nickel industry, and the major environmental and human impact of these illegal activities.[145] The latter has also triggered protests by local communities, such as those on the island of Halmahera, who oppose the destruction of historical sites and contamination of water reservoirs.[146]

*The case of Dong Pao, Viet Nam: **REEs***

Although there have been no significant reports of illegal mining involving critical minerals in Viet Nam, a notable case emerged in 2023 when six individuals were arrested and 13,715 tons of ore were seized during an investigation into REEs. Representatives from the company Vietnam Rare Earth JSC were arrested over the alleged forging of tax receipts related to projects in Dong Pao, an area expected to become the centre of new concessions highly sought after by several Australian companies.[147]

There have also been allegations of illegal exports of REEs to China, which would violate Vietnamese law.[148] However, operations at the Dong Pao mine (under various owners over time) have long faced accusations of environmental contamination from radioactive elements. In 2021, evidence of these environmental violations and their impact on the health of local communities was finally brought to light.[149] The investigations continued following the 2023 Dong Pao case and lasted until July 2024, when Vietnamese authorities arrested five more individuals, including a former environment deputy minister and four senior officials, for violating mining regulations.[150] These arrests come at a time when Viet Nam is seeking to significantly expand its REE production, making the authorities' actions particularly significant.

143 (Isaac and Arkyasa 2023)
144 (Nur 2024)
145 (Baraputri 2023)
146 (World Rainforest Movement 2023)
147 (Guthrie 2023)
148 (VOA News 2023)
149 (Van Dung and Anh 2021)
150 (Reuters 2024)

3.2.2 Political instability

Political instability is another key enabler of illegal mining in the region, although the issue is mostly concentrated in Myanmar, where it affects two specific regions: Wa State and Kachin State.

Political instability allows for the creation of areas where the absence of the rule of law enables the proliferation of illegal activities, from production to trade. In most cases in disputed areas or regions where national authorities do not have full control over the territory, illegal activities are concentrated in production and the early refinery processes, whereas advanced smelting and other downstream stages of the supply chain are legally conducted in the country importing the minerals. In this sense, production is completely illegal since it is done without any authorisation or oversight by the state. However, it is often still managed in a structured manner by the state-like entities that control the area (OCGs, militias, rebel groups, etc.). This results in significant environmental and health impacts from production and refining activities, coupled with extensive corruption, which further exacerbates the region's instability.

*The case of Wa State and Kachin State, Myanmar: **tin and REEs***

Illegal mining in Myanmar is likely the most prominent case across the region because of the intersection of political instability, a significant presence of critical minerals (mostly REEs and tin), and the proximity of reserves to the Chinese border. It is also one of the most investigated cases in the region, thanks to the strong presence of local civil society and community involvement in combating environmental offences, as well as the significant role played by international organizations such as Global Witness (which led a major investigation on the topic),[151] WWF, and Earth Rights International.

Illegal mining has always been a critical issue for Myanmar since it has been one of the key sources of income for the military that ruled the country from 1962 to 2011 (alongside a

151 (Global Witness 2022a)

few other natural resources, such as teak wood).[152] However, before the 2021 coup, the country had started a slow but steady path towards increasing the sustainability and legality of mining activities[153] through partnerships with international cooperation agencies and companies. These efforts also aimed to manage production, which was already significantly expanding after the re-establishment of democracy in the country.[154] This course of action abruptly stopped with the coup, and since 2021, the situation regarding illegal mining has heavily deteriorated.

Illegal mining in Myanmar is concentrated in the northern regions, particularly in the Kachin Special Region 1 (where REE production is located) and the Wa State area (tin). It is also worth noting that there have been reports of Australian companies still operating in the country, with little transparency and likely in violation of the international sanctions against the junta government.[155]

REEs in Kachin are mostly concentrated around the Pangwa and Chipwi townships and have witnessed the fastest and most worrying expansion in recent years. According to Global Witness' satellite analysis, what used to be only a handful of mines in 2016 had grown to more than 2,700 mining sites across 300 locations in 2022,[156] while sales of REEs to China reached $1.2 billion dollars by just the first half of 2023.[157] These exports are completely illegal: no official authorisation has been granted by the government of Myanmar.[158] It must be noted that the democratic government enacted a ban in 2018,[159] which was later repealed in 2019, although exports have been suspended on several occasions.[160] The modus operandi and trade mechanisms are relatively well known; in recent years, the area was run by a warlord, Zahkung Ting Ying,[161] but it was also fragmented into zones governed by local militias and OCGs, which were only partially under his control.[162] This has changed recently, as the Kachin Independence Organisation gained control of the region from

152 (Aratani 2023)
153 Interview WWF Myanmar
154 (Htun 2014)
155 (Justice for Myanmar 2024)
156 (Global Witness 2022a)
157 (Hay 2023)
158 (Business & Human Rights Resource Centre 2023b)
159 (Global Witness 2022)
160 Interview WWF Myanmar
161 (Global Witness 2022b)
162 Interview WWF Myanmar

Ying's New Democratic Army – Kachin. Since the Kachin Independence Organisation is an anti-junta force (unlike Ying), and considering the closure of border crossings with China, it remains unclear how this will affect the trade of critical minerals in the area.[163]

Previous mining operations in Myanmar's rare earth sector were relatively well documented, with available data indicating that Chinese companies have been the primary buyers of rare earth elements (REEs) extracted from the region. These companies have been reported to operate in or near mining areas, despite Myanmar's national regulations prohibiting foreign nationals from working directly in mines or other sensitive infrastructure.[164] OCGs and militias both deal with Chinese buyers, though they likely play different roles (i.e. OCGs acting as intermediaries and militia-run enterprises as sellers). Buyers have dealt with either militias or OCGs, depending on who controls the territory and where the reserves are located.[165] While export activities from these regions are widely understood to be informal or unlicensed under Myanmar's legal framework, Chinese import records have consistently reported the origin of REEs as Myanmar, indicating that these flows are openly acknowledged in customs documentation and reflected in official trade statistics.[166] China's reliance on Myanmar's REEs has significantly increased since its 2016 crackdown on illegal mining operations in its own Jiangxi region, which forced many of the affected companies to either relocate or establish ties with production in Myanmar. In many cases, the mining techniques and supply chain structures used in Myanmar have been reported to resemble those previously employed in Jiangxi, suggesting a transfer or replication of operational models.[167] This reliance is proving risky, as China faces challenges in diversifying away from such a close and cost-effective supplier.

The situation in Wa State is slightly different. Governments of Myanmar have historically struggled to control the region. Before the coup, the area enjoyed a form of de facto semi-independence (although it formally recognized Myanmar's sovereignty over its territory). Following the 2021 coup, this autonomy became full separation, although the region largely

163 (Fishbein et al. 2024)

164 Interview with an international NGO representative, anonymity requested.

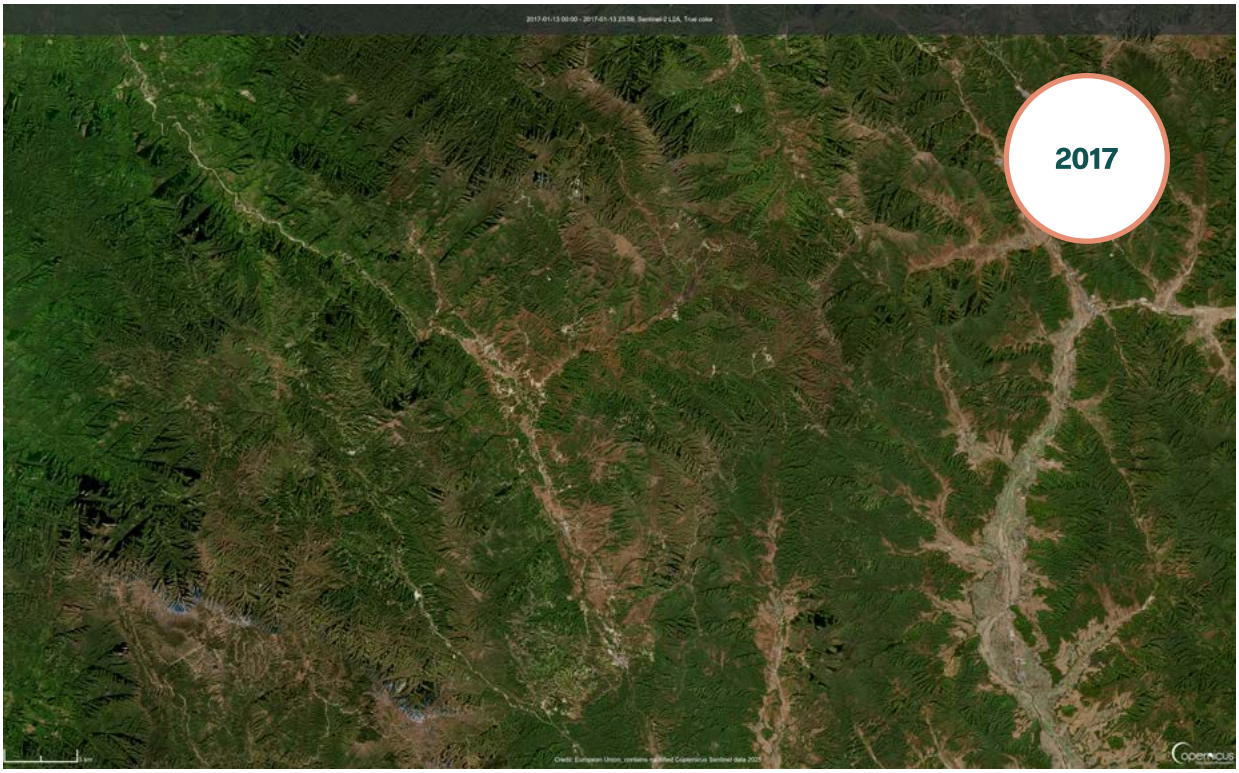
165 Interview Anrike Visser

166 Interview WWF Myanmar

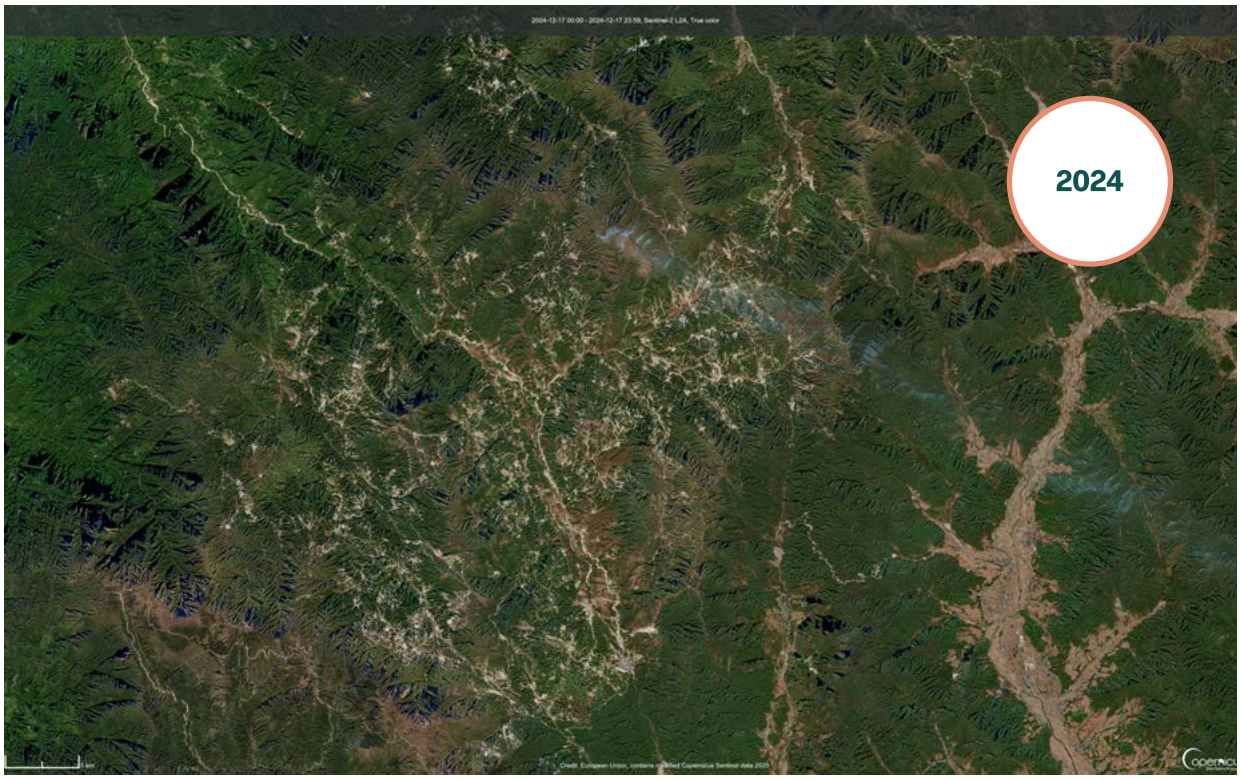
167 Ibid.

remained out of the fighting that followed the coup.[168] The Wa state has its own government and military, which in some respects resemble those of China (the working language is Mandarin). However, the Wa people have a distinct culture and history, and relations with Beijing fluctuate, particularly concerning tin. In summer 2023, Wa authorities enforced a ban on tin exports to China,[169] exposing China's dependence on Myanmar imports. This was partially lifted in January 2024,[170] but the situation remains volatile and unclear at the time of writing.

The environmental and social impacts of illegal mining are already evident and have sparked a series of local protests,[171] some of which have even led to successful outcomes.[172] Unregulated mining activities are contaminating local rivers and lakes, increasing the risk of landslides, accelerating deforestation, harming the health of residents, and threatening the region's high biodiversity. This damage risks extending further into the country, as hazardous waste is being discarded into the N'Mai Hka River, which flows into the Ayeyarwady River, Myanmar's main water source.



168 (Myanmar Peace Monitor 2024)
169 (Home 2023)
170 (Home 2024)
171 (Frontier Myanmar 2023)
172 Ibid.



Illegal mining for REEs in Myanmar Kachin State (January 2017 vs December 2024).
Contains modified Copernicus Sentinel data (2017 and 2024), processed by ESA

The case of Kuala Pilah and Perak, Malaysia: REEs

Malaysia has a history of combating corruption and addressing issues related to illegal mining. In 2017, the country imposed a bauxite export ban to curb environmental damage and illicit activities. However, the ban was frequently violated, particularly in its early stages. Despite the restrictions, exports to China continued at a steady pace, and bauxite stockpiles remained unchanged during the first six months, indicating ongoing illicit trade. [173]The ban was eventually suspended in 2019.[174]

The rapid growth of the REE industry could induce a new wave of illegal mining in the country and several cases have already been reported nationwide. This is, for instance, evident in the illegal REE mines detected in the Kuala Pilah area in May 2023[175] and in Perak in December 2023.[176] The latter case led to the arrest of 31 people, 21 of whom were from China,

173 (Reuters 2020)
174 (Reuters 2019)
175 (Bernama 2023)
176 (Reuters 2023b)

Myanmar and Viet Nam. The mine was located inside the Bintang Hijau Forest Reserve. Investigations in the state of Kedah led to two arrests related to alleged corruption and illegal REE mining involving the Kedah Menteri Besar Incorporated company in 2023.[177]

Illegal mining of REEs continues to draw increasing attention from Malaysian authorities. In December 2024, a series of police raids targeted illegal rare earth element (REE) mining, resulting in 55 arrests and the seizure of over 5 tons of illicit REE ore that was being disguised as "clay" and fertilizers for export.[178] Other illegal activities were uncovered in the Gua Musang forest in northern Malaysia, where authorities arrested 38 people that same month for unlawfully extracting REEs in a protected area.[179] More generally, 16,000 tons of such minerals have been illegally mined and exported to China in recent times, according to the Malaysian Natural Resources and Environmental Sustainability Minister.[180] With a total of 19,000 tons reported, less than 16 per cent was sourced legally. These figures were calculated by comparing national data with Chinese customs reports and will likely trigger further action by the government against illegal operations, as declared by the Minister in March 2024.[181]

3.2.3 Insufficient protection of community and Indigenous rights

Local communities and Indigenous people are often at the frontline of the fight against illegal mining, as they suffer directly from the impacts of unlawful activities, including health and environmental hazards. While in some cases they are also involved in corruption schemes that facilitate these illegal activities, it is usually limited to only a fraction of the community members. It often occurs due to a lack of awareness of the real impact of illegal mines or the absence of economic alternatives.[182]

Supporting communities and Indigenous people is, in the vast

177 (Malaymail 2023)
178 (Hendrich 2024)
179 (Abdullah 2024)
180 (The Star 2024b)
181 (The Star 2024c)
182 (Prieto, García-Estévez, and Ariza 2022)

majority of cases, particularly rewarding. Deforestation and illegal logging are frequently associated with land grabbing by external players, whereas local communities—especially Indigenous groups—usually adopt sustainable land and forest management techniques.[183] An effective civil society (as in the case of Myanmar or the Philippines) usually stems from informed and involved communities capable of effective monitoring, a task that would otherwise be highly challenging and costly for law enforcement agencies.

However, communities and Indigenous people's efforts are often undermined by several factors. The wealth promised by illegal miners is often irresistible in impoverished areas, and the local population can easily be enticed into accepting high-impact illegal activities.[184] In some cases, land tenure is weak, and in Southeast Asia corruption and document fraud are frequently used to appropriate land for new projects with little regard to decades- or centuries-old community land use. Such issues have long been reported in relation to mining projects in the past (particularly for gold or coal), but they are also becoming increasingly relevant for critical minerals. For instance, there have been cases of consultations with fraudulent groups of elders to satisfy due diligence obligations.[185] The insufficient digitisation of concession maps and other documents across the region further aggravates the situation.

Indigenous people in Southeast Asia are particularly exposed to such issues. In several countries, laws protecting Indigenous rights are relatively strong but tend to be too broad and open to interpretation. As a result, they often lack proper implementation or are only weakly enforced.[186] Unsurprisingly, there has been an increase in mining projects on Indigenous land in recent years,[187] leading to significant impacts on communities, including relocation, environmental destruction, and even cultural loss.[188]

183 (Colantoni and Sangiorgio 2024a)
184 (Prieto, García-Estévez, and Ariza 2022)
185 Interview Signe Leth
186 Interview Signe Leth
187 Interview Prabindra Shakya
188 (Huang and Ge 2024b)

The case of the Caraga Region and the Tawi-Tawi and Palawan islands: ***nickel***

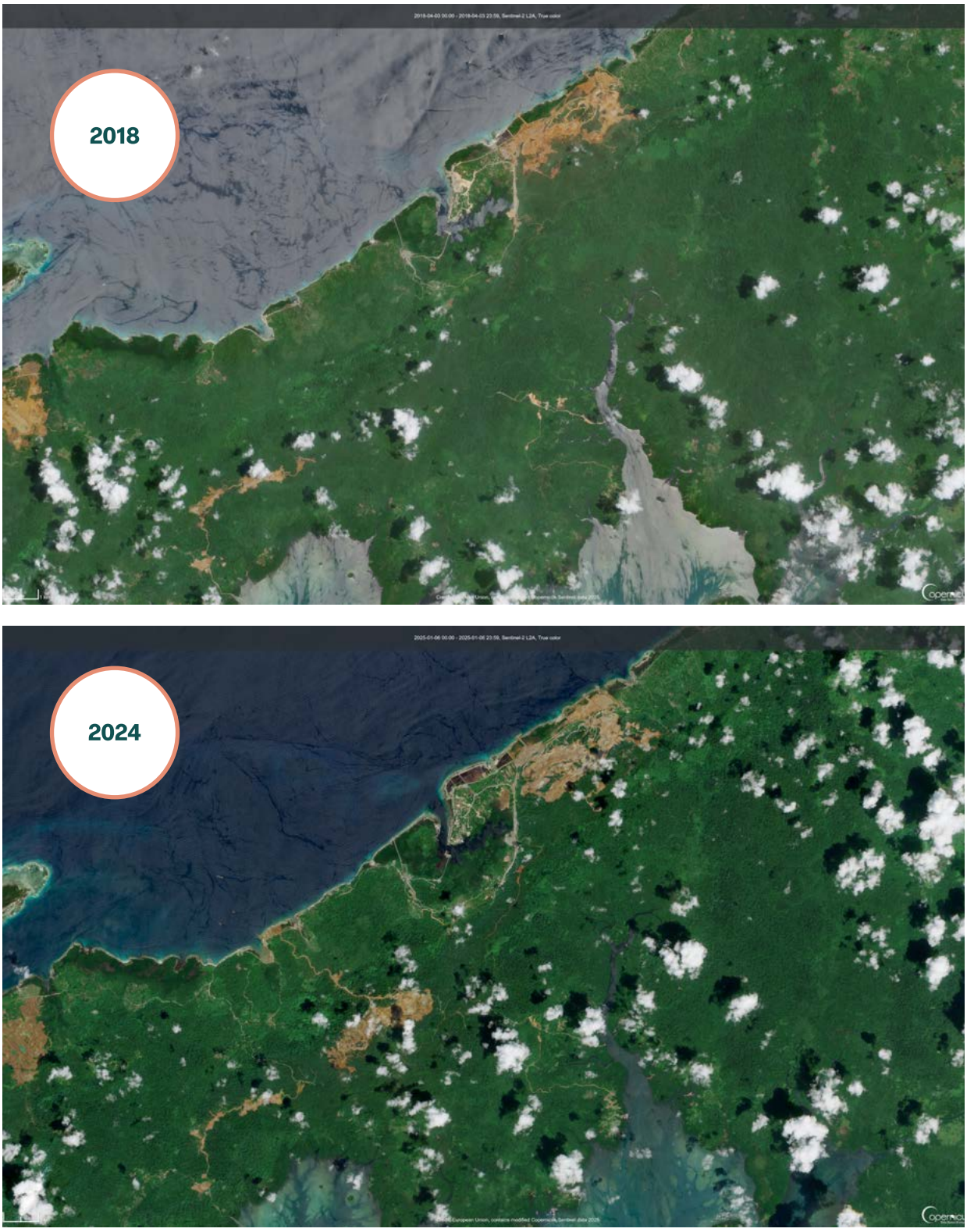
The Philippines has a long history of illegal mining, particularly involving gold and copper, carried out by both artisanal miners and large-scale operations lacking proper licences or causing excessive environmental harm.[189] However, the country also has a strong tradition of community engagement, which has influenced mining policies on several occasions. In 2012, a concern that the environmental and social costs of mining outweighed its economic benefits led to a ban on new mining permits.[190] This was followed in 2017 by a ban on open-pit mining and the suspension of 26 mines accused of environmental violations. The permit ban was overturned by President Rodrigo Duterte in 2021,[191] despite his early anti-mining stance;[192] this was followed shortly after by a four-year suspension of the open-pit mining ban.[193] As nickel demand soared following Indonesia's export ban, a wave of new mining projects emerged across the archipelago, many of which have been linked to human rights abuses and environmental violations.

Nickel mining is concentrated in the Caraga Region and on the islands of Tawi-Tawi and Palawan. The latter has been particularly exposed to violations, partly because it has historically been a major nickel mining area (and thus is the most explored). The Rio Tuba mine (a long-standing Philippine–Japanese enterprise) has been under scrutiny by civil society since the early 2000s, due to frequent cases of respiratory and skin diseases among communities living nearby.[194] Although levels of hexavalent chromium, a known human carcinogen, exceed WHO thresholds,[195] no direct link has been established between the reported health issues and mining activities so far. Nevertheless, several violations of Indigenous rights, particularly regarding the scale and impact of excavation activities, have been recorded over the years.[196]

189 (Castillo and Alvarez-Castillo 2009)
190 (Garcia 2021)
191 (Chavez 2021)
192 (Reuters 2018)
193 (Sarmiento 2022)
194 (Business & Human Rights Resource Centre 2023a)
195 (WHO 2025)
196 Ibid.

New projects pose a higher threat of environmental violations. A new project by the Altai Philippines Mining Corporation (APMC), a subsidiary of the Canadian Altai Resources Inc., on Sibuyan Island was found responsible for serious environmental violations (including the construction of an illegal causeway) during the exploratory stage,[197] before being issued an environmental compliance certificate. The Department of Environment and Natural Resources issued a cease-and-desist order in February 2023,[198] which was followed by further action from the Philippines Supreme Court against the company and the national agencies involved in the violations.[199] However, the company still holds a Mineral Production Sharing Agreement (MPSA), allowing it the possibility of resuming activities. This has led to extensive protests by local communities, which have been met with documented instances of police violence, harassment, and intimidation,[200] as well as legal action by APMC.[201] Local communities have resisted open-pit mining for more than 50 years because of the remarkable biodiversity found in the extensive pristine areas of the remote island. While the local population is now asking the Supreme Court to repeal the MPSA, the company continues to maintain that its operations are destructive, yet legal.[202] Protests against another nickel project, this time in Brooke's Point in southern Palawan, have also been met with brutality by private security forces and the Philippine police.[203] Extraction activities are not new here and have been run by the Ipilan Nickel Corporation since 1993. However, the company failed to obtain consent from Indigenous communities,[204] as well as the required Environmental Compliance Certificate,[205] which is necessary to renew its agreement with the Philippine government. Extraction activities continued despite this, leading to the felling of roughly 7,000 trees, some of which were centuries old and located in a UNESCO World Heritage site renowned for exceptional biodiversity.[206]

197 (Willis 2023)
198 (Mangaluz 2023)
199 (Sarao 2023)
200 (Commission on Human Rights 2023)
201 (Willis 2023)
202 (Gozum 2023)
203 (Rainforest Rescue 2023)
204 (Business World 2023)
205 (EJAtlas 2023)
206 (Fabro 2022)



Illegal mining for nickel in Tawi-Tawi, Philippines (April 2018 vs January 2025)
Credit: Contains modified Copernicus Sentinel data (2018 and 2024), processed by ESA

3.3 Solutions

Despite the complexities involved, technological, pollical, social, and economic solutions already exist to address the growing risks of illegal mining for critical minerals in Southeast Asia. If developed and implemented in a timely manner, they could set the quickly expanding sector on a path of sustainable development that could fully benefit communities and national economies, while minimising the impact on the environment and people's health.

The relative novelty of Southeast Asia's critical minerals sector offers an opportunity for effective, and potentially preventative, actions that require fewer resources compared to regions and sectors where illegality is more entrenched. For instance, countries can enact dedicated, up-to-date legislation for critical minerals instead of relying on decades-old

laws. Additionally, newly emerging criminal actors could be easier to detect than deep-rooted criminal groups. Legislative measures adopted for economic or strategic reasons, such as Indonesia's nickel export ban, can also generate positive spillovers by streamlining segments of the supply chain and improving traceability. However, such measures may also encourage vertical integration, whereby a single company controls multiple stages of production, from extraction to processing. While this can enhance operational efficiency, it may reduce incentives to disclose supply chain data, particularly in contexts with weak oversight or limited transparency requirements.

Furthermore, it is worth noting that, although critical minerals are relatively new in many cases in Southeast Asia, lessons can be drawn from other regions and sectors. This is particularly relevant for tracing (see below section 3.3.1), which is being implemented in timber and agricultural trade, but also applied to other issues, such as corruption. In the case of licensing and contracting for critical minerals, the risk is indeed particularly high, but patterns and methodologies tend to be similar across regions.[207] The presence of intermediaries in the award process, companies seeking licences being involved in national politics, and applicants with a history of violations facing few to no consequences are examples of warning signs. Identifying them could help reduce the high corruption risk in the contracting process, and potentially prevent illegally-awarded licences.[208]

Following a few guiding principles and focusing on a series of key aspects could significantly improve effective action against illegal mining in the region. In particular:

* **Understanding and monitoring the supply chain**. It will be crucial to understand and follow the supply chain of critical minerals. All critical minerals are, at some point, traded as legal commodities—in some cases after refining, in others immediately after production at the mining site. The key is to understand when, where and by whom the minerals are laundered and subsequently how they enter the global market, for example, through traders, producers, smelters, or other intermediaries.

207 For more information please see the 2024 study of the Nature Resource Institute on corruption risk for licensing and contracting for critical minerals: https://resourcegovernance.org/sites/default/files/2024-12/Ten_Red_Flags_Corruption_Risk_Transition_Minerals.pdf

208 (Sayne, Fitzgerald, and Shipley 2024)

* **Recognizing the breadth of illegality.** It will also be essential to understand that there can be different and multiple sources of illegality, occurring at different stages of the supply chain, and that corruption and political interventions may empower them. Illegal mining has traditionally been considered mostly in relation to production activities, but offences can affect the whole supply chain. Although reports of illegal smelting or refinery practices are currently scarce, the environmental and health impacts of these activities can be severe. The economic incentives to favour cheaper and illegal methods for waste disposal or pollution are high and will continue to grow.

* **Anticipating market and policy dynamics.** Understanding the evolution of markets and policies can help stakeholders to act preventively, or at least in a timely manner. Even if critical minerals prices fluctuate, it is already clear that the demand for several of these commodities will keep growing, such as nickel and REEs. Implementing regulations early in the expansion of production, building task forces, and trying to understand the dynamics of these new sectors from their onset can make enforcement action more effective, quicker and cheaper.

* **Adopting integrated solutions.** Avoiding a siloed approach and instead promoting holistic solutions is crucial for effective action. New technologies (described in section 3.3.1) can reduce costs remarkably and achieve results that would have been impossible in the past. However, they are most effective when used in synergy with economic, political and social measures to extend their reach and increase their acceptance at all levels. Conversely, economic, political, and social tools require significant technological support to enhance their effectiveness.

* **Exposing illegal activities, even without immediate prosecution.** Some of the solutions proposed may expose the extent and ramifications of illegal critical mineral sourcing but fail to result in prosecution (or in the imposition of adequate punishments) due to political interventions, weak regulations, or insufficient evidence. This has systematically been observed in other sectors in the region (for instance, early efforts against illegal palm oil) and has, to some extent, discouraged further action. This should not be the case: exposing illegal activities not only puts pressure on authorities to enforce or increase regulations, but it also compels

legal companies purchasing illegal products to find alternative suppliers. This, in turn, reduces the demand for illegal minerals and cuts off resources for illegal operations, while boosting incentives for legal production. Tools such as satellite imagery analysis and financial investigations play a key role in these efforts.[209]

3.3.1 Tracing

As discussed in section 3.1.1, tracing is one important element in combating illegal mining. Without traceability, it is impossible to determine the alleged illegal origin of minerals or to detect other violations across the supply chain. However, traceability alone is not sufficient to detect or prevent supply chain violations. It must be embedded within a broader due diligence framework, one that enables companies to assess risks, take action to mitigate them, and demonstrate accountability. Without a well-functioning due diligence process, the impact of traceability remains limited.

A key challenge is that while traceability systems for minerals do exist, they are still evolving and remain fragmented. Most existing systems are voluntary and developed by companies, either independently or through industry association. Globally, no legislation currently requires comprehensive and compulsory tracking across all mineral types. Instead, traceability is typically addressed indirectly through broader due diligence frameworks. Some jurisdictions have begun taking steps toward more structured approaches. A notable example is Indonesia's 2024 decision to expand its Sistem Informasi Mineral dan Batubara Antar Kementerian/Lembaga (SIMBARA) to cover tin and nickel.[210] The system was launched in 2022 to trace gold and coal, ensuring compliance with mining quotas through RKAB, a dedicated subsystem. It monitors compliance via document analysis, financial flows, workforce involvement, and traded quantities. The extension to tin and nickel will primarily focus on tracking mineral flows between mines and refineries to ensure that the quantities smelted correspond to the legally excavated amounts and detect any discrepancies.

209 (WWF UK 2024)
210 (Mining.com 2024)

There is growing momentum toward establishing more harmonized frameworks for traceability, transparency, and accountability in the critical minerals sector. While a single global tracking system may not be viable or appropriate across all contexts, there is increasing support for internationally aligned approaches. For instance, in September 2024, the UN Secretary-General's Panel on Critical Energy Transition Minerals called for the creation of a "traceability, transparency, and accountability framework", understood more as a protocol or guiding structure than a centralized system.[211] Similarly, international cooperation agencies and private sector actors, such as the International Council on Mining and Metals (ICMM), have been actively working on advancing traceability and responsible sourcing practices. Additionally, cooperation agencies[212] and private initiatives such as the International Council on Mining and Minerals[213] have been focusing on the issue for some time.

Establishing effective traceability will require progress on two fronts: the development and deployment of suitable technologies, and the creation of supportive legal and regulatory frameworks, alongside efforts to foster social and political acceptance of these measures.

Technologies for tracing are being developed rapidly, and they include a variety of different tools:

* **Apps and software to gather chain-of-custody information.** The backbone of tracing systems lies in the ability of supply chain participants to reliably collect and share data, such as the quantity and origin of the minerals, their refining status and location, and the intermediaries involved in prior trades. In most legislation, the operator at the end of the supply chain is responsible for collecting this information. Product-backwards traceability—where the final operator gathers data from various players in the supply chain—is, however, prone to errors due to the variation in collection methods. By contrast, source-forward traceability—where information is collected by each player and transmitted to the next—is typically more coordinated and effective. In this regard, blockchain technology has proven particularly suitable for the mining

211 (UN Secretary General's Panel on Critical Energy Transition Minerals, 2024)
212 (Nordic Innovation 2024)
213 (RCS Global 2017)

trade:[214] transactions are registered as unalterable "blocks" of information accessible in real-time by relevant stakeholders (auditors, buyers, authorities, etc.), thus reducing the risk of fraud. Apps are already being tested for other commodities, such as coffee and palm oil,[215] allowing producers, buyers, and other players to update a shared database in a structured and easily accessible format. Such models could be adapted for the mining sector. However, blockchain also poses a significant challenge: the data it stores, while tamper-resistant, is only as reliable as the information initially entered. If inaccurate or fraudulent data is input at any stage, the system will replicate and preserve these errors across the supply chain, a limitation sometimes referred to as the problem of "immutable garbage." As such, the effectiveness of blockchain-based traceability depends not only on the technology itself, but also on the robustness of data verification mechanisms at the source.

* **Satellite imagery.** This technology can aid efforts to combat illegal mining in various ways (see below), but it is also essential for tracing. Some traceability systems for other commodities use GPS coordinates to identify the source, and high-resolution satellite images are now widely available. One of the most comprehensive resources is the EU Copernicus Browser,[216] which offers free images with resolutions ranging from 2.5 to 10 meters, capturing the entire globe once or twice daily since 2016. These images include both optical and multispectral data. Through GPS coordinates, it is not only possible to identify the mines that produced the minerals, but also to track changes in operations over time, such as illegal expansions (by comparing mining activity to concession maps) or assessing whether environmental impacts remain within legal limits.

* **Geochemical fingerprinting.** This technique has existed for some time,[217] but the growing need for traceability is driving rapid advances across various mineral sectors. Geochemical fingerprinting involves a series of procedures designed to identify the unique chemical, physical or isotopic characteristics of a mineral to determine its origin. In some cases,

214 (RCS Global 2017)
215 (RSPO 2024)
216 Available at: https://browser.dataspace.copernicus.eu/
217 (Kamber 2009)

smelters or refiners can even add "signature" marks to the commodity at later stages of the supply chain.[218] Several initiatives are working to standardize and integrate these tools into traceability processes, such as BATTRACE (for battery-related minerals like lithium and cobalt),[219] the Geo-forensic Passport (for gold),[220] and CERA 4in1 (potentially for all minerals).[221] While these approaches show promise, their implementation requires careful consideration. Effective use of geochemical fingerprinting depends on comparing samples to reference databases of known sources, yet building and maintaining such a global dataset would be complex, politically sensitive, and resource-intensive.

Furthermore, promoting high-cost technical solutions risks marginalizing smaller supply chain actors and governments with limited capacity, particularly in low-income or high-risk areas. As such, while fingerprinting may complement broader due diligence efforts in specific contexts, it should be pursued with caution and in parallel with efforts to ensure equitable access and participation across the supply chain.

Tracing will require not only the implementation of new technologies but also the construction of a solid legislative, political and even social framework to ensure success. In particular:

* **Importance of public awareness.** Low environmental awareness and public exposure of buyers decrease their interest in tracing. The environmental impact of commodities such as cocoa and coffee has been widely recognized by the public for decades, driving the creation of certification schemes like Fairtrade and Rainforest Alliance that incorporate strong traceability systems. This has not been the case for mining, with only limited attempts for gold, silver and a few other sectors. Critical minerals are mainly traded between industrial actors, with limited direct exposure to consumers. While this lessens the impact of consumer pressure, responsible sourcing is increasingly driven by due diligence regulations and market requirements. Establishing regulatory frameworks that mandate traceability across the supply chain will be

218 Interview Pierre Viaud
219 (GTK 2023)
220 (Murray 2021)
221 (MADITRACE 2024)

essential to complement voluntary private sector initiatives and ensure accountability. One of the most noteworthy recent initiatives is the work done by the GBA, which launched a global and harmonized battery passport. This passport aims to trace information on seven key aspects: greenhouse gas emissions, environmental and human rights due diligence, forced labour, child labour, biodiversity, Indigenous peoples' rights, and circular design.[222] These passports will focus primarily on critical minerals—including lithium, cobalt, copper and nickel, which are discussed in this report—and could significantly improve traceability mechanisms in Southeast Asia, although the region's precise role remains unclear.

* **The need for global collaboration.** As tracing efforts require a global approach, both producing and buying countries should be involved. In this sense, the necessary tools and legislation must be implemented by both sides. More broadly, efforts towards sustainable production should be coordinated across the whole supply chain, with costs equitably shared among players—not just producing countries.

* **Lessons from other sectors.** Experiences and legislation from other sectors can help anticipate the obstacles that tracing critical minerals may face. A notable example is the 2023 EU Deforestation Regulation (EUDR), which prohibits the placement of seven key agricultural commodities on the EU market if linked to deforestation. Widely considered one of the most ambitious efforts to date, it requires extensive traceability across global supply chains. However, its implementation has faced considerable public pushback from producing countries, citing concerns over cost, administrative burden, and alignment with national systems.[223] These reactions have contributed to a one-year postponement of the regulation's enforcement. Similar concerns may emerge in the context of international traceability initiatives for critical minerals, underscoring the need for early engagement, flexibility, and sensitivity to local contexts.

222 (Global Battery Alliance 2024)
223 (Colantoni and Sangiorgio 2024a)

* **Integration with broader initiatives.** Finally, tracing efforts must be integrated with other tools and strategies, as they will not be effective in isolation. Traceability systems alone cannot address the full scope of illegal mining challenges. Vulnerable communities may seek to circumvent geolocation systems, while systemic issues, such as document fraud and corruption, may undermine enforcement efforts. For traceability to succeed, it must be part of a broader framework encompassing technological, economic, and social initiatives. A holistic approach, as outlined in this report, will be critical to fostering sustainable and inclusive solutions.

3.3.2 Increasing the reach of legislation and enforcement agencies

Effective traceability must be supported by robust enforcement, requiring substantial improvements to legislation and operational frameworks at both regional and global levels. Strong sanctions serve as a fundamental deterrent against economic crimes such as illegal mining. Yet, as discussed in section 3.1.3, in most cases legislative frameworks in Southeast Asia remain too weak relative to the significant economic gains that illegal activities such as the production, trade, or smelting of critical minerals can offer. Enforcement is further weakened by corruption (see section 3.2.1) as well as by a lack of specialized expertise and resources.

The issue of beneficial ownership transparency continues to present a major challenge for enforcement and accountability in the mining sector. Individuals and entities benefiting from illegal or corrupt operations frequently operate through layered corporate structures, shell companies, or anonymized holdings, which obscure the identity of ultimate beneficial owners and hinder investigations. This opacity facilitates corruption, enables conflicts of interest, and allows politically exposed persons or criminal networks to participate in resource extraction with limited scrutiny. While some ASEAN countries have legal frameworks for Beneficial Ownership Transparency disclosure in the mining sector,[224] many are still lagging behind.[225]

To address these challenges, it will be necessary to update the region's operational and legislative frameworks, which were largely designed for a mining sector that historically played a relatively small role in national economies compared to other commodities such as timber or palm oil. These frameworks mainly focus on conventional minerals like gold, coal, and, in some cases, tin or copper. A new approach should consider the diverse resources now being explored, and the increasing global demand's pressure on domestic production. It should also anticipate significant and, in some cases, unpredictable, changes due to price variability and the limited of exploration of Southeast Asian mineral resources.

Thus, both legislative and operational frameworks must be strengthened while adapting to rapidly changing circumstances. A combination of criminal enforcement tools, traditional enforcement measures, administrative mechanisms, and general monitoring will be necessary. Recent efforts suggest positive momentum. For example, in 2024, **the Indonesian Ministry of Energy and Mineral Resources established the Directorate General of Law Enforcement (Dirjen Gakkum)** to address illegal mining, marking an institutional step toward improving domestic enforcement capacity. Such initiatives can serve as models for regional replication.[226]

In particular:

224 (EITI 2024)
225 (Manuel and Russell-Prywata 2024)
226 (Antara 2025)

* **Empowering legislative frameworks.** The criminalization of illegal mining exists in a significant share of Southeast Asian countries (five out of the ten in the region, according to the United Nations Office on Drugs and Crime).[227] However, it is crucial to expand this to the entire region and significantly enhance sanctions to match the extraordinary level of earnings that illegal mining for critical minerals now generates. Furthermore, improving the coherence between different legal tools (such as financial laws) will be key to addressing crime convergence (see below).

* **Specialization.** Increasing specialization is fundamental not only for police forces but also (and perhaps more so) for judges and prosecutors, who often have an even lower level of sectoral expertise. Mining supply chains are complex, and those of critical minerals even more so. Criminal methodologies in Southeast Asia are still evolving due to the sector's relative novelty. Specialization not only allows for a full understanding of how criminals operate but also provides insights into the legislative and technological tools available, as well as the economic and social dynamics behind illegal mining. Capacity building has proven fundamental in improving action against environmental crimes in a number of international frameworks, particularly the EU's European Multidisciplinary Platform Against Criminal Threats.

* **Proposing an international approach.** Adopting a more international approach is also key, since critical minerals are widely traded across the region and predominantly exported to China, Australia, and Europe, resulting in illegal mining being largely a transnational crime. So far, legislative frameworks in Southeast Asia are highly heterogeneous, and inter-agency coordination across countries remains limited. Therefore, agreeing on shared definitions and standards, as well as implementing joint training and operations, could significantly improve enforcement effectiveness. Such initiatives have emerged through bilateral agreements in some cases (as seen in the Mutual Legal Assistance agreement between Indonesia and Viet Nam), but a wider, regionally coordinated approach would likely be more efficient. This could be achieved through ASEAN; despite having limited involvement in enforcement matters, it remains a critical reference

227 (UNODC 2023)

point for the region and has recently launched initiatives on mining. Additionally, Interpol can provide relevant assistance, but its engagement in the region has so far been limited—mainly because national agencies have not yet requested its support.[228] Nonetheless, Interpol's efforts in capacity building, support for the application of new technologies, and coordination of international operations against environmental crimes have proven very effective in recent years.

* **New technologies.** Integrating new technologies is essential, as they can reduce risks and costs while enhancing the rapidity of action. Satellite imagery is likely the most effective tool in this regard, allowing enforcement agencies to monitor large territories for illegal operations efficiently and safely. This technology is particularly powerful when combined with artificial intelligence (AI), which can identify the patterns of mines in landscapes. Satellite images can also reveal whether legal mining operations are violating environmental regulations: comparing the actual area of a mine with its concession boundaries can determine whether a company is exceeding its licence, while multispectral images can detect pollution and tailings.

* **Focus on corruption.** Strengthening anti-corruption units and initiatives can yield quick and significant results.[229] As discussed in section 3.2.1, corruption is the main enabler of illegal mining, and anti-corruption units have proven to be among the most effective tools against this challenge. The region has several positive examples in this regard: the Indonesian KPK, the Malaysian Anti-Corruption Commission and the Thai National Anti-Corruption Commission, among others. However, despite their key role in national enforcement frameworks, they are often hindered by limitations in their reach or power, faced with political opposition, or in need of additional resources and capacity-building support.

* **Bringing crime convergence into the discussion.** There is growing recognition that environmental crime is frequently linked to other offences—financial crime in particular, but also human rights violations, terrorism, and other serious crimes. While past efforts have focused primarily on wildlife crime,[230]

228 Interview Interpol

229 On the relation between the energy transition and corruption please also refer to this paper: https://baselgovernance.org/sites/default/files/2024-09/WP53.pdf

230 (Wildlife Justice Commission 2023)

increasing attention is now being given to crime convergence in the context of illegal mining.[231] To tackle this effectively, it will be key to integrate different types of investigations (particularly environmental and financial inquiries) and avoid the siloed approach that remains prevalent in this domain.

* **Addressing the entire supply chain.** It is also necessary to shift from viewing mining offences primarily in terms of production to a more comprehensive perspective that encompasses the entire supply chain. Moreover, criminal law should be applied more widely instead of relying solely on administrative regulations. This shift has already begun in other sectors in Southeast Asia, particularly in the fishing industry.[232] The previous focus on Illegal, Unreported and Unregulated Fishing is increasingly being replaced by broader enforcement targeting fishery crimes throughout the supply chain. Given the severity of violations and the involvement of OCGs, criminal law is being applied more frequently, and enforcement agencies (rather than solely environmental authorities or ministries) are taking a more active role. This approach should also be extended to the critical minerals sector.

* **Considering demand.** As discussed in section 3.3.1, it is crucial to consider not only the mining activities in Southeast Asia but also the demand drivers fuelling the surge in extraction. The role of customs authorities and national enforcement in importing countries remains limited, but with full traceability measures and robust due diligence laws in place, their involvement is expected to grow significantly. As a result, these authorities will need specialized training and additional resources—similar to those already required by enforcement agencies in producing countries.

3.3.3 Empowering local communities and Indigenous people

As discussed in section 3.2.3, local and Indigenous communities are at the forefront of action against illegal mining, since in the vast majority of cases, they are directly and severely impacted by the environmental and health conse-

231 (Interpol 2022)
232 (Colantoni and Sangiorgio 2024b)

quences of these activities. In the Philippines alone, 30 per cent of the land inhabited by Indigenous people is affected by extraction activities.[233] Their advocacy has led to tangible results in several cases: in August 2023, Indigenous communities in Palawan stopped a proposed nickel project that the country's Supreme Court ruled could cause irreversible harm to communities and nature.[234] In the case of Indonesia's tin extraction on Belitung island (see section 3.2.1), it was Indigenous communities that first exposed the damage done by illegal mining to ecosystems and villages. These communities have actively worked on the issue since 2017, long before authorities acknowledged the violations.[235]

Local and Indigenous communities play a crucial role in providing key information and conducting ongoing monitoring of mining activities, trade flows, and the impacts of operations, improving the transparency and accountability of stakeholders. However, they also represent one of the most vulnerable groups across the critical minerals supply chain, and they need to be protected and empowered for their role to be fully effective. Specifically, this includes:

* **Providing economic alternatives**. It is essential to offer viable economic alternatives to illegal mining. While in some cases, mining is carried out by people from other regions, some local communities (though rarely Indigenous ones) are also involved in illegal activities because they are offered better-paying jobs than their traditional livelihoods provide. Additionally, mining has significantly damaged agriculture, fishing, and other sources of income (as seen on Belitung island). Ensuring that local communities have stable and sustainable alternatives to illegal mining is crucial to securing their support and avoiding backlash against regulatory enforcement.

* **Strengthening legal protection for Indigenous communities and improving land tenure.** Countries like the Philippines and Indonesia have relatively comprehensive laws protecting Indigenous communities, but these often lack specificity, making them easier to circumvent or misinterpret. In other countries, legal protections are considered insufficient. Enhancing these frameworks would enable

233 (World Rainforest Movement 2011)
234 (IUCN 2023)
235 (Tomimi 2024)

Indigenous groups to more effectively challenge harmful or unlawful projects. In general, land tenure for local communities remains unclear and lacks strong legal safeguards, particularly for communal lands such as forests and pastures. This has frequently led to conflicts between large companies and smallholders, especially in sectors such as palm oil production, but also in gold, tin, and nickel mining, particularly in the Philippines. Companies often exploit legal ambiguities to extend or obtain concessions, sometimes illegally. Stronger land rights protections will be a key factor in empowering communities. Existing mechanisms could be effective, but they require reinforcement: FPIC procedures should be more transparent and enforce stricter requirements in line with the UN Declaration on the Rights of Indigenous Peoples to prevent fraud and ensure that community perspectives are accurately represented. Additionally, procedures for the formal recognition of Indigenous land claims should be expedited and improved, with safeguards to temporarily halt development projects until land tenure is fully established.

* **Enhancing FPIC implementation across the region.** Some stakeholders raised concerns about the misuse of FPIC, particularly in contexts where power imbalances exist between communities, state actors, and private sector interests. While FPIC is designed to uphold the right to self-determination, consultations are often undermined by coercion, lack of transparency, and externally driven decision-making processes. In some cases, FPIC has been perceived less as a means of genuine participation and more as a tool to legitimize projects that communities have had little real influence over. However, a notable and growing development is the emergence of Indigenous-led FPIC protocols.[236] These protocols, rooted in customary laws and traditions, allow communities to define consultations processes on their own terms, ensuring that engagement respects their governance systems rather than those of external actors. Strengthening FPIC mechanisms should thus focus not only on preventing manipulation but also on actively supporting Indigenous communities in asserting their rights and shaping FPIC procedures.

236 (Cultural Survival and SIRGE Coalition 2023)

* **Assessing the impact of mining on Indigenous and local communities and giving them visibility.** In several cases, the full extent of illegal mining's impact is underestimated—either due to inadequate detection methods or because critical factors such as cultural loss and the societal consequences of displacement from ancestral lands are overlooked. This, in turn, reduces communities' control over their territories and diminishes their ability to monitor illegal activities. Ensuring adequate compensation and acknowledging the broad spectrum of impacts are key to strengthening their agency. Additionally, increasing their visibility on both national and international platforms—such as media outlets and global forums—has proven highly effective in strengthening action against illegal mining. This approach has been successful in Southeast Asia and in other regions, particularly in the fight against illegal gold mining in the Amazon.

4. Conclusion and way forward

The increasing global demand for critical minerals, driven by the energy transition and digitalization, has positioned Southeast Asia as a key player in the sector. However, the region's mining industry remains highly vulnerable to illegal activities, including unregulated extraction, corruption, smuggling, and environmental degradation. As highlighted in this report, these criminal dynamics not only threaten sustainable development but also compromise governance, economic stability, and human rights.

To address these challenges, UNICRI has been actively working to strengthen regional capacities in tackling crimes associated with critical minerals. In December 2024, UNICRI, in collaboration with the Government of Cambodia, organized a Regional Expert-Level Workshop on combating organized crime and illicit trafficking related to critical minerals. This initiative provided a platform for law enforcement agencies, policymakers, and industry representatives from across the region to exchange knowledge and explore solutions to enhance supply chain transparency, legislative frameworks, and enforcement mechanisms.

Building on these efforts, UNICRI aims to continue supporting Southeast Asian countries in preventing and mitigating the risks posed by illegal mining and related crimes. This will include targeted capacity-building initiatives on: (i) investigative techniques to uncover illicit mineral trade networks; (ii) the integration of traceability mechanisms into supply chains; and (iii) the development of legal and regulatory frameworks to improve enforcement and compliance. Additionally, UNICRI will work closely with key stakeholders, including international organizations, civil society, and the private sector, to foster multi-stakeholder cooperation and encourage responsible sourcing practices.

Recognizing the need for sustained international engagement, UNICRI is also leveraging global platforms to raise awareness on the intersection between critical minerals, organized crime, and environmental governance. Future efforts will focus on mobilizing resources and technical expertise to support UN-led initiatives on ethical and legal supply chain management for critical minerals. By strengthening regional resilience and promoting responsible mining practices, these efforts aim to ensure that Southeast Asia's critical minerals sector contributes to sustainable development rather than exacerbating crime, corruption, and environmental harm.

Annex A

Key priority needs identified in the UNICRI Regional Expert-Level Workshop in December 2024

1. Strengthening Legal and Policy Frameworks

* Address inconsistencies, loopholes, and overlaps in existing national legislation regulating the extraction, trade, and export of critical minerals.
* Technical support for countries to develop legislative frameworks aligned with international best practices, including the OECD Due Diligence Guidance and UN conventions against organized crime and corruption.
* Resources for digitizing licensing and permitting systems to improve transparency and reduce vulnerabilities to corruption.

2. Enhancing Law Enforcement Capacities

* Specialized training programmes for law enforcement, customs officials, and regulatory agencies on detecting, investigating, and prosecuting crimes related to critical minerals.
* Dedicated enforcement units focusing on mineral-related organized crime, financial crimes, and environmental violations.
* Capacity-building on financial investigations, anti-money laundering, and forensic auditing to track illicit financial flows linked to mineral crimes.
* Training and resources for customs authorities to enhance screening, verification, and risk assessment of mineral shipments to prevent smuggling and document fraud.

3. Addressing Corruption and Governance Weaknesses

* Strenghtening of anti-corruption monitoring bodies to oversee licensing, permitting, and trade activities.
* Resources for public sector training on integrity, compliance, and transparency in the mining sector.
* Investment in digital tracking and monitoring systems to enhance transparency in supply chains.

4. Leveraging Technology for Traceability and Compliance

* Financial support for blockchain-based traceability systems, satellite monitoring, and AI-driven analytics to improve supply chain transparency.
* Investment in forensic laboratories for mineral authentication, origin verification, and tracking of illicitly mined resources.
* Resources for the digitization of mining sector records and the development of centralized data-sharing platforms for regulatory and enforcement agencies.

5. Strengthening Regional and International Cooperation

* Creation of regional intelligence-sharing networks and secure communication platforms for law enforcement agencies.
* Funding for regional workshops, bilateral engagements, and multilateral task forces to strengthen international collaboration on tackling cross-border mineral trafficking.
* Capacity-building programmes on international legal cooperation, mutual legal assistance, and extradition procedures related to mineral crimes.

6. Capacity-Building and Raising Awareness

* Development of awareness campaigns and "train-the-trainer" models to strengthen local and Indigenous community engagement in monitoring and reporting illegal mining activities.
* Funding for research and policy development on the socio-economic and environmental impacts of illicit mineral extraction and trade.
* Financial resources to increase public and industry awareness on responsible sourcing, due diligence, and compliance with international trade regulations.

Annex B

References

Interviews

Please find below a list of the interviews cited in this report:

Interview 1: Representative from Interpol. Online, 2024.

Interview 2: Representative from Greenpeace Indonesia. Online, 2024

Interview 3: Representative from WWF Myanmar. Online, 2024

Interview 4: Pierre Viaud, senior advisor on government affairs and business development. Online, 2024

Interview 5: Representative from the Asia Indigenous Peoples Network on Extractive Industries and Energy. Online, 2024

Interview 6: Representative from the International Work Group for Indigenous Affairs. Online, 2024

Interview 7: Interview with an international NGO representative, 2024. The interviewee requested anonymity.

Interview 8: Anrike Visser, senior advisor on illicit finance policy, The Sentry. Online, 2024

The report was also informed by other interviews with:

Global Witness

OECD

Greenpeace Malaysia

Philippe Gillet, professor, expert on Earth and Environmental Sciences, Material Sciences

International Council on Mining and Metals

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