Coal Mine Closure, Environmental Impacts, and Land Reclamation in Colombia, Mongolia, and Thailand:

A Case Study of Thailand's Mae Moh Mine

Dr. Paul Mitchell, Dr. Pipat Laowattanabandit and Suchart Klaikaew

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Just Energy Transition in Coal Regions



EGAT

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Deutsche Gesellschaft
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**Friedrich-Ebert-Allee 32 +
36 53113 Bonn, Germany**

www.giz.de

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Written by Dr. Paul Mitchell, Dr. Pipat Laowattanabandit and Suchart Klaikaew
Reviewer by Phusanisa Jiratuchakul, Jirawat Yuttapravest, Titikarn Wongkum

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The insights and expertise shared by all participating organizations and stakeholders have strengthened the analysis of policy and implementation challenges, informed the development of practical recommendations, and supported efforts to advance a people-centred and sustainable just energy transition in Thailand.

Executive Summary

This report is part of a wider study of coal mine closure processes that also includes Colombia and Mongolia. By assessing legal, institutional, environmental, technical and social dimensions in each country, the principal objective is to generate tailored, evidence-based recommendations that strengthen structured mine closure planning and post-closure land use and identify gaps and opportunities for actions to improve outcomes.

The work contributes to the objectives of the Innovation Regions for a Just Energy Transition (IKI JET) project and the Just Energy Transition in Coal Regions (JET-CR) Platform by equipping governments, mine operators and affected stakeholders with practical tools and knowledge to support environmentally responsible, socially inclusive and economically viable transitions in coal-dependent regions.

The work completed in Thailand encompassed desk research, field missions and stakeholder engagement and a detailed gap analysis comparing the national legal framework for mine closure with a benchmark constructed from the aggregated requirements of four international mine closure standards and guidelines. The results of this work were distilled into closure roadmaps and strategic recommendations, identifying priority actions, responsible institutions, enabling conditions and coordination mechanisms.

Comparison of the benchmark and Thailand's legal framework for mine closure highlighted a set of systemic gaps, alongside areas where existing provisions partially align with international good practice. The analysis confirms that while Thailand has established a comparatively robust framework for managing environmental impacts and Physical reclamation during mine operations, mine closure is not addressed as a distinct, integrated, lifecycle-based process.

In Thailand's regulatory framework, closure-related obligations are largely embedded within reclamation, environmental licensing and operational compliance requirements. As a result, closure planning tends to focus on Physical rehabilitation and environmental controls, with more limited treatment of post-closure governance, long-term liabilities and socio-economic transition.

In summary, the gap analysis identified limitations in early and integrated closure planning, the scope and updating of closure documentation, the treatment of progressive and contingency closure, social transition and workforce planning, the adequacy and transparency of financial assurance mechanisms, long-term post-closure monitoring and legacy management, and institutional coordination and capacity.

Collectively, these gaps indicate that while Thailand has developed a solid framework for managing the environmental impacts of mining during operations, its approach to mine closure remains narrower in scope and less integrated than that reflected in international good practice and the mine closure framework is still being developed. Consequently, there remains room for further improvement and to bring Thailand's laws into closer alignment with international standards, including:

- Clarifying and supporting an inter-departmental review process for closure plans with specific timeframes for each step or stage.
- Extending closure and reclamation requirements to exploration sites.
- Ensuring occupational health and safety are embedded in closure, reclamation and post-closure activities.
- Ensuring core closure activities are addressed in the closure plan.
- Ensuring a detailed mine closure plan is prepared as part of the project EIA and updated as the mine proceeds through its lifecycle.
- Requiring a plan that addresses sudden or temporary closure accompanied by a budget to implement the plan.
- Designing, testing and implementing a reformed flexible financial guarantee system that can cover the current cost of mine closure at any time in the mine lifecycle.
- Making progressive restoration and closure during the operational phase of the mine lifecycle a legal requirement.
- Improving stakeholder consultation in closure planning, to integrate the opinions and expectations of impacted local people and other stakeholders, including a grievance mechanism and making mine closure planning documents available to local communities and other stakeholders.
- Integrating social transition planning with mine planning and ensuring the transition plans are aligned with local development plans.

These findings provided the analytical foundation for the Mae Moh case study, which enabled national-level gaps to be contrasted with site-level practice, and directly informed the policy and site-specific recommendations. Mae Moh mine is a large open pit lignite mine situated in Mae Moh District, Lampang Province, Northern Thailand. Operated by the Electricity Generating Authority of Thailand (EGAT), it is the sole remaining operating coal mine in Thailand and supplies lignite to a set of adjacent coal-fired power plants. The mine is expected to operate until around 2040, at which it will be closed. The closure of the mine will significantly impact the region's employment, with 47% of the province's workforce employed by EGAT and related companies (amounting to around 9,000 jobs) and approximately 40,000 residents expected to be directly or indirectly affected by the closure.

The currently approved closure plan for the Mae Moh mine is primarily based on reforestation. While reforestation remains an essential component of environmental rehabilitation, stakeholder engagement, national energy transition planning, and technical assessments indicate that a more diversified post-mining land use strategy would reduce economic risk, strengthen long-term regional resilience, and contribute more effectively to Thailand's climate commitments. Although the approved closure scenario prioritises reforestation, alternative land-use scenarios—when assessed through a safeguard lens—offer potentially greater economic and social benefits while also improving long-term energy security. Closure planning must therefore be situated within a complex strategic and policy landscape to ensure that it supports, rather than duplicates or contradicts, existing and planned national and provincial initiatives, including

renewable energy deployment, regional development planning and climate adaptation strategies.

Closure planning at Mae Moh must therefore be integrated into Thailand's broader coal phase-out and Just Transition agenda, applying environmental and social safeguards across the full mine lifecycle.

EGAT is a large and professional organisation that brings together a wide range of departments and disciplines to work effectively on closure, reclamation and post-closure land use at Mae Moh. Given the scale and remaining life of the operation, progressive closure remains the most appropriate strategy and is consistent with international good practice. In practice, EGAT continuously updates its reclamation plans to reflect ongoing mining operations and financial conditions. Some reclaimed areas have already been handed over for public access and use, demonstrating strong institutional capacity for Physical rehabilitation and environmental management, in several respects exceeding national minimum requirements.

The team responsible for developing the mine closure plan possesses the necessary knowledge, skills, data and technical expertise to produce a plan that is both technically and economically feasible. However, from a safeguard perspective, data sharing between the central and mine offices appears to be partial. Certain datasets and reports are not consistently duplicated across locations, and some central office staff may be unaware of technical information available at the mine site, and vice versa. Strengthening internal coordination and knowledge management would improve transparency, support adaptive management, and reduce closure-related risks.

The team includes expertise to address operational social impacts through established procedures. However, there is currently no dedicated framework or procedure specifically addressing social impacts during closure and post-closure phases, representing a key gap relative to international safeguard standards. This gap is particularly significant given stakeholder expectations that closure planning should explicitly address livelihoods, economic diversification, workforce transition and long-term regional development.

Public disclosure of detailed closure and reclamation plans has been limited to date. Nevertheless, EGAT documents reclamation activities and communicates progress through presentations and public information materials aimed at both local and wider audiences. While these efforts contribute to transparency, stakeholders have expressed a desire for earlier, more structured and more inclusive participation in defining post-mining land use scenarios, consistent with evolving safeguard expectations on meaningful stakeholder engagement.

At Mae Moh, temporary or sudden closure is considered unlikely due to the mine's role in supporting electricity generation in northern Thailand. Nevertheless, mining delays remain possible. While a six-month coal stockpile is maintained as an operational contingency measure, international experience demonstrates that unexpected or accelerated closures can occur. As such, formal contingency planning for sudden or accelerated closure should be incorporated into updated closure documentation, consistent with international safeguard practice.

The principle of "do no harm" should serve as the minimum benchmark for closure. From a safeguard-integrated perspective, this implies not only restoring lost environmental value and avoiding negative impacts on surrounding communities, but also actively seeking opportunities to deliver shared benefits. Closure therefore presents an opportunity to add value through employment creation, equitable renewable energy development, biodiversity enhancement and sustainable livelihoods. An integrated scenario combining renewable energy deployment, diversified income generation, carbon management and ecological

restoration is likely to represent the optimal long-term outcome.

To supplement existing expertise and resources, the process of closure planning, reclamation and post-mining land use selection should be strengthened in alignment with the Lampang Just Transition Plan. Such alignment would facilitate a sustainable and equitable transition away from coal toward renewable energy sources, while systematically addressing socio-economic impacts on workers and local communities in line with safeguard principles.

In conclusion, Mae Moh closure must be treated as an integrated environmental, economic and social transition, rather than solely as a land rehabilitation exercise. The analysis highlights the need for coordinated, safeguard-led action across closure planning, renewable energy development, workforce transition, stakeholder governance and financial reform.

To translate these priorities into practical steps, five safeguard-integrated strategic recommendation pillars are proposed, comprising key actions grouped under Integrated Closure & Energy Transition Planning, Stakeholder Engagement & Just Transition Governance, Workforce Transition & Local Economic Diversification, Renewable Energy & Circular Economy Development and Financial & Risk Management Reform.

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Abbreviations and Acronyms

BESS	Battery Energy Storage System
CBPAR	Community-Based Participatory Action Research
CCUS	Carbon Capture, Utilisation and Storage
CEP	Closure Execution Plan
CSR	Corporate Social Responsibility
DMR	Department of Mineral Resources
DPIM	Department of Primary Industries and Mines
EGAT	Electricity Generating Authority of Thailand
EHIA	Environmental and Health Impact Assessment
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
EPPO	Energy Policy & Planning Office, Thailand
ESIA	Environmental and Social Impact Assessment
EV	Electric Vehicle
FGD	Flue Gas Desulfurisation
GPP	Gross Provincial Product
GWh	Gigawatt Hour
H&S	Health and Safety
ICMM	International Council on Mining and Metals
IKI	International Climate Initiative
IPP	Independent Power Producer
IRMA	Initiative for Responsible Mining Assurance

Abbreviations and Acronyms

JET-CR	Just Energy Transition in Coal Regions Interregional Platform
ktoe	Thousand Tonnes of Crude Oil Equivalent
LoM	Life of Mine
LoMP	Life-of-Mine Plan
MONRE	Ministry of Natural Resources and Environment
MW	Megawatt
NDC	Nationally Determined Contribution
NEC	Northern Economic Corridor
ONEP	Office of Natural Resources and Environmental Policy and Planning
PCD	Pollution Control Department
PM	Particulate Matter
PPA	Power Purchase Agreement
PV	Photovoltaic
SIA	Social Impact Assessment
SME	Small and Medium Enterprises
SPP	Small Power Producer
TSP	Total Suspended Particulates
USD	US Dollar
WP	Work Package

1.0 Project background





1.1 Overall project objectives and deliverables

This report is part of a wider study of coal mine closure processes that also includes **Colombia and Mongolia.** By assessing legal, institutional, environmental, technical and social dimensions in each country, the principal objective is to generate tailored, evidence-based recommendations that strengthen structured mine closure planning and post-closure land use and identify gaps and opportunities for actions to improve outcomes.

The work contributes to the objectives of the Innovation Regions for a Just Energy Transition (IKI JET) project and the Just Energy Transition in Coal Regions (JET-CR) Platform by equipping governments, mine operators and affected stakeholders with practical tools and knowledge to support environmentally responsible, socially inclusive and economically viable transitions in coal-dependent regions.

Beyond site- and country-specific findings, the project supports scaling-up and institutional learning at national and regional levels through the following cross-cutting deliverables:

- **Standards-based gap analysis:** A transferable analytical framework was developed by benchmarking national mine closure laws, regulations and practices against widely recognised international standards and guidance. The framework addresses regulatory alignment, institutional capacity, information availability and stakeholder expectations, and can be applied beyond the three case countries by regulators, operators and civil society actors.
- **Participatory and observation-based field methodology:** A rapid, qualitative assessment approach combining desk research, site observation and stakeholder engagement was applied during field missions. This methodology can support mining authorities, environmental regulators and academic institutions as an initial diagnostic tool for operating or legacy mine sites, informing closure planning, reclamation priorities and post-mining land-use options.
- **Stakeholder mapping and engagement insights:** An inclusive stakeholder mapping and consultation approach was used to capture local perspectives, institutional roles and capacity constraints. The findings provide transferable insights for just transition processes across extractive sectors, ensuring that community expectations, social risks and governance realities are integrated into closure and redevelopment planning.
- **Closure roadmap templates:** Site-specific closure roadmaps were developed for Colombia, Mongolia and Thailand, illustrating structured, actionable planning aligned with international good practice. These roadmaps are designed to be adapted to other sites and contexts, supporting improved consistency, credibility and implementation of closure strategies.

1.2 Overall project methodology

The project applied a phased, multi-dimensional methodology addressing legal, institutional, environmental, technical and social aspects of mine closure. The approach combined desk-based analysis, stakeholder mapping, field observation, site visits and structured gap analysis, resulting in practical, context-sensitive recommendations and closure roadmaps.

The study did not start from zero. Across all three countries, relevant laws, policies, data sources, institutional arrangements and community dialogues already exist and are documented in the respective country reports.

These existing resources were systematically reviewed and leveraged to avoid duplication and to focus analytical effort on priority gaps, risks and opportunities.

The project was implemented through four interlinked Work Packages (WPs):

- **WP1 – Preparatory desk research and scoping:** Established the analytical foundation through review of national legal frameworks, policies, technical documentation and institutional arrangements; preliminary site-level document review; stakeholder mapping; capacity assessment of key institutions and actors; and remote spatial analysis using satellite imagery and GIS. In parallel, selected international mine closure standards and guidance were reviewed and synthesised into a consolidated benchmark of good practice.
- **WP2 – Field missions and stakeholder engagement:** Generated site-specific and institutional insights through mine site visits, field observations, in-country review of Physical and non-public documents, and structured interviews and focus groups with government agencies, mine operators, workers, communities and civil society organisations.
- **WP3 – Gap analysis and strategic assessment:** Compared national frameworks and site conditions against the synthesised international benchmark, refining gap analyses based on field findings and stakeholder expectations. Preliminary results were shared with selected national experts and institutions to validate findings and enhance relevance.
- **WP4 – Closure roadmaps and recommendations:** Developed site-specific closure roadmaps and strategic recommendations, identifying priority actions, responsible institutions, enabling conditions and coordination mechanisms. Draft outputs were discussed with key stakeholders to support institutional learning, policy alignment and potential scale-up.

WP1 and WP2 were implemented in an iterative and overlapping manner, allowing field observations to validate and refine desk-based analysis and enabling emerging issues to be incorporated into subsequent analytical stages.

A synthesised benchmark of mine closure requirements was developed drawing on Bettercoal, Initiative for Responsible Mining Assurance (IRMA), International Council on Mining and Metals (ICMM) and World Bank guidance, recognising that no single standard fully addresses all closure-related dimensions. This benchmark was used to assess regulatory alignment, institutional capacity, data availability and stakeholder expectations in each country.

For the purposes of this study, the following simplified terminology is applied:

- **Progressive closure:** phased decommissioning and reclamation during operations.
- **Closure:** cessation of extraction and processing, implementation of reclamation and socio-economic transition measures.
- **Reclamation:** rehabilitation, revegetation and/or ecological restoration of disturbed land.
- **Post-closure:** the period following completion of closure works.

1.3 Country-specific methodology – Thailand

This country study applies a structured, multi-source research design to ensure analytical robustness, transparency and policy relevance. The methodology combines site-based observation, stakeholder consultation, participatory field research and documentary review, supported by independent fieldwork undertaken between 2023 and 2025.

Site assessment

Given the scale and spatial complexity of the Mae Moh mining concession, an initial site assessment was conducted to establish an integrated understanding of the Physical layout, operational status, infrastructure systems and land-use conditions. This included a car-based survey of the mine and associated power generation facilities, complemented by targeted visits to rehabilitated areas and adjacent communities. These observations provided spatial, environmental and socio-economic context for evaluating closure planning and post-mining redevelopment pathways.

Stakeholder engagement

Stakeholder engagement was undertaken through semi-structured interviews and focus group discussions to capture institutional, economic and community perspectives on mine closure, land rehabilitation and future land-use options.

Consultations were conducted with:

- Senior management and technical staff at EGAT headquarters (Bangkok).
- Technical and operational staff at the Mae Moh mine and power plant.
- The principal mining contractor.
- Representatives of the Commemoration Park (reclaimed site) and the Mae Moh Mining Museum.
- Officials from the Provincial Ministry of Mining in Lampang.
- Members of the resettled Tha Patun–Na Kham community and residents from all five subdistricts surrounding the Mae Moh mining complex.

Engagement was extended to central government policymakers, members of the Parliamentary Committee on Energy, provincial leadership, local administrative bodies, community leaders, youth representatives, workers from the mine and power plant, business operators, non-profit organisations and ethnic community groups to ensure cross-level and cross-sector representation.

Fieldwork implementation

Fieldwork was conducted between 1 September 2024 and 15 January 2025 across five subdistricts (tambon) in Mae Moh District, Lampang Province, covering 36 villages. The research applied qualitative methods and Community-Based Participatory Action Research (CBPAR) principles to generate in-depth, place-based insights into socio-economic conditions, community dynamics and transition-related impacts. Direct engagement with residents and local stakeholders formed a central component of the data collection strategy.

The surveyed areas included villages in Mae Moh, Ban Dong, Sop Pad, Na Sak and Chang Nuea subdistricts, ensuring broad territorial representation and diversity of perspectives. This extensive coverage strengthened the empirical foundation of the study by incorporating community-level evidence on development priorities, perceived impacts of mining operations and expectations regarding post-mining land use and economic transition pathways.

Integration of independent research

The analysis also draws on complementary fieldwork conducted between 2023 and 2025 by a local consultant under GIZ, documented in the Lampang Just Transition and Economic Transformation Master Plan. This work applied a participatory, mixed-methods framework, including stakeholder mapping, prioritisation exercises and scenario-building tools to assess transition pathways and economic diversification strategies.

Regional economic transition context

The study further considers regional initiatives under the Economic Development Model for Sustainable Lampang. Participation in consultations on the proposed governance framework for a provincial economic development entity provided additional insight into institutional coordination mechanisms and implementation approaches. Inputs from a public consultation held at the Lampang Chamber of Commerce were incorporated into the broader assessment.

Data validation and research integrity

To preserve confidentiality, stakeholder views are presented in aggregated form and are not attributed to specific individuals. Findings were triangulated across interviews, focus groups, field observation and documentary sources to enhance analytical reliability.

Information provided by EGAT was cross-referenced with publicly available research, academic studies and non-public materials shared by project partners. All sources reviewed are listed in the **References and Bibliography** section.

2.0 Mining and mine closure framework in Thailand





2.1 National legal and regulatory frameworks

All mining activities in Thailand are governed by the Minerals Act B.E. 2560 (2017). With respect to end-of-mine-life obligations, the Act requires mining operators to prepare a reclamation and rehabilitation plan at the time of applying for a mining licence. The legislation does not explicitly require a comprehensive mine closure plan as understood in international good practice, nor does it regulate post-closure management in an integrated manner. Instead, regulatory emphasis is placed on environmental impacts, Physical reclamation and site rehabilitation.

The Minerals Act classifies mining operations into three categories (Category 1, Category 2 and Category 3) based on the size of the mining area, mining method and operational complexity, with regulatory requirements increasing progressively from Category 1 to Category 3 (Table 1).

Table 1. Classification of Mining Operations under the Minerals Act B.E. 2560 (2017)

Category	General characteristics	Typical regulatory requirements
Category 1	Small-scale mining operations with limited land disturbance and relatively low environmental and social risk	Simplified permitting; basic reclamation obligations
Category 2	Medium-scale mining operations with moderate land disturbance and environmental impacts	Standard mining licence; reclamation plan; environmental controls
Category 3	Large-scale, complex mining operations with significant land disturbance, waste generation and potential environmental and social impacts	Full mining licence; detailed reclamation plan; EIA/EHIA; financial assurance; enhanced regulatory oversight

Mae Moh lignite mine is classified as a Category 3 mining operation, reflecting its large spatial footprint, long operational life, scale of overburden and waste management, and its close interaction with surrounding communities and regional infrastructure.

2.2 Environmental licensing

The types of activities that require an EIA are defined in the National Environment Protection and Promotion Act BE 2535 (1992) (Chandler MHM, 2017). This is the principal law for managing environmental issues and requires private and public sectors projects to prepare an environmental impact assessment (EIA) or environmental and health impact assessment (EHIA) report for prescribed operations and activities (Chandler Mori Hamada, 2025). The law is administered by the Office of Natural Resources and Environmental Policy and Planning, the Department of Pollution Control and the Department of Environmental Quality Promotion (Chandler Mori Hamada, 2025).

Most mining projects require an EIA report to be submitted with the mining lease application, but there are some exceptions such as sand or silica sand, marl and kaolin mining (these are instead addressed through other preventive and corrective measures prescribed under different regulations) (Chandler Mori Hamada,

2025) to ensure adequate environmental and social protection.

When required, an EIA must be conducted and submitted to the Department of Mineral Resources (DMR) along with the application for a mining lease.

Grounds for revocation of a mining licence are defined in several sections of the Minerals Act. The grounds include issues related to closure, including failure to restore a mining area to its former state during and after mine closure and failure to provide security for the rehabilitation of the mine site and compensation to those affected by the mining activities (Chandler Mori Hamada, 2025).

2.3 Mine closure and reclamation

Mining operations typically result in significant and long-lasting changes to landform, soil structure, hydrology and ecosystems. As a result, mine reclamation and rehabilitation are central regulatory obligations in Thailand's mining framework. However, these obligations are framed primarily in terms of Physical rehabilitation, rather than integrated mine closure planning that includes long-term environmental, social and economic transition considerations.

Under the Minerals Act B.E. 2560 (2017), mining licence applications must include a mine reclamation and rehabilitation plan. This plan defines how disturbed areas will be managed during operations and after mining has ceased and forms the primary regulatory instrument governing mine closure-related activities.

For mined-out areas, licence holders are required to implement one or more of the following measures, irrespective of whether the mining licence has expired:

- Backfilling open pits, shafts or sumps that are no longer in use.
- Reclaiming disturbed areas to approximate original landforms.
- Regrading slopes to ensure long-term safety and stability.
- Rehabilitating disturbed land through revegetation.

Reclamation and rehabilitation must be implemented progressively, in accordance with the approved mining plan. Prior to mine closure, all mining structures and facilities must be removed unless they are located on privately owned land and subject to alternative agreements (Chandler Mori Hamada, 2025).

Rehabilitation activities must also comply with the conditions specified in the approved EIA or EHIA and are subject to review by ONEP. The Minerals Act Act further defines the rights to explore, process or re-use tailings and mineral wastes for value, with such rights generally held by the mining leaseholder or an authorised sub-licensee (Chandler Mori Hamada, 2025).

2.4 Financial assurance

Mining operators are required to provide financial security to guarantee the restoration of mining areas and to remedy impacts on affected persons. For larger and more complex mining operations, this obligation may include insurance or other financial instruments to cover potential liabilities arising from environmental damage or failure to meet rehabilitation commitments (Chandler MHM, 2017).

Financial assurance mechanisms are intended to reduce the risk that rehabilitation obligations fall to the state in the event of operator default. However, the scope, adequacy and long-term sufficiency of these mechanisms vary depending on project scale and regulatory interpretation.

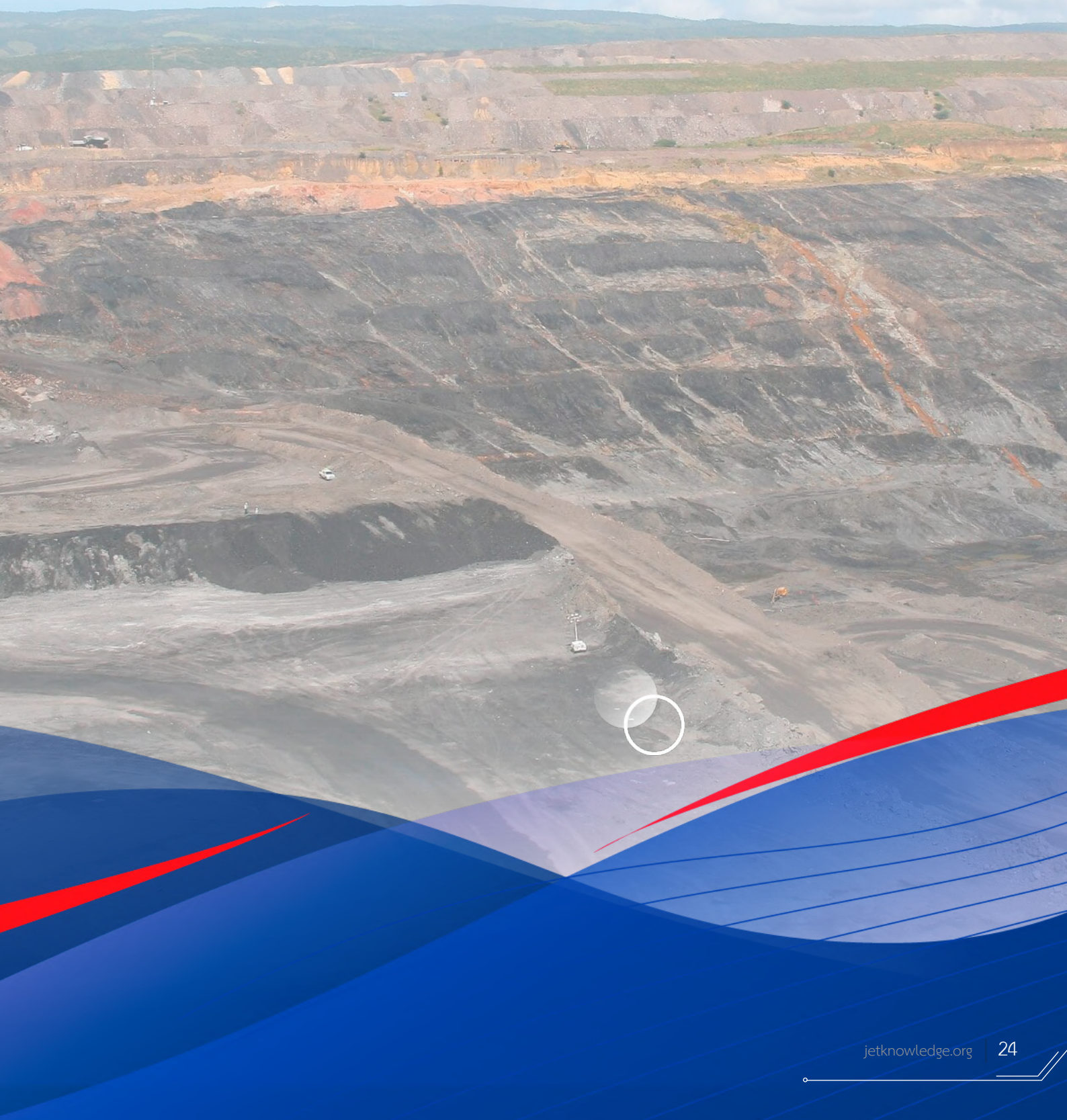
2.5 Responsible authorities

Several governmental entities play roles in the regulation, oversight, enforcement and sanctioning of mine closure and reclamation in Thailand:

- **Department of Primary Industries and Mines (DPIM)** – the principal authority responsible for regulating mining activities under the Minerals Act, including approval of mining licences, reclamation plans, monitoring compliance and recommending licence suspension or revocation.
- **Ministry of Natural Resources and Environment (MONRE)** – oversees national environmental policy and administers environmental legislation relevant to mining, including EIA/EHIA processes through its subordinate agencies.
- **Office of Natural Resources and Environmental Policy and Planning (ONEP)** – responsible for reviewing and approving EIA/EHIA reports and monitoring compliance with approved environmental conditions.
- **Pollution Control Department (PCD)** – monitors environmental quality and enforces pollution-related standards where mining activities result in air, water or soil contamination.

These entities are responsible not only for permitting and monitoring but also for enforcement and sanctioning, including issuing corrective orders, imposing administrative penalties and recommending licence suspension or revocation where legal requirements are not met.

3.0 Comparison of Thailand's mine closure framework with international standards and guidance



3.1 PURPOSE AND ANALYTICAL APPROACH

This chapter assesses Thailand's mine closure legal and institutional framework against internationally recognised mine closure standards and guidance, with the objective of identifying material gaps, implementation risks and opportunities for improvement.

Rather than applying a single international standard, the analysis draws on a set of complementary international references that collectively represent widely recognised good practice in mine closure governance and implementation. These references reflect both company- and government-oriented perspectives and span environmental, social, financial and institutional dimensions of closure.

To enable a structured and transparent comparison, a synthesised mine closure benchmark was developed. This benchmark consolidates overlapping and complementary requirements from the selected international standards and guidance into a single analytical framework, which is then applied to Thailand's national context.

The benchmark is applied through a structured gap analysis that considers:

- Regulatory alignment with international good practice.
- Institutional capacity and feasibility of implementation.
- Availability and adequacy of information and data.
- Stakeholder perspectives and expectations.

This chapter is structured as follows:

- Section 3.2 introduces the synthesised mine closure benchmark and compares this with Thailand's mine closure framework.
- Section 3.3 summarises the key gaps identified in Thailand's mine closure framework and links these findings directly to the Mae Moh case assessment presented in Chapter 4.

3.2 Synthesised mine closure benchmark and comparison with Thailand's mine closure framework

This section sets out the synthesised mine closure benchmark applied in this study and presents a comparative overview of how selected international standards and guidance address the benchmark requirements, together with a high-level indication of alignment with Thailand's current legal and regulatory framework. The section also establishes the analytical basis for the site-specific assessment of the Mae Moh mine presented in Chapter 4.

The synthesised benchmark consolidates overlapping and complementary requirements drawn from four widely recognised international references:

- **Bettercoal Code 2.0 (2021)** – which defines performance expectations for responsible coal mining, including stakeholder engagement, environmental management, and closure planning. The main closure related requirements in the Bettercoal Standard are provided in Principle 4 (Mine Rehabilitation and Closure). Additional requirements are noted in Principle 6 (Labour Rights), Principle 10 (Management of Emissions and Waste) and Principle 12 (Biodiversity and Land Use).

- **IRMA Standard for Responsible Mining (2018; revised version due 2026)** – which includes detailed closure requirements related to financial assurance, community consultation, and legacy management. The main closure-related requirements in the IRMA Standard for Responsible Mining are provided in Chapter 2.6 (Planning and Financing Reclamation and Closure). Additional closure-related requirements are noted in Chapters 3.3 (Community Health and Safety), 3.6 (Artisanal and Small-Scale Mining), 4.1 (Waste and Materials Management), 4.2 (Water Management) and 4.6 (Biodiversity, Ecosystem Services and Protected Areas).
- **ICMM's Integrated Mine Closure Good Practice Guide (3rd Edition, 2025)** – the most current and comprehensive industry guidance for integrated, progressive, and post-closure mine planning. The guide is applicable to new mines, existing mines and legacy (abandoned) sites, and is intended for use by companies of all sizes. While the guidance is for companies, it can be readily adapted to identify reasonable requirements that should be covered by a government's legal framework.
- **The World Bank's Mine Closure: A Toolbox for Governments (2021)** – a government-oriented toolbox for legal, financial, institutional, and technical aspects of closure, emphasising governance and early planning. Governments can use the toolbox of good practice for mine closure (that companies should be implementing) to inform and develop mine closure governance frameworks.

Collectively, these standards and guidance reflect a lifecycle-based approach to mine closure in which:

- **Closure planning is initiated early, prior to mine construction.**
- **Closure and reclamation plans are periodically reviewed and updated during operations.**
- **Environmental, social, economic and governance considerations are addressed in an integrated manner.**
- **Post-closure monitoring, long-term liability management and legacy issues are explicitly considered.**

Based on this review, **32 benchmark requirements** were identified, spanning five thematic areas:

- **Integrated and early closure planning.**
- **Environmental and technical closure measures.**
- **Workforce and community transition considerations.**
- **Financial assurance and long-term liabilities.**
- **Government oversight and institutional capacity.**

The full set of synthesised benchmark requirements, including their thematic grouping and the allocation of responsibility between companies and government, is presented in Table 2. To avoid unnecessary repetition, the individual requirements are not restated in full in the main text.

Table 2 also includes an indicative **Thailand alignment** column, which provides a high-level view of the extent to which Thailand's existing legal and regulatory framework reflects each benchmark requirement. This column is intended to support navigation and interpretation of the detailed gap analysis presented in **Section 3.3**, rather than to serve as a substitute for that analysis.

Importantly, the benchmark and comparative overview also provide the reference framework for the **Mae Moh** case study presented in **Chapter 4**. The Mae Moh assessment applies the same benchmark requirements to site-level practice, enabling a structured comparison between:

- National minimum requirements under Thailand's regulatory framework.
- Operational practices implemented at Mae Moh by the mine operator.

This approach makes it possible to identify instances where **Mae Moh practice exceeds national regulatory minima**, particularly in relation to progressive reclamation, waste facility management and operational monitoring, as well as areas where **gaps remain when assessed against international good practice**, including contingency closure planning, formalised closure execution planning, social transition planning and post-closure governance arrangements. These site-specific findings are discussed in detail in **Chapter 4** and are synthesised into targeted recommendations in **Chapter 5**.

Table 2. Consolidated mine closure benchmark – Thailand and Mae Moh alignment analysis

Req. No.	Thematic area	Synthesised benchmark requirement	Responsible party	Thailand alignment	Thailand alignment – brief analysis	Mae Moh–specific alignment – brief analysis
1	Integrated planning	Company will use a multidisciplinary team to integrate closure planning and the closure vision with life-of-mine planning activities	Company	Partial	Closure-related requirements exist but are fragmented across reclamation, EIA and sectoral regulations. International standards not formally referenced in law. Not explicitly required in regulation.	Integrated planning occurs operationally within EGAT, but not framed as an international-standard closure system. Practices align partially with ICMM concepts, but not explicitly benchmarked. Multidisciplinary teams exist (engineering, environment, social), but integration is informal.
2	Exploration	Company undertaking exploration will complete reclamation in accordance with regulatory requirements and pay for all necessary reclamation activities	Company	Largely aligned	Reclamation obligations clearly defined.	Fully implemented through EGAT operational procedures.
3	Exploration	Company undertaking exploration will complete reclamation within an acceptable timeframe	Company	Partial	Timeframes not consistently defined.	Generally timely, but not governed by formal closure milestones.
4	Exploration	Company will resolve complaints about exploration-related reclamation through discussions with relevant stakeholders and – if necessary – an arbitrator	Company	Limited	No formal grievance requirement.	Grievances handled informally through EGAT and local channels.
5	ESIA	Company undertaking an ESIA for a project will include social impacts that may occur during closure and post-closure phases in the ESIA Terms of Reference and Scope of Work	Company	Partial	Closure-phase social impacts inconsistently addressed.	Social impacts considered, but closure/post-closure treatment remains limited.

Req. No.	Thematic area	Synthesised benchmark requirement	Responsible party	Thailand alignment	Thailand alignment – brief analysis	Mae Moh–specific alignment – brief analysis
6	Health and safety	Scoping of health and safety risks and potential impacts will consider closure, reclamation and post-closure activities	Company	Partial	Closure-phase H&S not explicit.	H&S practices strong during operations; closure-phase risks less formalised.
7	Early planning	Company will draft a closure and reclamation plan before construction of the mine commences	Company	Partial	Reclamation plan required, not full closure plan.	Long-term closure intent exists but not formalised at early stage.
8	Plan updating	Company will have an up-to-date closure and reclamation plan that addresses environmental, social, economic and governance aspects	Company	Limited	ESG dimensions weak.	Environmental aspects updated; social and economic transition less explicit.
9	Contingency planning	Company will prepare and keep up to date a contingency closure plan for temporary or sudden closure that identifies key areas requiring modification	Company	Not aligned	No requirement.	No documented sudden-closure contingency plan.
10	Execution planning	Company will develop and regularly update a Closure Execution Plan (CEP)	Company	Not aligned	CEP not required.	No formal CEP, though operational plans exist.
11	Transparency	The current version of the closure and reclamation plan will be published or made available to stakeholders on request	Company	Limited	Limited disclosure.	Some information shared locally; no public closure plan.

Req. No.	Thematic area	Synthesised benchmark requirement	Responsible party	Thailand alignment	Thailand alignment – brief analysis	Mae Moh–specific alignment – brief analysis
12	Plan content	Based on robust information, the closure and reclamation plan will describe at a minimum: a. Site location, facilities and context. b. Relevant legal requirements. c. Relevant corporate requirements. d. Risks and opportunities relevant to closure, reclamation and post-closure. e. Relevant obligations to stakeholders. f. Implications of temporary and sudden closure scenarios. g. Potential for adverse soil- and water-related impacts during and following closure. h. Proposed mitigation measures to maximise opportunities, reduce risks and prevent or limit adverse impacts. i. Progressive and final closure and rehabilitation activities (including demolition and removal of hazardous materials). j. Final proposed landform and post-mining land use and facility use. k. Schedule for all activities. l. Long-term maintenance and post-closure environmental and socio-economic monitoring plan. m. Inputs from stakeholders (including affected communities). n. Role of the community in long-term monitoring and maintenance (if any).	Company	Partial	Many elements missing or implicit.	Technical elements largely covered; social monitoring and community role limited.

Req. No.	Thematic area	Synthesised benchmark requirement	Responsible party	Thailand alignment	Thailand alignment – brief analysis	Mae Moh–specific alignment – brief analysis
13	Progressive closure	Company will undertake progressive closure when technically and economically feasible	Company	Partial	Practiced but not required.	Progressive reclamation actively implemented at Mae Moh.
14	Open pit	Company will partially or completely backfill open pits when economically viable	Company	Partial	Discretionary.	Pit management planned with alternative land uses rather than full backfilling.
15	Underground	Company will backfill underground mine workings if technically viable	Company	Partial	Limited applicability.	Not applicable (open pit mine).
16	Soil and water	Company will undertake closure and rehabilitation using measures that address soil contamination and water access	Company	Partial	Long-term water obligations unclear.	Strong operational controls; long-term water quality monitoring needs formalisation.
17	Waste stability	Company will ensure waste storage facilities are designed, constructed, operated, maintained and closed to ensure stability	Company	Largely aligned	Strong regulation during operations.	High standard of waste dump management and monitoring.
18	Stakeholder engagement	Company will coordinate with a wide range of stakeholders throughout the project lifecycle to: a. Undertake inclusive engagement. b. Define post-closure land use. c. Develop activities that will reduce the adverse impacts of closure for workers, affected communities and artisanal and small-scale mining (ASM) operations.	Company	Partial	Lifecycle engagement limited.	Active engagement, but closure-specific dialogue still emerging.
19	Plan consultation	Company will give stakeholders the opportunity to comment on closure plans	Company	Limited	Not required.	Consultation occurs, but not specifically on closure plans.
20	Protected areas	Company operating in protected areas will develop closure plans with protected area managers	Company	Partial	Not formalised.	Limited relevance at Mae Moh.

Req. No.	Thematic area	Synthesised benchmark requirement	Responsible party	Thailand alignment	Thailand alignment – brief analysis	Mae Moh–specific alignment – brief analysis
21	Retrenchment	Company will have a retrenchment plan developed in consultation with workers	Company	Limited	Not mandated.	Workforce transition managed internally; no formal retrenchment plan linked to closure.
22	Social transition	Company will implement social transition planning aligned with government plans	Company	Not aligned	No requirement.	Social transition initiatives exist, but not structured as a closure programme.
23	Closure objectives	Company will define closure objectives and measurable and achievable success criteria early in the planning process, considering: a. Legal constraints. b. Stakeholder input. c. Technical and economic feasibility. d. Environmental aspects. e. Socio-economic aspects. f. Post-mining land use and facility use (including site relinquishment). g. Monitoring and evaluation of effectiveness. h. Refinement of success criteria as the plan is updated.	Company	Limited	Not formalised.	Closure objectives exist conceptually but lack measurable criteria.
24	Closure costing	Company will have up-to-date cost estimates for all closure scenarios	Company	Partial	Limited scenario coverage.	Costing exists, but sudden-closure scenarios not explicit.
25	Financial surety	Conservative financial surety instruments will be in place	Company	Partial	Adequacy uncertain.	Financial provision exists through EGAT, but not ring-fenced to closure benchmarks.

Req. No.	Thematic area	Synthesised benchmark requirement	Responsible party	Thailand alignment	Thailand alignment – brief analysis	Mae Moh–specific alignment – brief analysis
26	Surety engagement	Company will engage stakeholders on the adequacy of financial surety	Company	Not aligned	No requirement.	No stakeholder engagement on financial assurance.
27	Surety release	Release of financial surety will consider public comments	Company / Government	Partial	Public input limited.	Not clearly applicable due to EGAT structure.
28	Post-closure monitoring	Post-closure monitoring and maintenance should identify and address issues related to: a. Legal compliance requirements. b. Objectives and success criteria. c. Geotechnical stability and contamination from surface and underground workings and mine waste facilities. d. Impacts on aquatic and terrestrial fauna and flora. e. Pit lake water quality.	Company	Partial	Long-term monitoring unclear.	Monitoring ongoing, but post-closure phase not yet formalised.
29	Regulatory review	Government should have a clear process for reviewing closure plans	Government	Limited	No closure-specific process.	Review occurs through DPIM/ EGAT coordination, not a formal closure review.
30	Institutional capacity	Government should establish a dedicated inter-departmental closure review team	Government	Not aligned	No dedicated unit.	Mae Moh benefits from strong EGAT capacity, compensating for institutional gaps.
31	Financial system capacity	Government should ensure diverse financial assurance instruments	Government	Limited	Limited diversity.	Not directly applicable at site level.
32	Abandoned mines	Government should establish a registry of abandoned sites and funding mechanisms	Government	Limited	No comprehensive registry.	Not applicable (operating mine).

3.3 Summary of gaps in Thailand's mine closure framework

Application of the synthesised mine closure benchmark to Thailand's legal and institutional framework highlights a set of **systemic gaps**, alongside areas where existing provisions **partially align with international good practice**. The analysis confirms that while Thailand has established a comparatively robust framework for managing environmental impacts and Physical reclamation during mine operations, mine closure is not addressed as a **distinct, integrated, lifecycle-based process.**

In Thailand's regulatory framework, closure-related obligations are largely embedded within reclamation, environmental licensing and operational compliance requirements. As a result, closure planning tends to focus on **Physical rehabilitation and environmental controls**, with more limited treatment of post-closure governance, long-term liabilities and socio-economic transition.

To support clarity and avoid repetition, the principal findings of the gap analysis are summarised in **Box 1 (Key Gaps in Thailand's Mine Closure Framework)**. The summary consolidates cross-cutting issues identified across the **32 benchmark requirements.** Detailed, requirement-by-requirement analysis is provided in Annex A **(Table A.1)**.

Importantly, the gaps identified at the national level do not imply uniform outcomes at site level. As demonstrated in the **Mae Moh case study (Chapter 4)**, site-specific practice in some areas exceeds national minimum requirements, while in others it reflects the same structural limitations identified at the framework level. This distinction is critical for interpreting both the gap analysis and the recommendations presented in **Chapter 5**.

Box 1. Key Gaps in Thailand's Mine Closure Framework

Based on the detailed assessment presented in Annex A (Table A.1), the principal gaps in Thailand's mine closure framework are summarised below.

Early and integrated closure planning

Current regulations require submission of reclamation plans as part of the mining licence process but do not require integrated closure planning embedded in life-of-mine decision-making or developed through multidisciplinary inputs. Closure considerations are therefore often addressed later in the mine life, reducing flexibility and increasing implementation risk.

For example, approved reclamation plans are not systematically revisited when mine design parameters, production schedules or workforce profiles change. At Mae Moh, long-term operational planning partially compensates for this gap, but this reflects operator practice rather than regulatory requirement (see Chapter 4).

Scope, transparency and updating of closure planning

There is no explicit requirement to prepare, periodically update or publicly disclose a comprehensive closure plan covering environmental, social, economic and governance dimensions. This limits transparency and constrains adaptive management as site conditions evolve.

While Mae Moh maintains extensive technical and environmental planning documentation, these materials are not consolidated into a single, publicly accessible closure plan aligned with international good practice.

Progressive closure and contingency planning

Progressive rehabilitation and planning for temporary or sudden closure are not explicitly required under current regulations. Although some operators apply progressive reclamation in practice, such measures are not consistently mandated, reviewed or linked to defined closure objectives.

At Mae Moh, progressive reclamation is implemented to a relatively advanced standard compared to national requirements; however, formal contingency closure planning remains absent, consistent with national-level gaps.

Social transition and workforce impacts

The legal framework does not require structured social transition planning or retrenchment strategies linked to mine closure. Socio-economic impacts are typically addressed through general labour legislation or ad hoc measures rather than through closure planning aligned with regional development objectives.

For example, workforce retrenchment is generally managed through statutory severance provisions without advance planning for reskilling, redeployment or alternative employment. Mae Moh benefits from broader regional transition initiatives, but these are not mandated through mine closure regulation.

Financial assurance and long-term liabilities

Financial guarantees are required, but mechanisms are generally based on expected rehabilitation costs and provide limited provision for risk-adjusted estimates, stakeholder engagement or periodic reassessment over the mine lifecycle.

In practice, guarantees are often established at the licensing stage and are not systematically updated to reflect changes in mine scale, cost structures or closure risk profiles. At Mae Moh, strong operator capacity reduces immediate financial risk, but this does not substitute for a closure-specific financial assurance framework aligned with international standards.

Post-closure monitoring and legacy management

Post-closure monitoring requirements are typically time-bound and linked to licence conditions. Institutional arrangements for long-term oversight are limited, and there is no national registry of abandoned mines or dedicated funding mechanism for legacy site remediation.

These gaps are particularly relevant in the context of future mine closures beyond Mae Moh and are only partially mitigated by operator-led monitoring practices.

Institutional coordination and capacity

Responsibilities for mine closure oversight are distributed across multiple agencies without a dedicated inter-agency review mechanism or specialised closure unit. This fragmentation increases the risk of inconsistent interpretation, gaps in enforcement and limited institutional learning.

At Mae Moh, strong internal capacity within the state-owned operator partially offsets these institutional constraints, but this is not representative of the broader mining sector.

In summary, the gap analysis identifies limitations in **early and integrated closure planning**, the **scope and updating of closure documentation**, the treatment of **progressive and contingency closure**, **social transition and workforce planning**, the **adequacy and transparency of financial assurance mechanisms**, **long-term post-closure monitoring and legacy management**, and **institutional coordination and capacity**.

Collectively, these gaps indicate that while Thailand has developed a solid framework for managing the environmental impacts of mining during operations, its approach to mine closure remains narrower in scope and less integrated than that reflected in international good practice.

The findings presented in this section provide the analytical foundation for the Mae Moh case assessment in Chapter 4, where national-level gaps are contrasted with site-level practice, and directly inform the policy and site-specific recommendations in Chapter 5. A detailed, requirement-by-requirement assessment supporting these conclusions is provided in **Annex A (Table A.1: Gap analysis relative to synthesised benchmark requirements – Thailand's laws and regulations.)**

4.0 Closure and reclamation of Mae Moh mine





4.1 Introduction

This chapter examines the closure and reclamation context of the Mae Moh lignite mine and its associated power plants, within the broader national energy system and regional socio-economic setting. The objective is to provide a robust factual and analytical basis for assessing closure challenges, risks, and transition opportunities at Thailand's only remaining coal mine.

The chapter begins with an overview of energy production in Thailand and the evolving role of coal and lignite in the national power mix. It then introduces the Mae Moh mine and power plant complex, including its location, operational history, scale, and socio-economic significance. Subsequent sections describe the Physical setting, mining operations, environmental and social management systems, stakeholder engagement, and existing closure and reclamation arrangements. Together, these elements provide the necessary context for evaluating Mae Moh against international mine closure good practice, as introduced in Chapter 3, and for informing the site-specific assessment and recommendations presented in Chapter 5.

4.2 Energy production in Thailand

Thailand's power sector operates under a single-buyer model in which the Electricity Generating Authority of Thailand (EGAT) is responsible for system planning and transmission, while also owning a significant portion of generation assets. EGAT accounts for roughly one-third of total installed capacity, a share that has remained broadly stable in recent years. The remainder of capacity is supplied by Independent Power Producers (IPPs), Small Power Producers (SPPs) and contracted electricity imports under long-term power purchase primarily at the Mae Moh complex (EGAT, 2025).

In 2024, total electricity generation reached 235,500 GWh, representing an increase of 5.5% compared to the previous year. Natural gas remained the dominant fuel, accounting for 58% of total generation (136,373 GWh), up 5.4%. Generation from imported coal and lignite increased by 9.3%, while electricity imports and exchanges rose by 9.7%. Renewable energy generation grew marginally by 0.1%, whereas hydropower and oil-fired generation declined by 2.6% and 68.9%, respectively. Electricity consumption totalled 214,469 GWh, up 5.2%, driven by economic expansion and elevated temperatures. The business and household sectors recorded strong growth, while industrial demand increased moderately overall (EPPO, 2025).

Coal and lignite consumption trends reflect evolving dynamics within the generation mix. In 2024, total coal and lignite consumption amounted to 14,672 thousand tonnes of crude oil equivalent (ktoe), an increase of 1.5% year-on-year. Imported coal consumption reached 11,517 ktoe, rising by 2.2%, largely due to a 37.1% increase in coal use by IPP power plants. This was partly offset by a 38.2% decline in coal consumption by SPP plants and a marginal reduction (-0.4%) in industrial coal use (EPPO, 2025).

Lignite consumption totalled 3,155 ktoe in 2024, a decrease of 0.8%, with all lignite used exclusively for electricity generation by EGAT. This confirms the continued concentration of domestic lignite use within the power sector, primarily at the Mae Moh complex. (EGAT, 2025).

Mae Moh's coal-fired capacity is expected to decline significantly. As of January 2026, installed capacity at Mae Moh is projected to fall to approximately 1,200 MW, representing around a 50% reduction from earlier levels. Current long-term planning foresees the complete phase-out of coal-fired generation by 2051 (EGAT, 2026).

Looking ahead, the decline in domestic lignite production and coal-fired capacity reflects broader structural adjustments in Thailand's energy system. Expansion of renewable energy, grid modernisation and energy efficiency improvements are expected to progressively reduce reliance on coal. Closure of the Mae Moh mine is widely regarded as inevitable, driven by declining reserves and the structural shift towards cleaner energy sources. Both national and local stakeholders increasingly articulate a future economic model and power sector without coal, supported by expanded renewable capacity, improved energy efficiency, promotion of electric vehicles and restructuring of the energy industry under the4DIE framework (digitalisation, decarbonisation, decentralisation, deregulation and electrification).

As a state-owned enterprise, EGAT's mandate prioritises energy security and system reliability rather than profit maximisation. Nevertheless, it must identify technically feasible, economically viable, environmentally sustainable and socially acceptable pathways to replace coal with renewable and low-carbon alternatives while maintaining affordability and system stability.

4.3 Overview of Mae Moh mine and power plants

Mae Moh mine is a large open pit lignite mine situated in Mae Moh District, Lampang Province, Northern Thailand (Figure 1), approximately 630 km north of Bangkok. Mae Moh District comprises five sub-districts (Ban Dong, Mae Moh, Sob Pad, Na Sak and Chang Nuea) with 45 villages and a population of 39,119 (EGAT, 2025b). Most people are farmers, with an income of less than USD1,473 per year. In Lampang Province, agriculture contributes approximately the same to the provincial economy as mining. Diversified sectors contribute to economic stability against economic shocks, as the province is not reliant on just one or two primary sectors.

The initial exploration of Mae Moh resources started in 1917. King Rama VII gave a royal command to conserve the lignite resource of Mae Moh mine for official use in 1927. Then, in 1954, the Lignite Electricity Authority was founded for coal mine operation in Mae Moh District. In addition to use coal as fuel in electricity generation, lignite was sold to tobacco curing houses, the State Railway of Thailand, and cement factories. Later, the Lignite Electricity Authority was changed to the Lignite Authority. After that, under the enactment of EGAT Act BE 2511 (1968), the Lignite Authority, the Yanhee Electricity Authority, and the Northeastern Electricity Authority were merged under the state-owned Electricity Generating Authority of Thailand (EGAT) in 1969, which is fully funded by the Royal Thailand Government. Since then, Mae Moh mine and power plants have been operated by EGAT, with responsibility split between its headquarters in Bangkok and the mine site (see Figure 21, Section 4.8 for the overall organisation chart for EGAT).

Currently, Mae Moh mine is the only operating coal mine left in Thailand, with a coal reserve of approximately 198.8 million tonnes by the end of 2021 (Klaikaew and Hartmann, 2024). According to EGAT data, coal from Mae Moh mine could be produced at the current rate for 13 years, but the government plans to reduce production by half, extending the life-of-mine until around 2051 or until reserves are depleted (Klaikaew and Hartmann, 2024).

The closure of Mae Moh mine in Lampang Province will significantly impact the region's employment, with 47% of the province's workforce employed by EGAT and related companies (amounting to around 9,000 jobs) (Klaikaew and Hartmann, 2024). Around 40,000 residents are expected to be directly or indirectly affected by the closure (Klaikaew and Hartmann, 2024).

The mine is located mainly on government land and supplies lignite for adjacent coal-fired power plants (Figure 2).

The layout of the principal components is provided in Figure 3, with an aerial view of the mine and power plant units shown in Figure 4.



Figure 1. Location of Mae Moh mine and power plant

Source: photo from www.egat.co.th; annotations by the authors.



Figure 2. Mae Moh power plants (Units 4-14)

Source: www.egat.co.th.

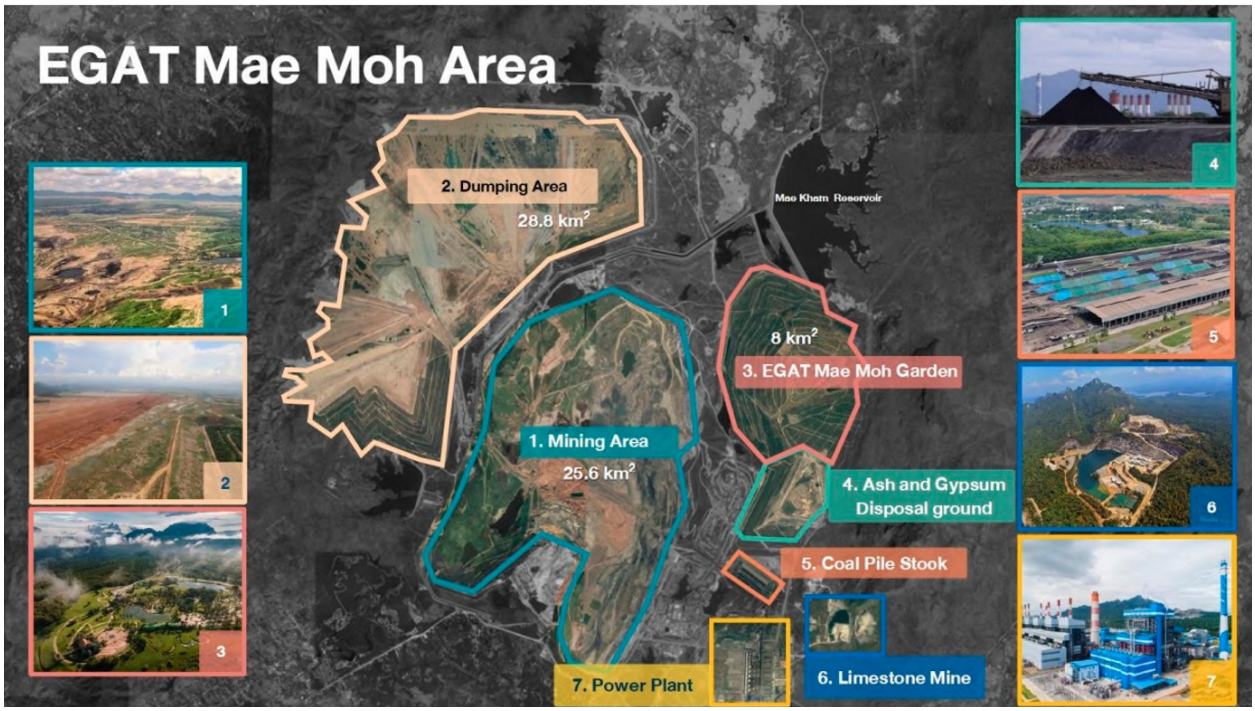


Figure 3. Layout of Mae Moh mine, power plant and limestone quarry areas

Source: EGAT, 2025.



Figure 4. Mae Moh mine with power plant (facing east)

Source: photo from www.egat.co.th; annotations by the authors.

The mine is scheduled to cease mining in 2040. The mine covers a total area of 64.3 km2, consisting of mining area: 25.1 km2 and dumping area: 39.2 km2 (Mine Engineering Department, 2025). Annual production at the mine is in the range 10-16 million tons, depending directly on demand from the power plants. Recently, annual production has dropped to less than 10 million tons due to the depletion of coal and the expiration of some units of power plants.

A coal resource of 100 million tonnes resource is forecast to be remaining by 2040, but it will not be economic to mine due to the depth (500 m). The methane concentration in the coal deposit is low, which is likely to limit the feasibility of coalbed methane extraction from the remaining coal resource at depth (in cases where the methane concentration is high, capture and use of methane will reduce its contribution to climate change, as combustion produces the less potent carbon dioxide and methane use can displace coal consumption (with methane producing lower carbon dioxide emissions per unit of energy than coal).

The Mae Moh power plants are located on the eastern side of the mine and have been developed in several phases to support Thailand's electricity system while progressively upgrading technology and reducing environmental impacts. The first phase comprised Units 1 to 3 (3 × 75 MW), commissioned between 1978 and 1981. This was followed by a second phase, Units 4 to 7, completed between 1984 and 1985, with a combined installed capacity of 600 MW (4 × 150 MW).

A third development phase took place between 1989 and 1991 with the construction of Units 8 to 11, adding 1,200 MW of capacity (4 × 300 MW). Subsequently, Units 12 and 13, each with a capacity of 300 MW, were commissioned in 1995 and 1996. As newer and larger units entered operation, Units 1 to 3 were decommissioned, resulting in a total installed capacity of 2,400 MW across Units 4 to 13. At its peak, Mae Moh became one of the most important power generation facilities in Thailand.

The contract capacity of Mae Moh power plant in operation in 2026 and the contract capacity for the period 2024-2037 are shown in Figure 5.

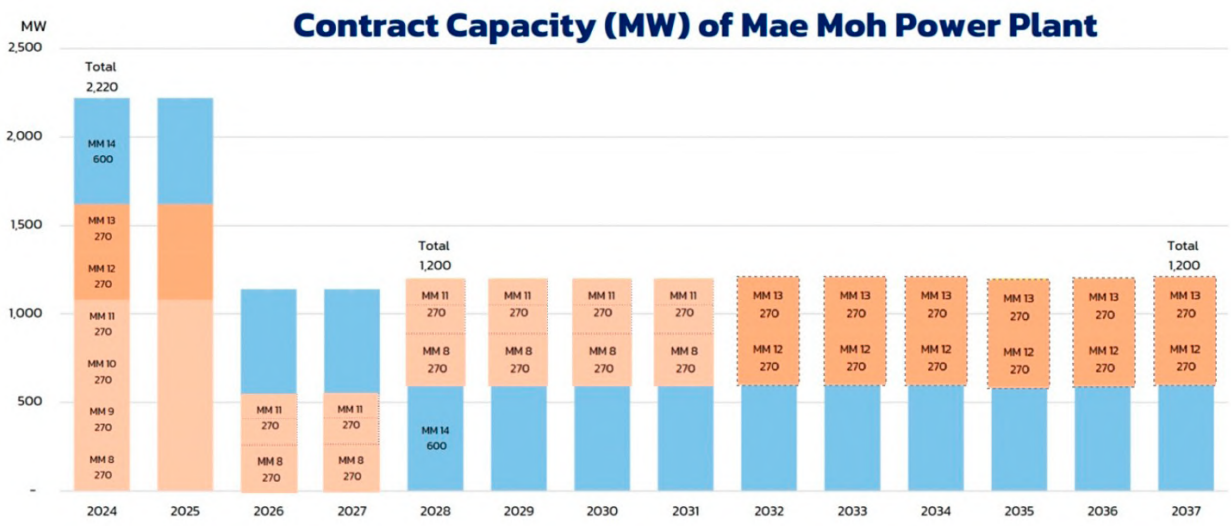


Figure 5. Mae Moh coal-fired power plant in operation in 2026

Source: GIZ analysis of EGAT data.

In recent years, EGAT has sought to modernise the power plant fleet and reduce emissions by retiring older units and replacing them with newer, more efficient capacity. Units 4 to 7 have now been replaced by new power plants, RP1–2 (also referred to as Unit 14), with a combined installed capacity of 600 MW. As of 2026, electricity generation at Mae Moh is provided by Units 8, 11 and 14, with a total installed capacity of approximately 1,200 MW.

Decisions regarding the operational timeline of the remaining units reflect broader national energy policy considerations, including energy security, fuel cost management and the pace of power system transition. While earlier planning under the first revised Thailand Power Development Plan 2018–2037 envisaged the complete decommissioning of Units 8 to 13 by 2026, subsequent policy decisions have extended the operating life of certain units. Units 8 and 11 are now expected to operate until 2031, while Units 12 and 13 are planned to be refurbished and continue operating until 2048, two years prior to the scheduled shutdown of the Mae Moh power plant as a whole. These decisions are linked to Thailand's objective of reducing reliance on imported fuels and maintaining affordable electricity supply during the transition period (Mongabay, 2025).

The Mae Moh power plant operates under a Power Purchase Agreement (PPA) with a term of 25 years, providing a stable contractual framework for electricity supply.

To support emissions control in the operating units, a limestone quarry located to the east of the mine, with an approximate footprint of 1 km², supplies material for flue gas desulphurisation (FGD) systems. This arrangement forms part of EGAT's ongoing efforts to mitigate air quality impacts associated with lignite-based power generation.

4.4 Setting

Topography

The area hosting the mine and power plant is the so-called Mae Moh Basin, which comprises a gently rolling area surrounded by high mountain ranges.

Climate

Mae Moh mine is in a tropical climate with distinct wet and dry seasons influenced by monsoons. Temperatures vary, with April being the hottest (around 41°C) and January the coolest (around 6.8°C). The area also sees varying wind patterns, with the prevailing wind from the south during the northeast monsoon (October-January). The wet season is heavily influenced by monsoons, with heavy rainfall occurring when the cool air mass from the north meets the southwest monsoon or cyclonic storms.

Geology

The mine is part of the Tertiary Mae Moh basin. Coal seams are part of Mae Moh group, which consists of, in descending order, Huai Luang Formation (HL-Fm), Na Khaem Formation (NK-Fm) and Huai King Formation (HK-Fm) as illustrated in Figure 6. HL formation mainly consists of red to brownish red, semi-consolidated and unconsolidated claystone, siltstone and sand. NK formation is composed of lignite layers and grey to greenish grey claystone and mudstone. Five lignite seams, marked as J, K, Q, R and S seam, are found in NK formation. However, in respect to economic point of view, only J, K, and Q seams are mineable seams. The thickness of K and Q seams ranges from 20 to 30 m. The shape of coal zone is synclinal form. Depth of economic coal seams is ranging from a few meters up to several hundred metres in the central area. Overburden is all material above the coal zone. The interburden (IB), material between K and Q seams ranges from 20 to 25 m. HK formation consists of semi-consolidated fine to coarse sandstone, claystone, mudstone and congLoMerate with green, yellow, blue and purple in colour. The underburden (UB) is material below Q seam. Several faults have existed in the mine, particularly at the periphery of the basin.

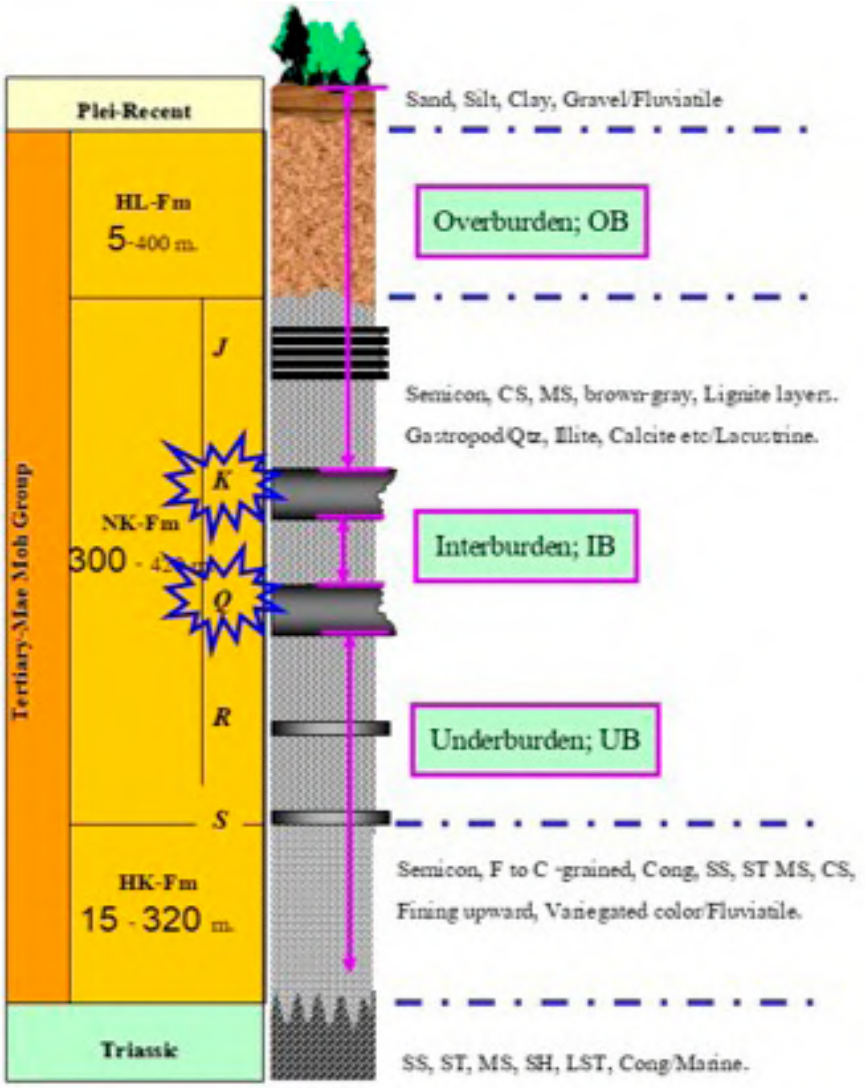


Figure 6. Rock units at Mae Moh mine

Source: EGAT's Coal Utilization, Presentation on 18 January 2013.

4.5 Mining operation

Mae Moh coal mine is an open pit mining operation. The mine started with area preparation, then overburden removal before coal production commenced. The mine is sufficiently large that it has been subdivided into several sub-areas as illustrated in Figure 7 for better management.

An open pit coal mine, also known as an open-cast or open-cut coal mine, is a surface mining method where coal is extracted and transported to crushers for size reduction after overburden (the material above the coal) has been removed to expose the coal seam. This method is commonly used when coal seams are relatively close to the surface, and the overburden is not too thick. However, at Mae Moh mine, overburden is getting deeper (up to 400-500 m) as mining approaches the central area, resulting in several big waste dumps (NE Dump, NW Dump, SW Dump, and CW Dump). Reclamation in the NE Dump area was completed, with land use changed to a recreation area. Mine plans, which are used to guide the development of Mae Moh according to established safety, efficiency, technical and environmental parameters, are shown for 2008, 2016, and

2035 (final pit) are provided in Figure 8, Figure 9 and Figure 10 respectively. These effectively show how the mine should look in these years if the mine plans are implemented as currently designed. Figures 11 to 15 depict changing land use in the Mae Moh mine greater area in years 2000, 2005, 2010, 2015, and 2020, using Google Earth satellite images.

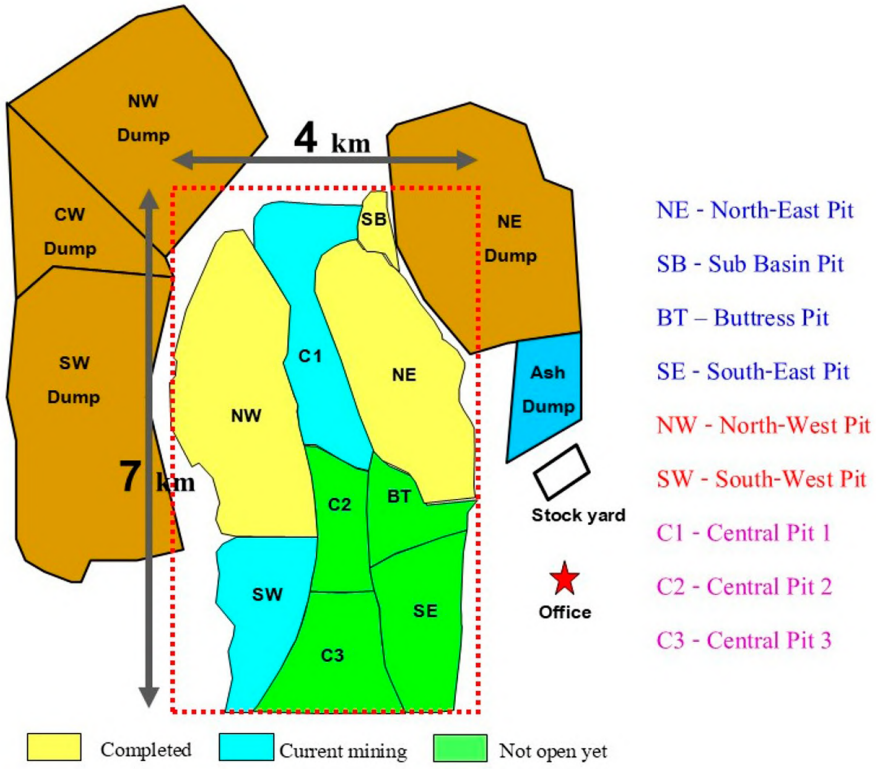


Figure 7. Subdivisions of Mae Moh mine

Source: EGAT's Coal Utilization, Presentation on 18 January 2013.

Sahakol Equipment Public Company Limited is a major mining contractor at the Mae Moh lignite mine, with past and current contracts for overburden removal and coal extraction under an agreement with the Electricity Generating Authority of Thailand (EGAT) (Contract No. 3000001558, ZL.VA). The current contract commenced in January 2016 and is scheduled to conclude in December 2025, with a planned annual coal production of approximately 4.5 million tonnes and a total contract volume of around 31 million tonnes.

Overburden removal activities are conducted with operational flexibility, with a primary focus on efficiency, while coal extraction is carried out strictly in accordance with EGAT's production plans. Although the company's operations are not directly linked to mine closure activities, they do incorporate elements of progressive reclamation as part of ongoing mining practices.

Between 2018 and 2024, annual coal production ranged from approximately 4.7 to 5.6 million tonnes, with cumulative production reaching about 30.9 million tonnes by 2024. Production levels in the later years of the contract indicate a downward trend, reflecting adjustments toward the end of the contract period and a gradual reduction in coal extraction.

Sahakol Equipment currently employs 977 workers, with a strong local employment profile: approximately 88% of employees are residents of Lampang Province, including Mae Moh District, exceeding EGAT's requirement that at least 50% of the workforce be locally sourced. As the contract approaches completion, the company expects a gradual reduction in employment in line with the winding down of mining activities and the broader transition away from coal mining.

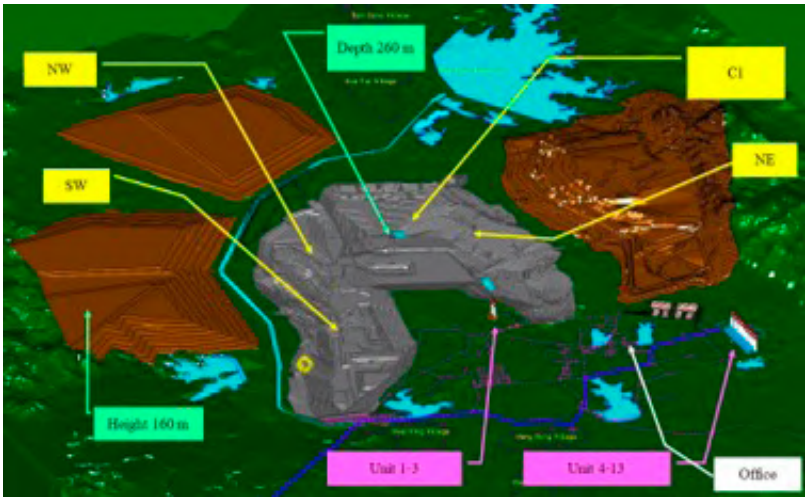


Figure 8. Plan of Mae Moh mine in 2008 (brown – waste dumps, grey – current or completed mining areas)

Source: EGAT's Coal Utilization, Presentation on 18 January 2013.

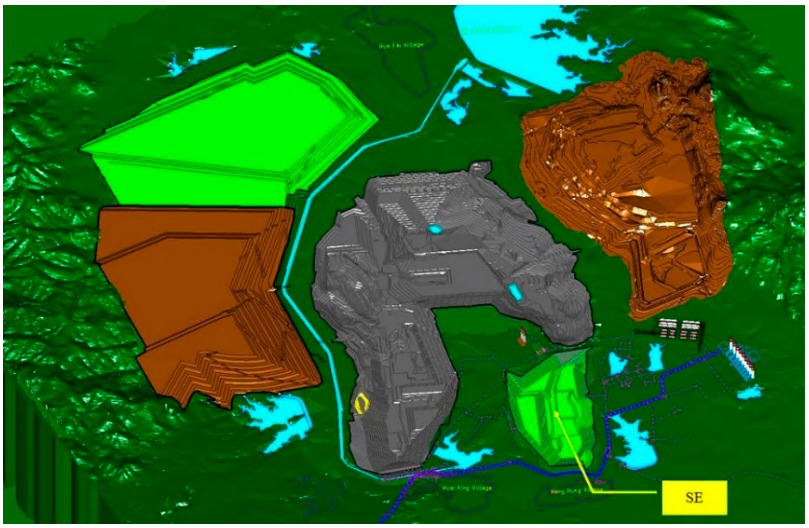


Figure 9. Plan of Mae Moh mine in 2009-2016 (brown – waste dumps, grey – current or completed mining areas, green – area of future mining or dumping)

Source: EGAT's Coal Utilization, Presentation on 18 January 2013.

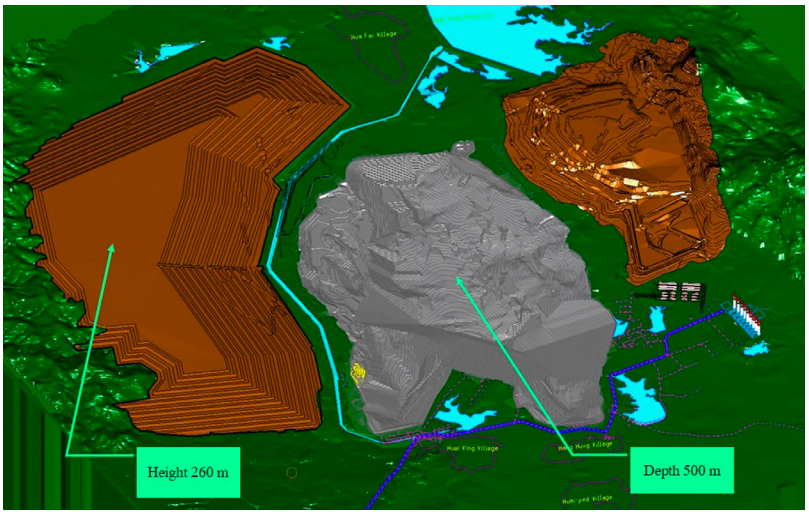


Figure 10. Final forecast plan for Mae Moh mine at the point of closure in 2035 (brown – waste dumps, grey – current or completed mining areas)

Source: EGAT's Coal Utilization, Presentation on 18 January 2013.

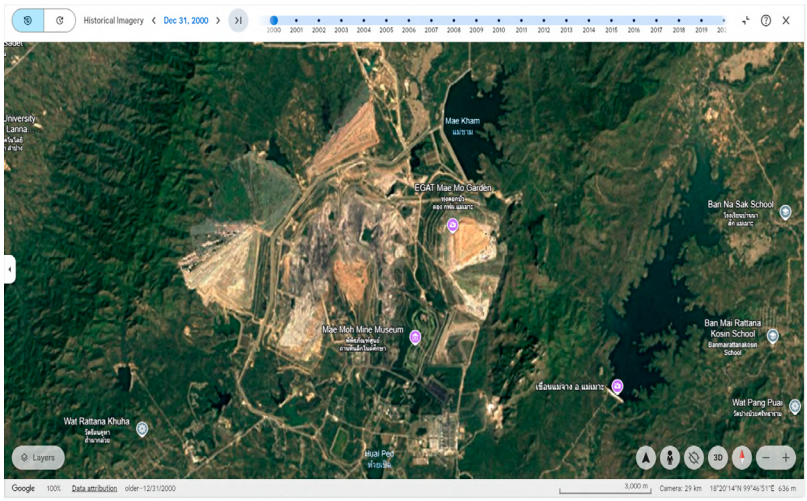


Figure 11. Land change in year 2000 in Mae Moh greater area

Source: Google Maps Mae Moh mine. Google, Year, 2000.

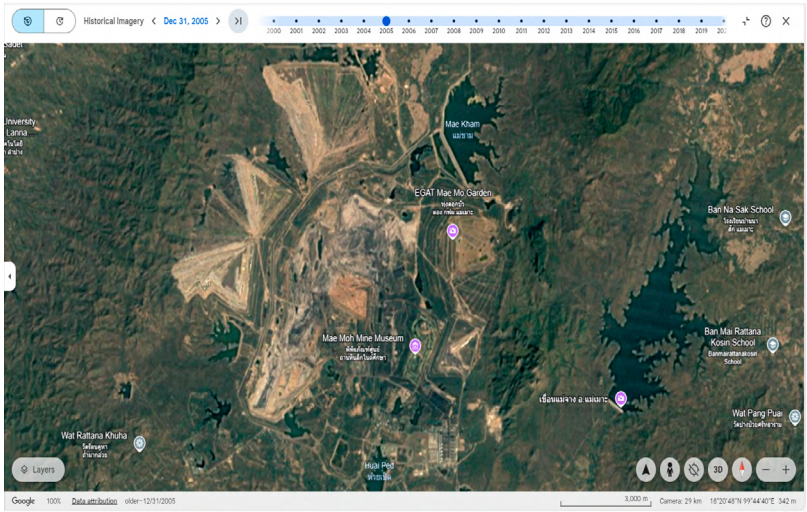


Figure 12. Land change in year 2005 in Mae Moh greater area

Source: Google Maps Mae Moh mine. Google, Year, 2005.

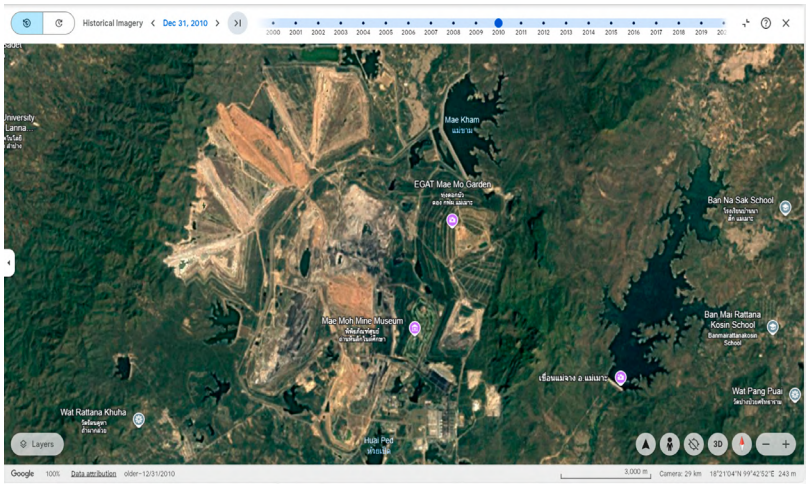


Figure 13. Land change in year 2010 in Mae Moh greater area

Source: Google Maps Mae Moh mine. Google, Year, 2010.

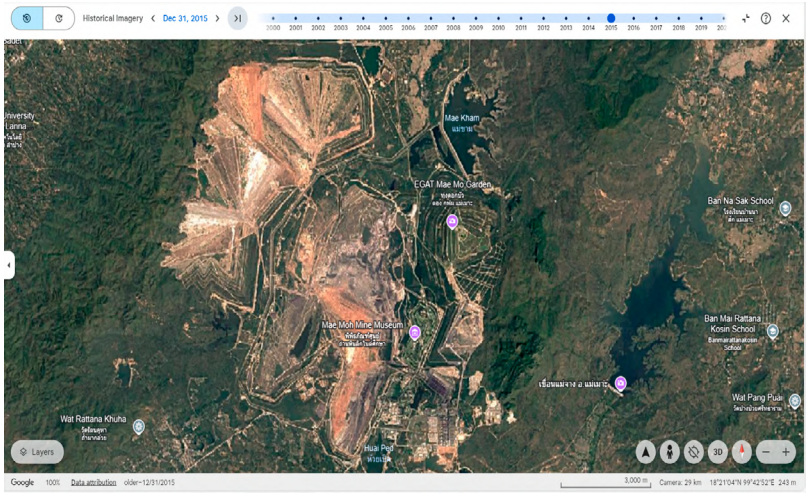


Figure 14. Land change in year 2015 in Mae Moh greater area

Source: Google Maps Mae Moh mine. Google, Year, 2015.



Figure 15. Land change in year 2020 in Mae Moh greater area

Source: Google Maps Mae Moh mine. Google, Year, 2020.

4.6 Environmental and social management

Environmental and social management at Mae Moh is increasingly framed within a closure and post-mining transition context. As Thailand's only remaining lignite mine, the site represents a significant long-term environmental liability, particularly with respect to overburden dump stability, water management, landform rehabilitation and socio-economic transition. Closure planning therefore requires integration of ongoing operational mitigation measures with forward-looking geotechnical risk assessment and economic restructuring strategies.

EGAT reports that it conducts continuous monitoring of environmental and social impacts associated with operations at the Mae Moh mine and power plant complex. Monitoring covers air quality, water quality, noise, vibration, waste management and selected community health indicators. The site operates under ISO 14001-certified environmental management systems—an international standard for Environmental Management Systems (EMS) that establishes requirements for systematic environmental risk management, regulatory compliance and continuous improvement. Environmental Impact Assessments (EIAs) have been undertaken for major project phases to identify, prevent and mitigate potential environmental and social impacts.

According to EGAT, extensive ecological baseline studies were conducted prior to the construction of the lignite-fired power plant, including assessments of air, water, soil and local living conditions. EGAT further indicates that, relative to other projects in its portfolio, the Mae Moh complex has undergone comparatively extensive environmental study and mitigation measures. While historical public concern has focused primarily on emissions from the power plant, recent geotechnical incidents at the mine underscore that landform stability and waste dump management remain critical environmental risks, particularly in the context of long-term closure and post-closure land use.

Environmental management and closure-relevant controls

Water management and hydrogeological controls

- Process water from electricity generation undergoes biological treatment and sedimentation prior to discharge.
- Circulating water systems within the mine reduce wastewater generation.
- Treated effluent is released only after meeting regulatory standards.
- Water quality monitoring is conducted quarterly across dry and wet seasons.

From a closure perspective, these measures are directly relevant to long-term pit lake development, groundwater rebound modelling, acid generation risk and downstream water quality protection. Post-mining water balance assessments and geochemical characterisation of overburden materials will be required to evaluate residual contamination risks.

[1] ISO 14001:2015 – International standard specifying requirements for an Environmental Management System (EMS), published by the International Organization for Standardization (ISO).

Air quality and emissions control

Operational controls include:

- Monitoring of TSP, PM10 and PM2.5 via 16 EGAT stations and 3 Pollution Control Department stations.
- Real-time reporting to authorities and health facilities; operational curtailment if SO2 exceeds legal thresholds.
- Electrostatic precipitators (89.5–99.7% dust capture efficiency).
- Flue Gas Desulphurisation (FGD) systems at Units 8–13 and MM-T1 (approximately 95% SO2 reduction).
- District-wide deployment of 44 air quality sensors providing public alerts and hotspot identification.
- Biomass co-firing using agricultural residues to reduce open burning and PM2.5 emissions.

While these controls mitigate combustion-related emissions, post-closure dust management from waste dumps and regraded landforms will require surface stabilisation, vegetation establishment and long-term erosion control strategies.

Noise, vibration and operational controls

- Source-based noise monitoring ensures compliance with legal thresholds.
- Vibration monitoring is conducted in nearby communities (Ban Hua Fai, Ban Hang Hung, Ban Huay King).

These controls are less significant post-closure but inform baseline conditions for environmental monitoring obligations.

Combustion and fire risk

- Coal stockpiles are limited to approximately two weeks' supply to reduce spontaneous combustion risk.
- Infrared thermography

As coal use declines, decommissioning of stockpile areas will require contamination assessment and thermal stability verification.

Geotechnical risk and waste dump stability

Two major slope failures underscore the geotechnical risk profile of the Mae Moh complex:

- 18 March 2018 – a 1.2 km-long waste dump failure occurred.
- 4 November 2025 – a significant landslip affected approximately 5.7 km2 of overburden dump area following heavy rainfall, causing an estimated USD 4 million in damage (no fatalities reported) (Figure 16). Figure 17 shows the extent of the landslip based on satellite images, with the west-to-east movement stretching over a 1.4 km distance.



Figure 16. Landslip at Mae Moh mine in November 2025

Source: Image released by EGAT.



Figure 17. Landslip at Mae Moh mine in November 2025

Source: Base map – https://eos.org/thelandslideblog/mae-moh-mine-3, annotations by the authors.

These events highlight key closure-related risks:

- Long-term stability of overburden dumps under extreme rainfall scenarios.
- Pore pressure development and drainage capacity.
- Shear strength variability in weathered lignite overburden.
- Progressive failure mechanisms in large-scale spoil piles.
- Potential downstream sediment transport impacts.

Closure design must therefore incorporate:

- Revised slope angle optimisation based on factor-of-safety modelling.
- Enhanced drainage and surface water diversion systems.
- Instrumentation (e.g., piezometers and inclinometers) for long-term monitoring.
- Engineered landform design to reduce erosion and mass movement risk.
- Clear land-use zoning that restricts high-risk development in unstable areas.

These geotechnical considerations directly influence the feasibility of post-mining land uses, including solar installations, tourism infrastructure, and recreational development. The implications for closure design and land-use planning are further discussed in Section 5.2.

Socio-economic transition and Smart City integration

Resettlement linked to the development of the Mae Moh mine and power plant resulted in the establishment of Tha Patun–Na Kham village, supported by public infrastructure including water supply, electricity, a filtration plant, primary school, hospital, government centre and local market. While these measures provided Physical infrastructure and basic services, the long-term economic base of the resettled community remains relatively narrow. Fewer than 10% of residents are directly employed by the mine, and the availability of agricultural land is limited. As coal-fired generation declines, these structural characteristics increase socio-economic vulnerability, particularly in the absence of diversified employment opportunities.

In anticipation of a gradual transition away from coal, EGAT has promoted the Mae Moh Smart City framework, which was recognised under Thailand's national Smart City programme in 2021. The initiative is structured around three pillars—Smart Energy, Smart Economy and Smart Environment—and is positioned as a regional diversification strategy intended to support long-term economic restructuring in Mae Moh District. Figure 18 provides an overview of the quick win projects proposed as part of the Smart City programme.



Figure 18. Quick win projects proposed as part of the Mae Moh Smart City programme

Source: Mae Moh Smart City website, EGAT.

Under the Smart Energy pillar, initiatives include the development of a 50 MW solar installation and expansion of rooftop solar systems, as well as the deployment of Energy Management Systems (EMS) across 21 government agencies to improve energy efficiency and demand management. Training programmes in Solar Cell Installation and Maintenance have been implemented in partnership with vocational institutions and GIZ, aimed at developing new technical skills aligned with low-carbon technologies.

The Smart Economy pillar incorporates circular economy and local enterprise initiatives, including biomass co-firing using agricultural residues (over 6,000 tonnes procured during 2022–2023), development of leonardite- and humic-based soil improvement products derived from mining by-products, indoor vertical farming and organic agriculture pilots, and an agrivoltaics project integrated beneath a 38.5 MW solar installation. These initiatives are intended to create alternative income streams and support local enterprise development as coal-related employment declines.

The Smart Environment pillar includes the establishment of a City Data Platform, developed in collaboration with Chiang Mai University, to monitor air quality, greenhouse gas emissions, water resources and waste streams. A district-level greenhouse gas inventory identifies stationary energy as the dominant source of emissions, providing a baseline for transition planning and emissions reduction strategies.

Collectively, these initiatives contribute to mitigating employment and fiscal risks associated with coal phase-down. However, their long-term effectiveness will depend on scale, sustained investment, private sector participation and alignment with national energy and industrial policies.

Closure implications

The closure of the Mae Moh mine will require coordinated action across technical, environmental and socio-economic domains. Key requirements include geotechnical stabilisation of overburden dumps, long-term hydrogeological and water quality management, decommissioning of coal-related infrastructure, and structured economic diversification under the Smart City framework. Workforce transition mechanisms and fiscal substitution strategies will also be necessary to offset declining coal-related revenues.

While operational environmental controls and early-stage transition initiatives are in place, closure will fundamentally shift the site's risk profile. The focus will move from managing operational emissions and production-related impacts to ensuring long-term landform stability, water balance management and sustainable regional economic restructuring.

4.7 Stakeholder engagement

As described in Section 1.3 (Country-Specific Methodology – Thailand), this assessment builds on substantial prior stakeholder engagement undertaken in Mae Moh and Lampang Province. The present study did not replicate earlier consultation processes; rather, it used them as a foundation for more targeted engagement focused specifically on mine closure, land rehabilitation and post-closure land-use options. The analysis presented here draws primarily on structured engagement conducted by GIZ and local partners (Klaikaew et al., 2024; GIZ, 2025), complemented by interviews and site-based consultations undertaken by the authors during the October 2025 field visit.

Earlier engagement processes identified institutional constraints, including limited environmental and public health baseline data and regulatory frameworks that did not require systematic stakeholder participation throughout the full mine life cycle. In response, EGAT has adopted a more proactive and forward-looking engagement approach, initiating consultations earlier in the closure planning process and framing mine closure within a broader regional economic transition strategy.

Stakeholder engagement for the Mae Moh mine closure is structured around economic transition, environmental rehabilitation and community participation. Key stakeholders include EGAT, local communities, government agencies, academic institutions, and international partners (Table 3).

Institutional context and governance challenges

Earlier engagement processes identified structural constraints that limited the effectiveness of stakeholder participation. These included insufficient environmental and public health baseline data, limited regulatory requirements mandating stakeholder engagement throughout the mine life cycle, and fragmented coordination between national and local authorities.

While national energy policy determines the trajectory of coal phase-down, the socio-economic impacts of closure are concentrated locally in Lampang Province. This vertical governance gap creates uncertainty regarding land-use planning, workforce redeployment and fiscal transition mechanisms. Strengthening coordination between central ministries, provincial authorities and the mine operator is therefore essential to manage closure risks coherently.

In response, EGAT has adopted a more proactive engagement strategy, initiating dialogue earlier in the closure planning process and framing mine closure within a broader regional economic transition strategy. Engagement is structured around three interlinked pillars: economic transition, environmental rehabilitation and community participation.

Key stakeholders include EGAT, local communities, government agencies, academic institutions, and international partners (Table 3).

Table 3. Stakeholders with a role in mine closure

Stakeholder category	Name / description	Role in mine closure
Mine operator	EGAT	As the operator, EGAT is the lead entity planning the mine and power plant phase-out by 2050
Central government authorities	Department of Primary Industries and Mines (DPIM)	Regulation of all mining activities to follow the Minerals Act, including mine rehabilitation and reclamation
	Ministry of Natural Resources and Environment (MONRE)	Administers the Minerals Act, including provisions for EIAs and environmental protection
	Pollution Control Department (PCD)	Enforces ambient air quality standards and requires compliance

Stakeholder category	Name / description	Role in mine closure
Local government authorities		Collaborate with EGAT on developing clear transition plans
Local communities and residents	Original communities	Communities are primary stakeholders significantly impacted by the mine's operations and future closure
	Resettled communities	
Academic and international partners	Multilateral organisations (e.g., GIZ) and academic / research institutions	Collaborate with EGAT to provide expertise, local experience, conduct studies, and facilitate knowledge exchange for JET
International partners	Foreign embassies, multilateral organisations (e.g., GIZ, KOICA)	Support for good governance, development programs, policy alignment with international standards, and support for mine closure planning and implementation

Participation gaps and representation challenges

The GIZ Just Transition Assessment highlights uneven representation across stakeholder groups. While institutional actors such as EGAT and provincial government bodies hold significant decision-making authority, local communities, informal workers, subcontracted labour and trade unions have historically exercised more limited influence in formal planning processes.

Participation has broadened in recent years through public hearings, thematic studies and consultation workshops. However, earlier phases of mining expansion and relocation were associated with perceptions of limited transparency and contested narratives regarding consent. These historical tensions continue to influence trust dynamics.

The 2025 community assessment in Ban Dong subdistrict illustrates these challenges. Ban Dong has long hosted spoil disposal areas associated with the Mae Moh mine and was affected by relocation decisions under the Cabinet Resolution of 15 October 2013. Although administrative boundary adjustments later altered royalty allocations, spoil disposal areas remain within Ban Dong territory. Residents report environmental burdens without commensurate fiscal benefits, contributing to perceptions of inequity.

Community consultations reveal widespread awareness that mine closure is inevitable, but also uncertainty regarding timing, compensation mechanisms and post-mining land use. Many former workers were employed as casual or labour-intensive wage labourers rather than permanent employees, increasing vulnerability to abrupt economic adjustment.



Figure 19. Example stakeholder engagement photos from 2023-2025

Source: GIZ.

Labour market implications and economic transition

The decline of coal production poses significant structural risks to Lampang's economy. Provincial labour data indicate a labour force of approximately 363,000 persons, with concentrations in agriculture, services and skilled trades. Structural challenges include ageing demographics, outmigration of skilled workers and limited high-value employment opportunities.

Economic projections presented in provincial consultations suggest that coal decline could result in cumulative Gross Provincial Product losses exceeding THB 12.5 billion if diversification measures are not implemented.

This underscores that closure is not solely an environmental issue but a macroeconomic transition challenge.

In response, stakeholders have explored the establishment of a multi-stakeholder legal entity to coordinate regional economic diversification. Proposed measures include workforce reskilling programmes aligned with green industries, upgrading skills for approximately 2,500 workers, attracting skilled returnees to the province, and developing green industrial or eco-industrial initiatives.

The Mae Moh Smart City initiative operates as a regional platform supporting these objectives through renewable energy development, circular economy pilots and agricultural innovation. However, the scalability and long-term employment absorption capacity of these initiatives remain key uncertainties.



Figure 20. Green Jobs Project

Source Mae Moh Smart City, EGAT.

Trust, transparency and social dialogue

Historical public concern regarding sulfur dioxide emissions from the Mae Moh power plant led to protests and compensation claims, shaping perceptions of environmental governance. Although recent monitoring suggests improved air quality management, residual distrust persists among segments of the community.

Stakeholder consultations emphasise the importance of:

- Transparent financial management of transition funds.
- Clear governance rules for post-mining land allocation.
- Independent oversight and monitoring mechanisms.
- Continuous communication rather than one-off consultation events.

Gender-differentiated perspectives have also emerged, with women often prioritising ecological restoration and long-term health considerations. These findings reinforce the need for inclusive participation mechanisms in closure planning.

The analysis indicates that mine closure at Mae Moh must be managed as a coordinated socio-economic transformation process rather than solely a technical rehabilitation exercise. Effective closure governance will require:

- Strengthened multi-level institutional coordination.
- Formalised social dialogue mechanisms.
- Targeted labour reskilling and employment transition policies.
- Transparent benefit-sharing arrangements.
- Integration of community priorities into post-mining land-use planning.

The technical dimensions of closure—geotechnical stabilisation, water management and infrastructure decommissioning—must therefore be integrated with social protection and regional economic diversification strategies. Without such integration, closure risks exacerbating local economic vulnerability even if environmental rehabilitation objectives are achieved.

4.8 Closure planning

In Thailand, as described in Section 2, the closure of coal mines presents a complex intersection of socio-economic, environmental, institutional and legal challenges that government departments and agencies and other key stakeholders must understand, navigate and act on. This in itself is not necessarily unusual – many countries with established mining industries face the same or similar challenges.

Responsible departments

Several units from both EGAT headquarters and Mae Moh Mine are involved in mining operations, including closure and reclamation aspects. The overall organisation chart is provided in Figure 21 and the organisational structure for mine reclamation and post-mining in Figure 22.

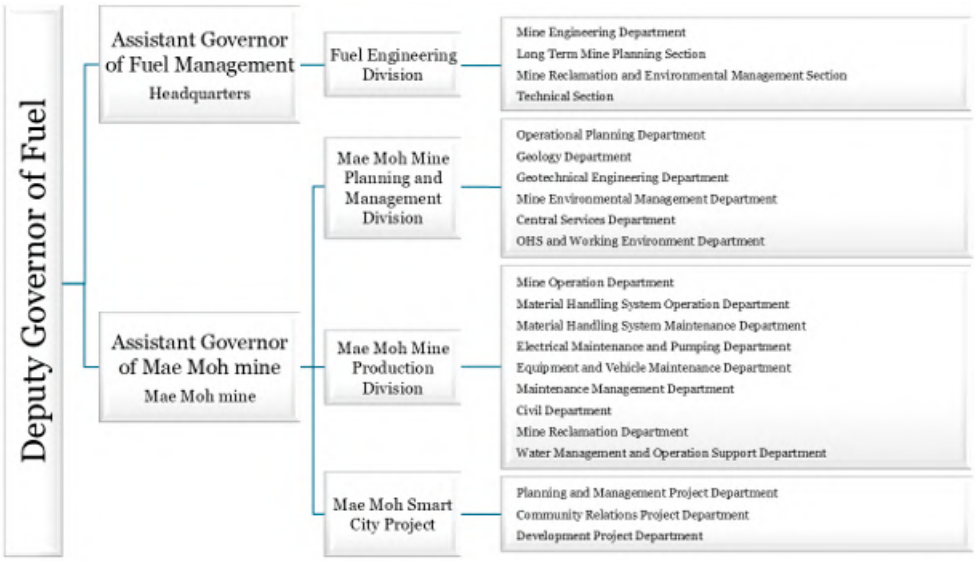


Figure 21. Mae Moh mine operational units

Source: Adapted by authors from Mine Engineering Department, 2025.

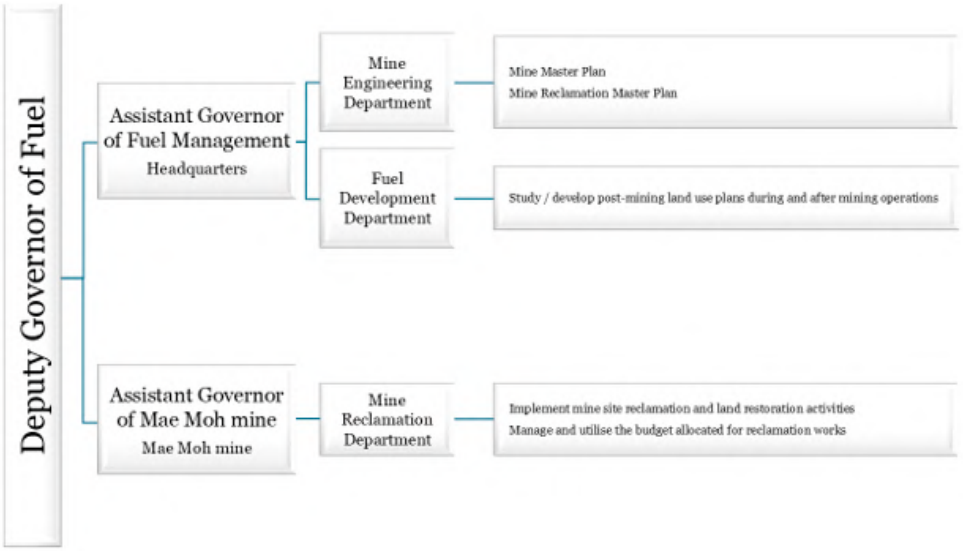


Figure 22. Organisational structure for mine reclamation and post-mining at Mae Moh

Source: Adapted by authors from EGAT, 2025a.

Organisational structure for mine closure and reclamation at Mae Moh mine

Mine closure and reclamation at Mae Moh Mine are implemented through a multi-layered organisational structure involving operational departments, planning units, environmental management functions, and financial oversight mechanisms. Responsibilities are distributed across technical, environmental, and governance units to ensure that reclamation activities are integrated into life-of-mine planning while also meeting financial and regulatory requirements.

The primary departments and their respective responsibilities are summarised in Table 4.

Table 4. Organisational responsibilities for mine closure and reclamation at Mae Moh mine

Unit / department	Core responsibility	Key functions
Mine Reclamation Department	Implementation of reclamation and land restoration	• Execute mine site reclamation and land restoration activities • Manage and utilise allocated reclamation budget
Mine Engineering Department	Mine Master Plan and Mine Reclamation Master Plan	• Overall responsibility for long-term mine planning and technical coordination
Sections within the Mine Engineering Department		
Long-Term Mine Planning Section	Strategic mine planning and design	• Develop and review mine advancement plans and layouts • Design final pit layout • Plan and review water management and drainage systems • Study slope stability and erosion prevention • Support research on mine water management • Coordinate technical data for planning and erosion control • Provide consultation on mine advancement and drainage system design

In addition to departmental responsibilities, governance and financial oversight of reclamation activities are coordinated through a dedicated committee structure. The Mae Moh Mine Reclamation Management Committee was officially appointed by the Deputy Governor of Fuel to ensure that reclamation planning, budgeting, and implementation are conducted effectively and in alignment with institutional objectives. The composition and functions of the Committee are summarised in Table 5.

Table 5. Mae Moh Mine Reclamation Management Committee structure and responsibilities

A. Committee composition

Mine Reclamation Department	Implementation of reclamation and land restoration
Mine Engineering Department	Mine Master Plan and Mine Reclamation Master Plan
Position	**Role in Committee**
Assistant Governor of Mae Moh Mine	Chairperson
Director of Mae Moh Mine Production Division	Vice Chairperson
Director of Design and Construction Management Division	Member
Director of Accounting and Financial Reporting Division	Member
Director of Fuel Engineering Division	Member
Chief of Mine Reclamation Department	Member
Chief of Mae Moh Mine Accounting and Finance Department	Member & Secretary
Head of Mine Reclamation and Environmental Management Section	Member & Assistant Secretary
Head of Mine Reclamation Technical Section	Member & Assistant Secretary

B. Committee roles and responsibilities

Function	**Description**
Strategic Planning	Define conceptual design, plan, and execute reclamation activities within Mae Moh Mine
Financial Estimation	Evaluate total reclamation value and estimate Provision for Mae Moh Mine Reclamation for approval
Budget Oversight	Review items and budgets for reclamation operations
Budget Governance	Approve transfers and budget adjustments in accordance with EGAT regulations
Accounting Oversight	Assign accounting unit to record estimated liabilities and related expenses

This organisational arrangement demonstrates that technical planning, environmental management, financial provisioning, and governance oversight are institutionally embedded within Mae Moh's operational framework.

However, effective closure delivery ultimately depends on coordination between planning units, reclamation implementation teams, and financial governance mechanisms, particularly as closure transitions from progressive rehabilitation to full post-mining land use transformation.

Financial assurance

Thailand's regulatory framework for mining financial assurance has evolved over time. However, the Mae Moh concession predates the introduction of more stringent financial guarantee requirements under the revised Minerals Act. As a result, the financial provisioning structure for Mae Moh differs from that applied to more recent mining projects.

Despite not being legally mandated under earlier concession terms, EGAT established a Reclamation Fund in 1982 to allocate budget for mine rehabilitation. In 2002, this mechanism was revised and formalised as a Provision for Mine Reclamation, recognising reclamation costs as a priority obligation associated with mine closure. This demonstrates a proactive institutional approach to environmental liability management, even in advance of regulatory compulsion.

EGAT has established a Provision for Mine Reclamation to ensure sufficient budget for reclamation during and after mining operations. The Reclamation Fund was established by EGAT in 1982 to allocate budget for mine reclamation (Mine Engineering Department, 2025). In 2002, the fund was revised to "Provision for Mine Reclamation", recognising reclamation costs as a priority obligation upon mine closure (Mine Engineering Department, 2025). The provision is based on a royalty of USD0.3 per tonne of lignite, which generates approximately USD6 million per year (Mine Reclamation Department, 2025). The fund is currently USD100 million.

According to the Mine Reclamation Department, this should be a sufficient budget for reclamation during mining operations and after mine closure.

Separate from the Provision for Mine Reclamation, the Power Development Fund is derived from power development and spent to help fund local development (similar to a 'community fund'). According to Klaikaew and Hartmann (2024), the Power Development Fund:

- Supports the development or rehabilitation of areas affected by power plant operations.
- Includes 790 entities covering Thailand's 77 provinces, consisting of 59 large and medium-sized funds and a total of 731 small funds. Of these, Mae Moh Power Development Fund is the largest in Thailand, covering the five sub-districts in Mae Moh District.
- Receives funds of 50,000 baht per megawatt per year during construction or a minimum of 50,000 baht per year. During operation, 1-2 satang per unit of electricity generated is received by the fund, with the per unit charge based on the fuel type (coal is charged at 2 satang).
- Requires community development around power plants to consider: health, education, local economy, environment, utility and energy.
- Faces challenges such as lack of transparency and national rather than local planning. For example, the Mae Moh Power Development Fund has 29 members – 20 from community leaders, 8 appointed by the Lampang Province governor, and 1 from EGAT, resulting in EGAT having limited authority to access the fund.

The Power Development Fund has been generating approximately USD 10 Million per year, reducing to USD 5 Million (as power generation in 2026 will decline) with a huge impact for Lampang.

Mine reclamation

Mine reclamation at Mae Moh has evolved over more than four decades. Initial rehabilitation efforts began in the early 1980s through experimental programmes, including reforestation trials (1982–1988), ground cover plant studies (1983–1984), and agricultural experiments assessing the viability of economic crops in mining-disturbed soils. These early initiatives provided the technical foundation for the development of a formal Reclamation Master Plan in 1988. The plan has since been updated in 1998, 2002 and 2010 to incorporate operational experience, technical refinements and progressive reclamation practices.

The overarching objectives of reclamation are to improve land stability and ensure public safety, prevent environmental degradation—particularly erosion from natural processes—restore land for beneficial post-mining use, conserve local biodiversity, and ensure compliance with legal requirements, EIA conditions and EGAT policies. In practice, reclamation focuses on stabilising both the Physical landform and the biological environment following mining activities.

The reclamation process follows a structured approach. Areas are first transferred from operations and classified either as intermediate rehabilitation sites—temporarily inactive areas stabilised with cover crops to reduce erosion—or as final rehabilitation areas where mining is complete and land preparation for permanent post-mining use begins. A stage-specific reclamation plan is then prepared, costs are estimated, and rehabilitation works are implemented. Progressive reclamation is integrated into mining operations to minimise long-term closure liabilities.

The reclamation master plan and progressive rehabilitation strategy are jointly developed and updated by EGAT personnel at Mae Moh and at headquarters in Bangkok. Over time, several former dumping areas have been transformed into public-use and recreational spaces. Notably, the former NE dump has been redeveloped into Commemoration Park, covering approximately 8.5 km2, featuring forestry areas and seasonal Mexican sunflower fields that host the annual Mae Moh Festival. Additional developments include botanical gardens, a golf course, and a mining museum that provides educational information on coal extraction and utilisation. While the museum employs modern multimedia presentation techniques, coverage of climate change and energy transition issues remains limited

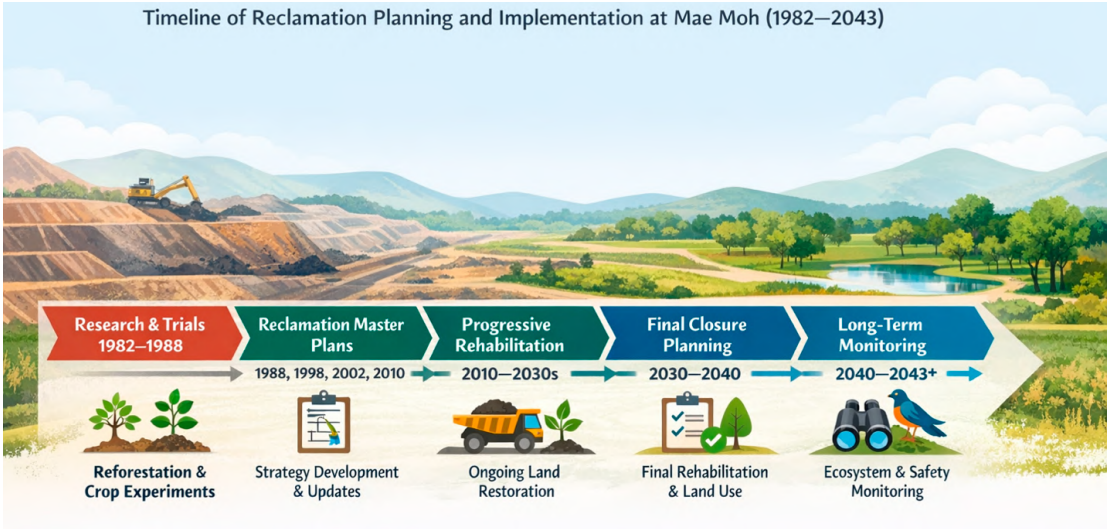


Figure 23. Timeline of reclamation planning and implementation at Mae Moh mine

Source: GIZ analysis from EGAT data.

Figure 23 illustrates the implementation timeline of the current Mine Reclamation Master Plan. Rehabilitation activities are integrated into ongoing mining operations and continue progressively until the planned end of mining in 2040. Following the cessation of operations, a final rehabilitation phase is scheduled for approximately three additional years, after which the rehabilitated area will be formally handed over to the legally responsible authority.

The master plan defines the scope and sequencing of reclamation works throughout this period. Rehabilitation begins with landform stabilisation and soil preparation, followed by phased ecological restoration. Fast-growing plant species are first introduced to stabilise the substrate and reduce erosion risks. These are subsequently complemented by slower-growing native species to support long-term ecological recovery and biodiversity development.

Reclamation activities include plant nursery preparation, land preparation, tree and groundcover planting, maintenance of roads and drainage systems, plantation management, forest fire prevention, and the development and maintenance of recreational areas (Mine Reclamation Department, 2025). As a result of sustained reforestation efforts, 27 plant families comprising 90 species have been established. Wildlife has progressively returned to the area, with 105 species recorded, including birds, small mammals, reptiles and amphibians.

In addition to environmental restoration, reclamation at Mae Moh has generated socio-economic benefits for surrounding communities. As discussed above, rehabilitation activities are integrated into ongoing operations and extend beyond ecological stabilisation to include community participation mechanisms. Local communities are directly involved in reclamation through employment in tree and groundcover planting, tree maintenance, and the management of recreational areas. Indirect economic benefits are also generated through the purchase of planting materials from local suppliers and income opportunities associated with the collection of non-timber forest products in reforested areas. Reclaimed areas further serve as educational resources for learning about mining practices and provide recreational space for local residents and visitors (Mine Reclamation Department, 2025).

Quantitative results indicate substantial progress in land restoration. Between 1982 and 2024, approximately 2.1 million trees were planted across 21 km2, representing 32% of the total area designated for rehabilitation. Over a slightly different reporting period (1982–2022), 50.74 km2 were restored, with more than 2.8 million trees comprising 80 species planted and an average survival rate of 88.88% (EGAT, 2025b). Relative to the proposed end-use allocation—primarily focused on reforestation (see Figure 24 – reforestation (green) will be 93% of land area, recreation (pink) 4% and water storage (blue) 3%)—progress is reported at 34% of the required reforestation area, 49% of the required recreational area, and 3% of the required water storage area (EGAT, 2025b).

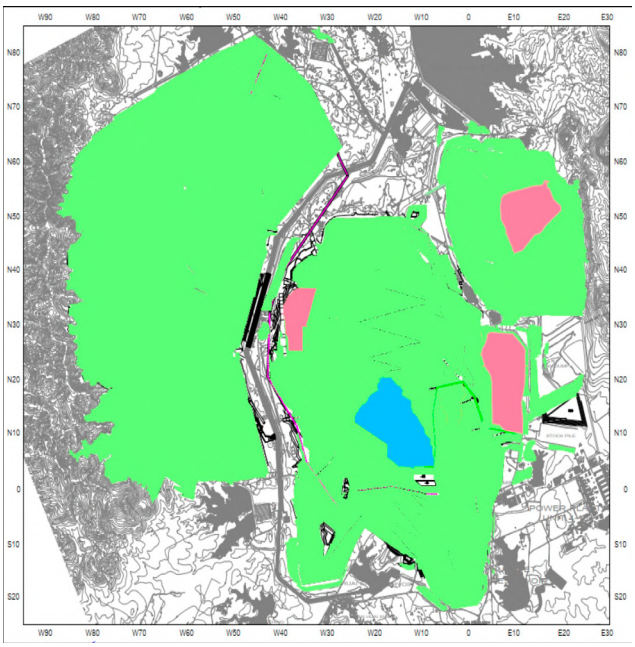


Figure 24. Final land use based on the current Mine Reclamation Master Plan

Source: EGAT

Closure planning and related studies / pilots

EGAT is determined to transition the region away from coal to renewable energy by 2050. To ensure the sustainability of the transition, the closure plan must take a holistic approach, looking beyond simple regulatory compliance to explore options that will deliver long-term sustainability benefits.

The closure plan must comply with extant legal and environmental regulations and is divided broadly into two phases: the mining phase (up to 2040) and the closure phase (2041-2043). A plan for post-mining land management is required to guide the future utilisation of the land and assets, as well as to ensure effective rehabilitation of the mined areas (Mine Engineering Department, 2025).

The transition to mine closure comprises (Mine Engineering Department, 2025):

- Mining phase (present-2040):
  - Implement the reclamation plan.
  - Comply with the EIA mitigation measures.
  - Conduct annual health check-ups for employees.
  - Prepare a hazardous materials list.
  - Renew explosive material licenses.
- Closure phase (2041-2043):
  - Implement the reclamation plan.
  - Apply for the return of mining concession rights.
  - Request the return of forest land use.
  - Comply with the EIA mitigation measures.
  - Conduct the final health check-ups for employees and issue personal health records upon termination.
  - Apply for the cancellation of radioactive material licenses.
  - Dismantle mining equipment and office buildings.

'Business as usual'

By law, EGAT is required to rehabilitate the mine areas affected by mining operations up to the point of mine closure, to enhance land stability, prevent environmental impacts and prepare the land for final use. At present, reforestation (93% or 59.52 km2), recreation area (4% or 2.72 km2) and water storage (3% or 2 km2) is the assumed land utilisation in 2043 (based on targets established in the early stages of mining).

These areas must then be handed over to the relevant land-owning agencies in accordance with legal requirements and environmental impact mitigation measures. However, these targets are no longer relevant in the context of replacement power generation capacity, which will be required when coal production at Mae Moh mine ceases.

The legal requirements related to mine closure and rehabilitation can be categorised into four main groups (Mine Engineering Department, 2025):

- Reclamation:
  - Implement the reclamation plan as specified in the conditions attached to the mining concession/ license for forest land use.
  - Provide financial assurance for reclamation.

- Environmental monitoring:
  - Comply with environmental mitigation and monitoring measures as outlined in the EIA report.
  - Continue environmental impact monitoring for 3 years after mine closure, as required by the EIA report.
- Health and safety:
  - Conduct annual health check-ups for employees and issue personal health records upon termination of employment.
  - Prepare a hazardous materials list.
  - Dispose of hazardous materials in accordance with regulatory guidelines.
  - Apply for the cancellation of radioactive material licenses in case of radioactive waste management.
- Decommissioning:
  - Notify local authorities regarding the demolition of buildings and structures.
  - Remove all structures within the site unless the future land user intends to retain them.

However, there is the opportunity to consider other post-closure land uses. EGAT is in the process of developing and refining a plan to close Mae Moh coal mine. Ahead of closure, EGAT has been conducting studies to identify ways to create new jobs for locals as well as restore the surrounding environment. Several thousand people have depended on the mine and power plant for a long time. The closure plan requires careful consideration to mitigate the impact on locals.

Impact of Mae Moh EGAT production reduction is forecast to be significant, with USD380 million lost per year by 2050 from the total gross provincial product (GPP) from mining and electricity generation industries (falling from a forecast USD2,171 million to USD1,791 million), dropping the province from 41st (in 2021) to 48th position (out of 77) in GPP rankings in Thailand (EGAT, 2025b). If left unmitigated, the decrease in production capacity will lead to unemployment, affecting the economy of Mae Moh District and neighbouring areas, resulting in substantial unemployment and economic decline. This will also make the investment to upgrade infrastructure to support renewable energy more difficult to support.

From Mae Moh Smart City to the Lampang Green Model

The Mae Moh Smart City Concept represents a district-level transition initiative designed to mitigate the socio-economic impacts of coal phase-down through renewable energy deployment, economic diversification, and workforce reskilling. However, as the energy transition extends beyond a single mining site, a broader regional framework has emerged under the **Lampang Green Model.**



Figure 25. The Lampang Green Model

Source: Mae Moh Smart City, EGAT.

The Lampang Green Model expands the Smart City approach from a local pilot to a provincial transformation strategy. While the Smart City framework focuses on community-scale energy systems, green job creation, and digital innovation within Mae Moh District, the Lampang Green Model integrates these elements into a wider economic restructuring agenda. This includes:

- **Large-scale renewable energy development (solar, biomass, hydrogen, CCUS).**
- **Development of logistics and transportation infrastructure.**
- **Establishment of the Mae Moh Green Industrial Park.**
- **Integration with the Northern Economic Corridor (NEC).**
- **Strengthening of community cohesion and green industrial investment.**

In this context, the Smart City functions as an operational platform, while the Lampang Green Model serves as the overarching strategic vision. The proposed Mae Moh Green Industrial Park acts as the Physical anchor for this transition, linking renewable energy resources, industrial diversification, and regional economic development.

Thus, the evolution from **"Smart City"** to **"Lampang Green Model"** reflects a shift from site-level adaptation to province-level structural transformation aligned with Thailand's broader green growth and energy transition objectives.

Renewable energy potential and post-closure options at Mae Moh

Renewable energy development presents a viable pathway for post-closure land use at the Mae Moh mine site. Thailand benefits from strong solar irradiation across much of the country, making solar photovoltaic (PV) deployment one of the most technically and economically attractive renewable energy options. By contrast, national wind potential is generally moderate. Economically exploitable wind resources are concentrated in selected areas of the northeast and south, while most other regions have limited wind intensity (Klaikaew and Hartmann, 2024). The Mae Moh area is likely to fall within this lower wind resource category, reducing the feasibility of large-scale wind development at the site.

EGAT's internal assessments identify significant renewable energy potential at Mae Moh, including solar farms with an estimated capacity of 1,660 MW (see Figure 26), biomass generation potential of approximately 1,800 MW, hydrogen fuel production opportunities, and carbon capture, utilisation and storage (CCUS) options (EGAT, 2025b). Among these, solar PV is currently the most advanced in terms of implementation. EGAT is constructing a 38.5 MW solar farm at Mae Moh, primarily intended to supply electricity for mining operations rather than export to the national grid. In parallel, pilot solar PV installations have been implemented at various facilities as part of broader transition initiatives.

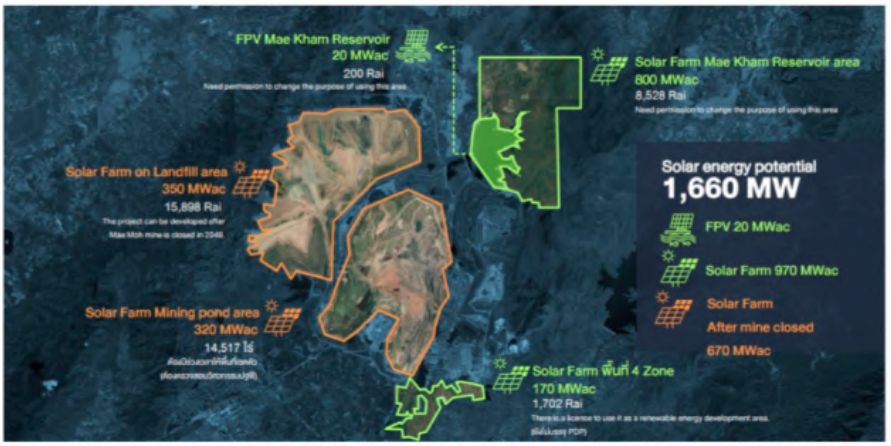


Figure 26. Solar energy potential areas at Mae Moh mine

Source: Mae Moh Smart City.

Economic modelling conducted by EGAT indicates that the installation of 930 MW of solar PV capacity between 2030 and 2035 could generate a net benefit of approximately USD 5,051 million over the period 2023–2050 (EGAT, 2025b). However, this projected benefit would not fully compensate for the estimated economic losses associated with reduced coal production at Mae Moh, forecast at USD 6,906 million over the same period. Investment in social enterprises is expected to contribute an additional USD 340.45 million in economic offset between 2023 and 2050 (EGAT, 2025b), yet a structural economic gap remains.

Recognising the employment implications of this transition, EGAT has initiated training programmes to equip workers with skills relevant to renewable energy technologies. These programmes aim to enhance workforce readiness and create opportunities for local employment as the energy system gradually shifts from coal-based generation toward renewable energy sources.

Post-mining options

Integrated post-mining development framework for Mae Moh

Post-mining development planning for the Mae Moh lignite mine is being shaped through two complementary and mutually reinforcing frameworks: EGAT's Mae Moh Post-Mining Development Plan, which focuses on site-specific land rehabilitation and energy transition pathways, and the Lampang Energy Transition and Economic Transformation Master Plan, which provides a province-wide economic, industrial, and workforce transition strategy. Together, these plans aim to ensure that mine closure supports long-term economic resilience, clean energy development, environmental restoration, and social well-being.

EGAT's Mae Moh Post-Mining Development Plan

EGAT has conducted a systematic study on post-mining development options for Mae Moh mine to formulate a rehabilitation and land use plan. This balanced economic, social and environmental considerations, while also supporting the development of clean energy and transition away from coal. The work was supported by a strategic partnership with DMT-Gesellschaft für Lehre und Bildung mbH (DMT-LB), with a memorandum of understanding (MOU) signed in 2016 and a research phase in 2020-2023, with Chulalongkorn University commissioned to research the development models and guidelines (EGAT, 2025a).

The original pre-feasibility study considered six options. Of these, the study highlighted three potential options for the sustainable development of the Mae Moh area and community post mining (EGAT, 2025a):

- **Concept line 1 – Mae Moh Mine Heritage Geopark (reclamation focus – see Figure 27).**
- **Concept line 2 – Mae Moh Energy Scape Towards Carbon (renewable energy focus – see Figure 28).**
- **Concept line 3 – Mae Moh Green Hydrogen Valley (hydrogen generation focus – see Figure 29).**

Concept Line 2 is the preferred option (and there are cost reductions now compared to even five years ago) and Concept Line 3 is considered unlikely to be feasible for Mae Moh mine. For Concept Line 2, the Power Development Fund is a gatekeeper – the inclusion of renewable energy installation at Mae Moh needs to be agreed before it is possible to move to the next stage.

Mae Moh Post-Mining Development Plan (EGAT, 2025a):

- **Phase 1: 2020-2023 – conceptual framework study and development.**
- **Phase 2: 2024-2025 – comprehensive study and selection of development concepts.**
- **Phase 3: 2026-2028 – design the detailed Concept Line**
- **Phase 4: 2029-post mining – preparation and development.**

It will require significant amounts of funding to transform Mae Moh into a renewable energy hub, with limited access to funding from the Mae Moh Power Development Fund a significant constraint.

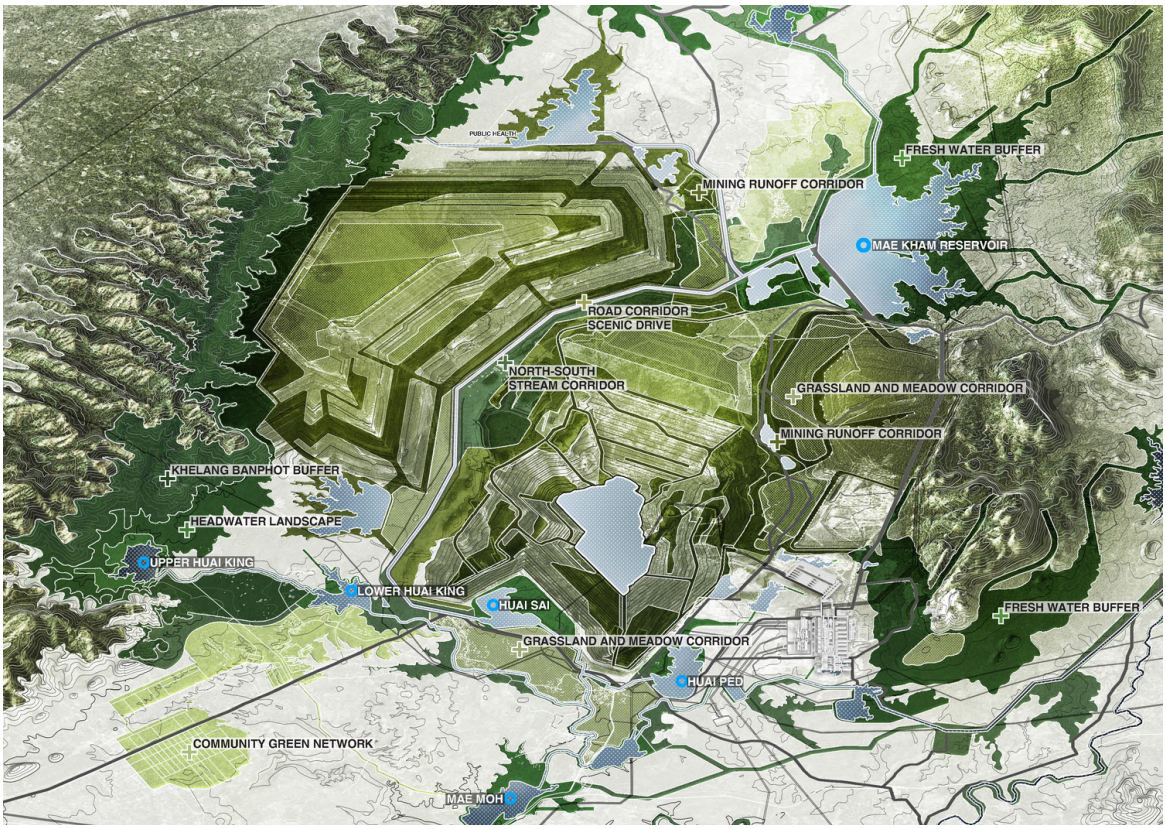


Figure 27. Overview of Concept line 1 – Mae Moh Mine Heritage Geopark

Source: https://tin.land/master-plan:-post-mining-mae-moh.

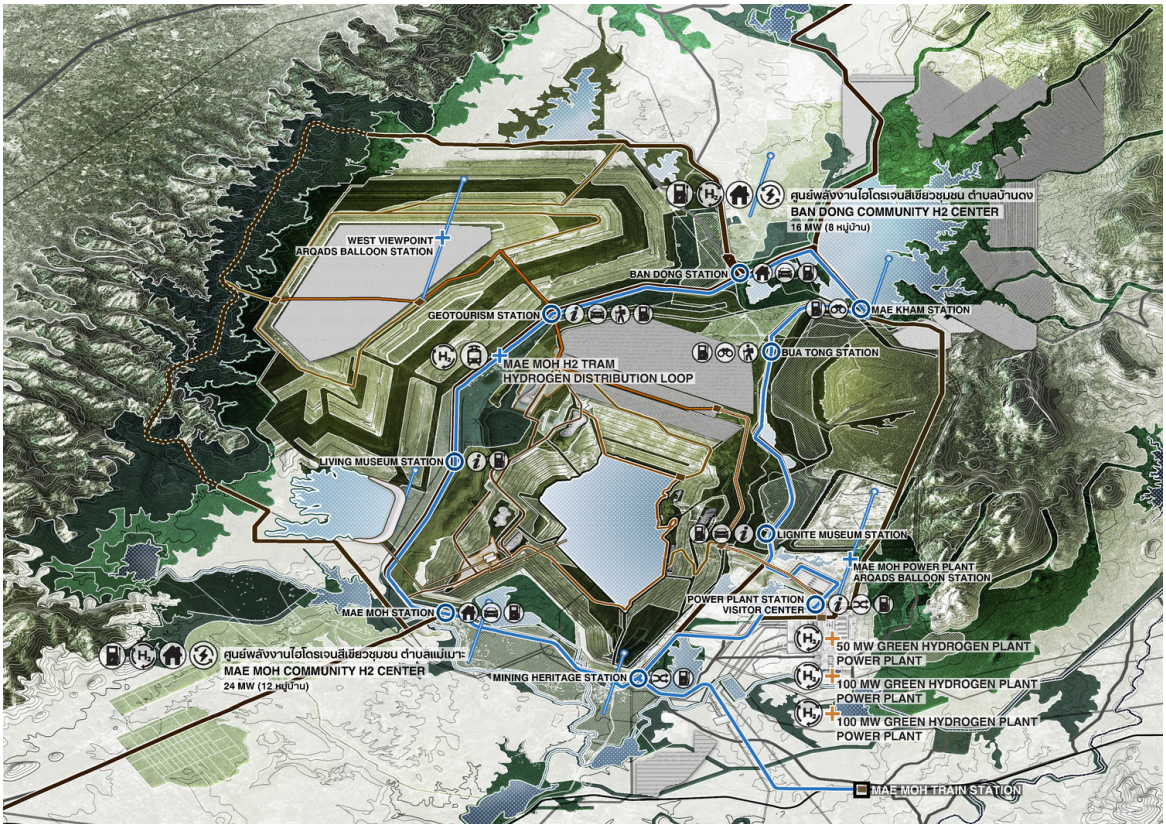


Figure 28. Overview of Concept line 2 – Mae Moh Energy Scape Towards Carbon

Source: https://tin.land/master-plan:-post-mining-mae-moh.

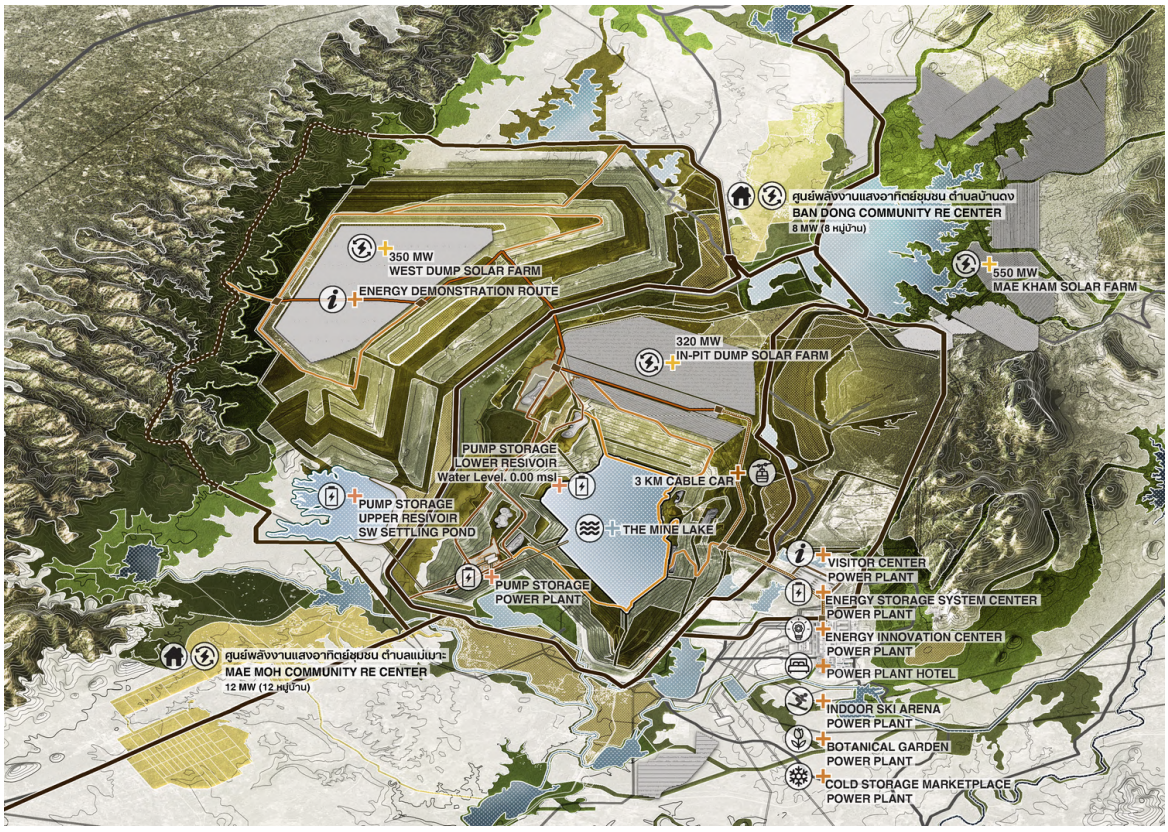


Figure 29. Overview of Concept line 3 – Mae Moh Green Hydrogen Valley

Source: https://tin.land/master-plan:-post-mining-mae-moh.

Lampang Energy Transition and Economic Transformation Roadmap

At the provincial level, **the Lampang Energy Transition and Economic Transformation Master Plan**, supported by GIZ and Chiang Mai University, and developed in partnership with the Lampang Provincial Government, provides a comprehensive socio-economic and industrial transition framework that complements EGAT's site-specific planning for Mae Moh. The roadmap is structured around five strategic directions and is explicitly guided by Just Transition principles, ensuring that the shift away from coal delivers fair, inclusive, and socially sustainable outcomes for workers, communities, and local economies affected by mine and power plant closure.

A Just Transition Assessment is incorporated as a core analytical foundation of the Lampang JET Roadmap. This assessment examines employment impacts, skills transferability, income and livelihood risks, local economic dependencies on coal-related activities, and distributional effects across different social groups.

The findings are used to inform the design, sequencing, and prioritisation of strategies and projects across all pillars of the master plan, ensuring that economic restructuring and decarbonisation are aligned with social protection, decent work creation, and community resilience.

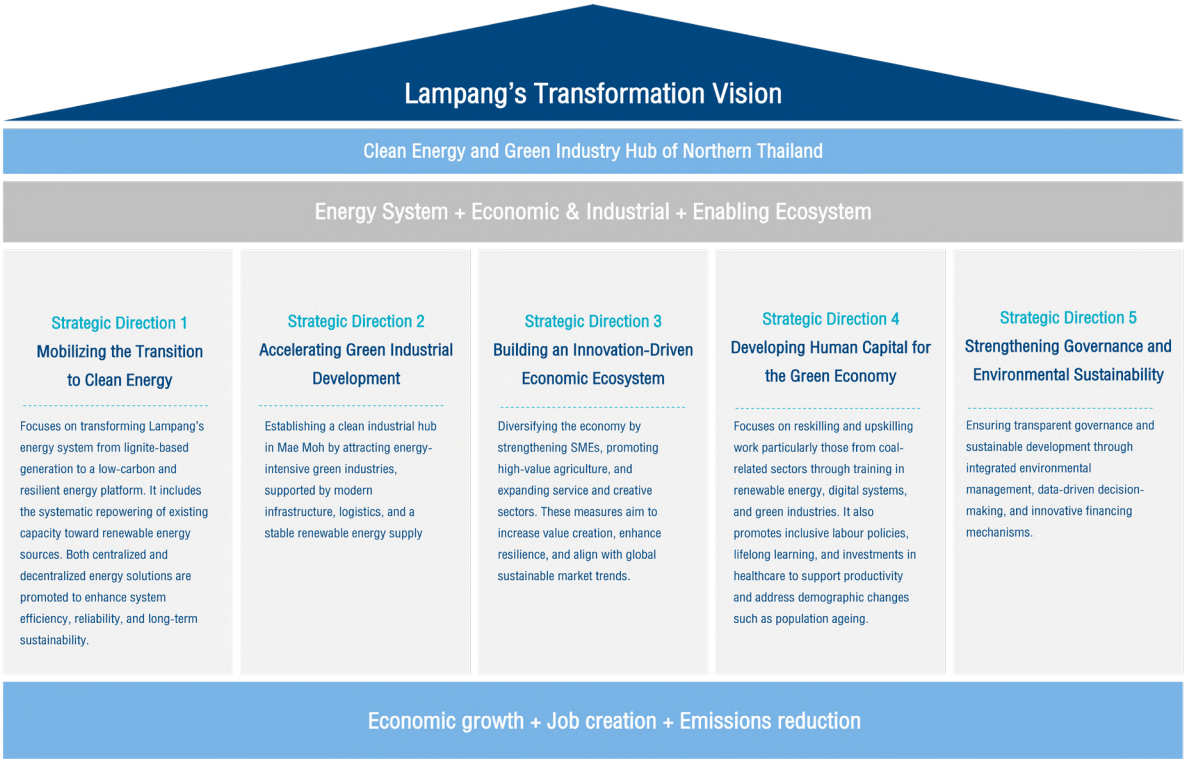


Figure 30. Lampang Energy Transition and Economic Transformation Roadmap

Source Lampang Just Energy Transition Roadmap, 2026

The first strategy, **Mobilising the Just Transition to Clean Energy**, aligns closely with EGAT's preferred post-mining development pathway by proposing large-scale renewable energy projects at Mae Moh. These include utility-scale solar farms (both during and after mine closure), floating solar installations, battery energy storage systems (BESS), pumped-storage hydropower, and biomass co-firing. **Guided by Just Transition principles**, this strategy is designed not only to decarbonise the local energy system, but also to support workforce transition by prioritising local employment, facilitating the redeployment of mine and power plant workers, and creating inclusive economic opportunities for surrounding communities across the renewable energy value chain. These measures aim to ensure that the clean energy transition at Mae Moh delivers both climate benefits and socially equitable outcomes.

The second strategy, **Accelerating Investment in High-Value and Green Industries**, seeks to leverage reclaimed mine land and emerging clean energy infrastructure to attract investment in green industrial promotion zones, digital infrastructure such as data centres, EV-related industries, renewable energy recycling, and waste to energy businesses, and improved rail connectivity linking Mae Moh to regional logistics networks. This strategy prioritises industries with strong job creation potential and skills alignment with the existing workforce, as identified through the Just Transition Assessment.

The third strategy focuses on **building an innovation-driven and entrepreneurial ecosystem** to support economic diversification beyond coal. This includes innovation institutes, SME and startup incubation programmes, and support for high-value service sectors such as tourism, wellness, creative industries, and cultural industries. These activities build on reclaimed landscapes and existing public-use developments at Mae Moh, while providing alternative livelihoods for communities affected by mine closure.

The fourth strategy, **Developing human capital for the green economy**, directly addresses workforce transition risks highlighted by the Just Transition Assessment. It includes targeted green job training programmes, reskilling and upskilling initiatives for former mine and power plant workers, skills certification pathways, and measures to strengthen socio-economic security for workers, families, and vulnerable groups during the transition period.

Finally, the fifth strategy, **enabling governance and environmental-social sustainability, establishes the institutional** and policy conditions necessary for a Just Transition. This includes integrated pollution control and resource management, waste management systems (including EV and renewable energy waste), city-level data platforms for Mae Moh and Lampang, strengthened governance and financial facilitation mechanisms, and ongoing social dialogue with workers, communities, local authorities, and the private sector to monitor and adjust transition outcomes over time.

Overall integration

Taken together, **EGAT's Mae Moh Post-Mining Development Plan** provides the site-specific foundation for land reclamation and clean energy transformation, while the **Lampang Energy Transition and Economic Transformation Roadmap** embeds Mae Moh's transition within a broader regional process of economic restructuring guided by **Just Transition principles**. The integration of a dedicated Just Transition Assessment ensures that mine closure and decarbonisation efforts not only restore land and reduce emissions, but also deliver equitable economic opportunities, protect livelihoods, and support a socially inclusive transition for workers and communities, contributing to Thailand's long-term clean energy and climate objectives.

5.0 Conclusions and recommendations





5.1 Thailand's laws and international standards

Mining operations typically cause some changes to the landscape. Therefore, it is necessary to restore the mining area to a condition similar to its pre-mining condition or to its new condition based on its final use. This requires management and planning to optimise the use of natural resources. The final use plan for the mining area will determine the mine rehabilitation plan.

In Thailand, the coal mine closure process is hindered by a multifaceted interplay of environmental, social, and operational factors. A primary concern relates to the inherent characteristics of the resource. Coal, particularly lignite mined at Mae Moh, is characterised by low energy content and high sulfur levels, resulting in significant environmental pollution when burned. The Mae Moh mine, the largest open pit lignite mine in Thailand, supports a nearby power plant and serves as a prime example. Closure requires not only land reclamation, landscape redesign and rehabilitation of the mine itself, but also the management of long-term pollution risks arising from power plant wastes such as residual fly ash, bottom ash, and synthetic gypsum stored on-site. Mining sites are frequently close to communities, increasing the likelihood of community exposure to dust, noise, and water contamination, thereby intensifying local opposition and complicating closure processes. Despite the introduction of more robust environmental legislation and frameworks in Thailand, many mines have insufficient resources and technical capacity tocarry out closure in accordance with best practices.

Another significant challenge in Thailand pertains to the proximity of mining sites to communities and the limited funding available for mine closure and post-mining rehabilitation. In contrast to sparsely populated countries, Thailand's relatively dense population and dispersed settlements mean that few mining sites are truly remote. This spatial closeness increases the likelihood of community exposure to dust, noise, and water contamination, thereby intensifying local opposition and complicating closure processes. The legacy of historical mining activities, including arsenic contamination in Ron Phibun and lead in Klity Creek, has adversely impacted public trust due to the long-term risks posed by inadequate closure. Despite the introduction of more robust environmental legislation and frameworks in Thailand - including the establishment of the Rehabilitation Fund, Health Surveillance Fund, and Community Infrastructure Improvement Fund - many mines, particularly small-scale operations, still struggle with insufficient resources and technical capacity to carry out proper closure in accordance with best practices. As outlined in the DPIM guideline, comprehensive closure planning and early integration of environmental concerns into mine design are essential, yet these remain inconsistently applied across the sector.

Thailand's mine closure framework is still being developed. While the regulation incorporates some elements of international best practices there are gaps in the framework and in implementation. Consequently, there remains room for further improvement and to bring Thailand's laws into closer alignment with international standards, including:

- Expanding the capacity of central and provincial government authorities to oversee closure planning and enforce implementation, the minimum target for which should be ensuring ensuring closure plans as approved are fully implemented. In addition to training of existing staff on closure and reclamation related topics, new staff with specific expertise are likely to be required to supplement generalists and biophysical experts (for example, specialists with health, social and stakeholder and community engagement expertise).

- Clarifying an inter-departmental review process for closure plans with specific timeframes for each step or stage. The capacity of central and provincial government authorities must be sufficient for the timeframes to be realistically achievable.
- Extending closure and reclamation requirements to cover exploration sites and ensure these are completed within an acceptable timeframe.
- Ensuring occupational health and safety are embedded in closure, reclamation and post-closure activities.
- Ensuring core closure activities are addressed in the closure plan (see Table 4 or examples).
- While Thailand requires the preparation of a reclamation closure plan as part of the application for a mining licence, a closure plan is not required. A detailed mine closure plan should be prepared as part of the project EIA and then updated and refined as the mine proceeds through its lifecycle. Failure to develop a closure plan at the earliest possible stage (even if the plan is only conceptual) can result in closure and reclamation becoming more complex, more expensive and more likely to fail, as the opportunity to integrate closure and reclamation aspects in the mine design and operational phases has been lost. At the end of a mine's life, it becomes more difficult for government to enforce strong closure planning and implementation as the options are increasingly limited as the operational phase proceeds. International experience clearly indicates that sudden (unplanned) and rapid closure of a mine is possible. Good practice is therefore that a company should plan for such unexpected events by having, and keeping up to date, mine closure plans that are as detailed as possible (based on limitation on available information at any specific point in the mine's lifecycle) from the outset of operations. A detailed closure plan should be part of the permitting process, with this plan updated periodically as operation and development of the mine proceeds.
- Requiring a plan that addresses sudden or temporary closure, as this may happen and mean that the long-term life-of-mine closure plan is no longer fully applicable. Budget for sudden closure should also be available, to eliminate the creation of abandoned / legacy mines.
- Requiring a Closure Execution Plan (CEP) to be developed and regularly updated, defining roles, responsibilities and timelines assigned to the implementation of the detailed closure plan.
- Designing, testing and implementing a reformed financial guarantee system that can cover the cost of mine closure at any time in the mine lifecycle. This may require the development of other forms of financial assurance such as an irrevocable or unconditional letter of credit issued to the relevant authority by a bank, a security guarantee by a bank, or a company legally able to do so, security interests, a trust fund, and a combination of the above (Erdenebat, 2022).
- Ensuring financial assurance to cover closure, reclamation and post-reclamation activities is approved by relevant authorities and available at the commencement of mining activities and periodically updated to reflect the current closure cost (consistent with any updates to the closure plan).
- Where relevant authorities are not satisfied with the amount of financial assurance for closure, an independent assessor should be used to validate or modify the level of assurance required (Erdenebat, 2022).
- Clarifying the requirements for progressive restoration and closure (during the operational phase of the mine lifecycle) and making these explicit in the laws and regulations.
- Improving stakeholder consultation in closure planning, extending beyond central and local government departments and integrating the opinions and expectations of local people and other stakeholders directly impacted by mine closure and/or post-closure land use.

- Integrating social transition planning with mine planning and ensuring the transition plans are aligned with local development plans.
- Undertake a census of abandoned mine sites, including the nature and extent of environmental and safety risks associated with each. Once this is completed, a funding mechanism to rehabilitate and make safe such abandoned sites will need to be developed.
- Reinforce grievance mechanisms and requirements for stakeholder engagement to ensure stakeholder opinions, perspectives and concerns are fully embedded in closure planning and reclamation (including during the exploration phase).
- Reinforce transparency and make mine closure planning documents available to local communities and other stakeholders, so these can understand and contribute effectively to the closure planning process.

Table 6. Closure aspects and core activities

Aspect / category	Core closure activities
Physical stability	Adequacy, recovery, restoration, rehabilitation, and morphological modification of the affected area in accordance with post-closure use. Ensuring Physical stability of the affected area and remnant structures.
Chemical stability	Mine drainage/tailings: defining drainage type, modelling acid potential generation, prevention, control, and treatment alternatives, monitoring and surveillance, risk management. Remediation, recovery, and rehabilitation of surface water and groundwater.
Soil	Remediation, recovery, and rehabilitation of soil, according to its type and potential use.
Atmosphere	Development of good practices for mitigation and control of atmospheric emissions, noise, and vibrations associated with mine closure activities. Temporal and spatial analysis of monitoring results for atmospheric pollutants, sound pressure levels, and vibrations.
Climate change	Climate change scenarios for mine closure activities, including precipitation, temperature, and sea level rise aspects.
Circular economy	Implementation of strategies to improve resource and process efficiency, reducing waste production and the need for waste management and disposal.
Landscape	Landscape recovery. Integration of recovered areas with the surrounding landscape. Creation of areas providing cultural and/or environmental services.
Biotic environment	Ecological rehabilitation and landscape functionality, associated with biodiversity status and ecosystem services. Ecological restoration, rehabilitation, or recovery of intervened areas. Monitoring the status of terrestrial fauna and aquatic life in the area of influence.
Socioeconomic environment	Communication and participation strategy with stakeholders (territorial authorities, environmental authorities, associations, and communities). Development of programmes during the operation phase focused on implementing new economic practices in the post-closure phase, to avoide community dependence on the project. Reactivation or recovery of the territory's economic vocation.

Aspect / category	Core closure activities
Risk	Reduction of threat, vulnerability, and risk management for post-mining area use. Risk assessment for remnant buildings and infrastructure.

Following the stakeholder consultation, proposals were put forward regarding legal and regulatory factors to assess the alignment and interlinkages across multidimensional legal frameworks governing mining operations, land use, natural resource conservation, and sustainable development.

Based on the analysis of legal and regulatory considerations related to readiness for post-mining land use transition in Lampang Province, the key findings are as follows:

- First, activities related to mining operations and post-mining land development must comply with the conditions stipulated under the Mineral Act B.E. 2560 (2017), as well as measures prescribed in the Environmental Impact Assessment (EIA) approved under the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992). Any change in land use requires prior approval from the relevant regulatory authorities to ensure legal compliance and mitigate potential disputes in the future.
- Second, most project areas are located within forest zones and national reserved forests, where land use is permitted under the Forest Act B.E. 2484 (1941) and the National Reserved Forest Act B.E. 2507 (1964), subject to specific conditions on land use objectives and site rehabilitation. Therefore, mine closure and subsequent development must strictly adhere to these conditions or proceed with formal amendments in accordance with legal procedures.
- Third, the project area falls under the Lampang Provincial Comprehensive Plan pursuant to the Town Planning Act B.E. 2562 (2019), which designates the area as forest conservation land. Although mining activities are classified as pre-existing uses prior to the enforcement of the plan, post-mining land development must comply with current land use regulations. Alternatively, revisions to the comprehensive plan and the development of community-level plans may be required to systematically accommodate new activities.
- Fourth, the integration of rail transport infrastructure into the province's economic transition plan must be undertaken in parallel with the preparation of an Environmental Impact Assessment (EIA) under the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992), serving as a key strategic instrument from the early stages. This is to comprehensively assess legal, environmental, and social dimensions, particularly for large-scale infrastructure projects with spatial complexity and Physical constraints, such as mountainous areas requiring tunnel construction, as well as environmentally sensitive areas including watershed class 1 zones, forest areas, national parks, and other conservation areas. Within this framework, the feasibility study for the development of a nationwide rail network to enable seamless multimodal connectivity (R-Map) should systematically integrate EIA findings into spatial planning. This includes priority railway development programs connecting industrial estates and industrial zones (Short-term plan: 2023–2027, and a pipeline of projects under consideration to promote industry, tourism, and mobility), particularly the Green Industrial Estate for agro-processing and food industries at EGAT Mae Moh. The proposed railway segment from Mae Moh Station – Green Industrial Estate – Ngao Station, with an approximate distance of 80 kiLoMeters, aims to enhance industrial logistics efficiency and has the potential to connect with the Den Chai – Chiang Rai – Chiang Khong railway line, a strategic corridor for expanding trade opportunities to neighboring countries and major markets such as China.

In conclusion, the transition of post-mining land use in Lampang Province must be undertaken through an integrated approach that aligns both the "legal framework" and "strategic infrastructure development" to effectively drive long-term economic development in accordance with the principles of sustainable and equitable development (Just Transition).

5.2 Closure, reclamation and post-closure land use at Mae Moh mine

The currently approved closure plan for the Mae Moh mine is primarily based on reforestation. While reforestation remains an essential component of environmental rehabilitation, stakeholder engagement, national energy transition planning, and technical assessments indicate that a **more diversified and safeguard-integrated post-mining land use strategy** would reduce economic risk, strengthen long-term regional resilience, and contribute more effectively to Thailand's climate commitments under **NDC 3.0.**

Closure planning at Mae Moh must therefore be integrated into Thailand's broader coal phase-out and **Just Transition** agenda, applying environmental and social safeguards across the full mine lifecycle. Mae Moh should not be treated as a conventional mine closure case. Rather, it represents a **structural energy transition** for Lampang province and can serve as a **national demonstration site** for safeguard-led coal phase-out implementation.

Although the approved closure scenario prioritises reforestation, alternative land-use scenarios—when assessed through a safeguard lens—offer potentially greater economic and social benefits while also improving long-term energy security. Closure planning must therefore be situated within a complex strategic and policy landscape to ensure that it supports, rather than duplicates or contradicts, existing and planned national and provincial initiatives, including renewable energy deployment, regional development planning and climate adaptation strategies.

EGAT is a large and professional organisation that brings together a wide range of departments and disciplines to work effectively on closure, reclamation and post-closure land use at Mae Moh. Given the scale and remaining life of the operation, **progressive closure** remains the most appropriate strategy and is consistent with international good practice. In practice, EGAT continuously updates its reclamation plans to reflect ongoing mining operations and financial conditions. Some reclaimed areas have already been handed over for public access and use, demonstrating strong institutional capacity for **Physical rehabilitation and environmental management**, in several respects exceeding national minimum requirements.

The team responsible for developing the mine closure plan possesses the necessary knowledge, skills, data and technical expertise to produce a plan that is both technically and economically feasible. However, from a safeguard perspective, data sharing between the central and mine offices appears to be partial. Certain datasets and reports are not consistently duplicated across locations, and in some instances central office staff may be unaware of technical information available at the mine site, and vice versa. Strengthening internal coordination and knowledge management would improve transparency, support adaptive management, and reduce closure-related risks.

The team includes expertise to address **operational social impacts** through established procedures. However, there is currently no dedicated framework or procedure specifically addressing **social impacts during closure and post-closure phases**, representing a key gap relative to international safeguard standards. This gap is

particularly significant given stakeholder expectations that closure planning should explicitly address livelihoods, economic diversification, workforce transition and long-term regional development.

Public disclosure of detailed closure and reclamation plans has been limited to date. Nevertheless, EGAT documents reclamation activities and communicates progress through presentations and public information materials aimed at both local and wider audiences. While these efforts contribute to transparency, stakeholders have expressed a desire for **earlier, more structured and more inclusive participation** in defining post-mining land use scenarios, consistent with evolving safeguard expectations on meaningful stakeholder engagement.

Lessons learned from stakeholder engagement over the past decade highlight several safeguard-relevant considerations for strengthening closure planning:

- **First, trust remains conditional and must be continuously reinforced**. Although engagement has been intensive, complaints continue to arise regarding land use, environmental impacts and long-term safety. Communities expect transparent communication and credible grievance mechanisms, particularly in light of Thailand's historical mining legacies.
- **Second, livelihoods and economic transition are central concerns**. Stakeholders consistently emphasise that closure should not simply restore land Physically but should also replace lost economic value. Workers and local businesses expect structured support for reskilling, income diversification and integration into emerging renewable energy and green economy activities.
- **Third, participation must extend beyond regulatory compliance**. While the legal framework emphasises reforestation, local communities and provincial actors have shown strong interest in diversified land uses, including renewable energy generation, agrovoltaics, biodiversity conservation, water resource management and tourism-related development. Stakeholders expect meaningful involvement in evaluating and shaping these options.
- **Fourth, grievance mechanisms must remain active throughout closure and post-closure phases**. Mae Moh mine maintains liaison offices to address complaints related to mining operations, including reclamation activities, and the power plant operates a similar mechanism. From a safeguard perspective, these mechanisms should evolve and remain operational as renewable energy projects and post-closure land uses are implemented.

At Mae Moh, temporary or sudden closure is considered unlikely due to the mine's role in supporting electricity generation in northern Thailand. Nevertheless, mining delays remain possible. While a six-month coal stockpile is maintained as an operational contingency measure, international experience demonstrates that unexpected or accelerated closures can occur. As such, **formal contingency planning for sudden or accelerated closure** should be incorporated into updated closure documentation, consistent with international safeguard practice.

EGAT has the technical capacity to backfill the open pit; however, the economics of full backfilling are not currently considered feasible. Limited in-pit dumping will continue in selected areas to improve slope stability. Following closure, groundwater rebound is expected to form a reservoir that may provide water for agriculture and other beneficial uses. These hydrological changes require careful long-term monitoring and integration into post-mining land use planning to manage environmental and social risks.

The principle of "**do no harm**" should serve as the minimum benchmark for closure. From a safeguard-integrated perspective, this implies not only restoring lost environmental value and avoiding negative impacts on surrounding communities, but also actively seeking opportunities to **deliver shared benefits**. Closure therefore presents an opportunity to add value through employment creation, equitable renewable energy development, biodiversity enhancement and sustainable livelihoods. An integrated scenario combining renewable energy deployment, diversified income generation, carbon management and ecological restoration is likely to represent the optimal long-term outcome.

To supplement existing expertise and resources, the process of closure planning, reclamation and post-mining land use selection should be strengthened in alignment with the Lampang **Just Transition Plan** (Klaikaew, 2025). Such alignment would facilitate a sustainable and equitable transition away from coal toward renewable energy sources, while systematically addressing socio-economic impacts on workers and local communities in line with safeguard principles.

In conclusion, Mae Moh closure must be treated as an integrated environmental, economic and social transition, rather than solely as a land rehabilitation exercise. The analysis highlights the need for coordinated, safeguard-led action across closure planning, renewable energy development, workforce transition, stakeholder governance and financial reform.

To translate these priorities into practical steps, **five safeguard-integrated strategic recommendation pillars** are proposed. **Table 7** summarises the key actions, responsible actors and expected outcomes to guide implementation.

Table 7. Key recommendations for Mae Moh mine closure and post-closure transition

No.	Recommendation area	Key actions	Responsible actors	Expected outcomes
1	Integrated Closure & Energy Transition Planning	• Align closure timeline with NDC 3.0 and national coal phase-out targets • Update closure plan beyond reforestation to include renewable energy, biodiversity and diversified land use • Conduct updated ESIA covering closure and post-closure land use scenarios • Integrate climate risk (precipitation, temperature, groundwater rebound) into landform design	EGAT, EPPO, DPIM, provincial government	Closure aligned with climate commitments; reduced stranded asset risk; climate-resilient land use

No.	Recommendation area	Key actions	Responsible actors	Expected outcomes
2	Stakeholder Engagement & Just Transition Governance	• Establish a Lampang Just Transition Committee with multi-stakeholder representation • Formalise closure-specific engagement procedures, including early and continuous consultation • Strengthen grievance mechanisms during closure and post-closure phases • Ensure inclusion of women, vulnerable and marginalised groups • Improve public disclosure of closure plans and financial assurance	EGAT, provincial authorities, civil society, labour representatives	Increased trust; inclusive governance; reduced conflict
3	Workforce Transition & Local Economic Diversification	• Workforce reduction and reskilling plan • Implement green skills training (solar PV, BESS, agrovoltaics, environmental monitoring) • Support SME incubation and green entrepreneurship • Establish local labour market monitoring system • Provide income protection during transition	EGAT, Ministry of Labour, vocational institutions, universities	Reduced unemployment risk; diversified regional economy; smoother transition
4	Renewable Energy & Circular Economy Development	• Assess large-scale solar PV + BESS feasibility on post-mining land • Pilot community-scale and cooperative renewable projects • Integrate landform design with solar optimisation • Assess reuse of fly ash and FGD gypsum • Explore agrovoltaics and livestock integration	EGAT, DEDE, private investors, industry partners	Increased renewable capacity; equitable benefit sharing; circular value creation
5	Financial & Risk Management Reform	• Review and update closure financial assurance using risk-adjusted costing • Integrate carbon pricing scenarios into economic modelling • Establish Mae Moh Green Transition Fund • Conduct independent validation of closure and post-closure costs • Incorporate contingency planning for sudden or accelerated closure	Ministry of Energy, Ministry of Finance, EGAT Independent Auditors	Financially secure closure; reduced fiscal risk; long-term sustainability

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Annex A

Table A.1. Gap analysis relative to synthesised benchmark requirements – Thailand's laws and regulations

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
1. Company will use a multidisciplinary team to integrate closure planning and the closure vision with life-of-mine (LoM) planning activities	Legal requirements do not conform with good practice: • While Thailand regulations require the mine to submit a reclamation and closure plan to obtain a mining license, the law does not mention a requirement to use a "multidisciplinary team".	Many large-scale mining companies in Thailand (including coal operators) follow international best practices and do use multidisciplinary teams for closure planning – involving geologists, mining engineers, ecologists, hydrologists, community liaison officers, etc. Regulators evaluate the submitted plans, not the composition of the teams who made them. There is thus no institutional check on whether a plan was developed with sufficient interdisciplinary input, aside from the plan's quality itself.	A multidisciplinary approach ensures that diverse information is considered in closure planning: e.g., mine engineers provide data on pit slopes and infrastructure, environmental scientists bring data on soil and water restoration, and socio-economic teams contribute information on community needs and post-mining land use plans. Effective integration of closure and LoM planning requires comprehensive baseline and monitoring data from a wide variety of disciplines as defined in the detailed EIA (baseline data) and to demonstrate compliance with annual environmental management plans (monitoring data). Collectively, these should be sufficient for the government to define minimum expectations for the disciplines to be included when integrating closure planning and LoM planning.	Stakeholders, particularly local communities and workers, expect that companies plan for mine closure in a way that addresses all facets of impact. This means they assume companies will bring various experts to the table. Other less directly affected have a range of views and understanding on mining, closure and reclamation. Overall, the requirement for most stakeholders is that mining and related closure and reclamation activities result in no adverse impacts for them.
2. Company undertaking exploration will complete reclamation in accordance with any regulatory requirements and pay for all necessary reclamation activities.	Legal requirements do not conform with good practice: • The Minerals Act addresses requirements related to exploration, but does not detail an explicit requirement to undertake and pay for reclamation of areas affected by exploration.	Central and provincial government authorities require clarification of legal tools to regulate and verify reclamation of exploration impacts. Enforcement may be limited by resource constraints.	Effective reclamation requires baseline data on pre-exploration land conditions (soil profiles, vegetation cover) to guide reclamation targets. It also needs documentation of exploration disturbances (maps of drill sites, access roads) and monitoring data to demonstrate successful rehab. This should be acquired as part of a general EIA, allowing sufficient baseline data to be collected to define pre-exploration conditions and act as a benchmark for reclamation targets and verification.	Some stakeholders expect to be kept informed about reclamation but some may have limited interest as long as there is no adverse impact to them.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
3. Company undertaking exploration will complete reclamation within an acceptable timeframe. Company will resolve complaints about exploration-related reclamation through discussions with relevant stakeholders and – if necessary – an arbitrator.	Legal requirements do not conform with good practice: • The Minerals Act addresses requirements related to exploration, but does not detail an explicit requirement to undertake reclamation of areas affected by exploration within an acceptable timeframe. Legal requirements do not conform with good practice: • Thailand mining and environmental laws do not provide a dedicated arbitration mechanism for complaints about exploration- or exploitation-stage reclamation. • However, Thailand mining and environmental laws do have some procedures to handle complaints or impact from mining operation, especially the cases with losses of lives or property damage.	Central and provincial government authorities require clarification of legal tools to regulate and verify reclamation of exploration impacts. Monitoring timely reclamation is feasible but may be limited by resource constraints. In practice, resolution of exploration-related complaints is likely to largely depend on a company's grievance mechanism and related stakeholder engagement activities. In the absence of company mechanisms and engagement, it is unclear whether central and local government would have sufficient resources to provide an alternative route to resolve complaints.	Companies should maintain logs of when each exploration site was disturbed and when it was rehabilitated, along with before/after photos or site reclamation metrics. Currently, this detailed scheduling data may not be systematically acquired, making enforcement of reclamation timelines (if these are agreed with authorities) more difficult. Transparent information is key to preventing and resolving complaints. Since reclamation is part of environmental management scheme, the mine should keep records of reclamation commitments, timelines, and completion status and share these with stakeholders. If a complaint arises, having data helps clarify what was done and what might have failed. Data on grievance handling (number of complaints, response times, outcomes) is useful for both the company and regulators to monitor performance. Currently, such data might remain internal; establishing a requirement to document and report reclamation grievances could improve accountability.	In general, stakeholders expect the mining operation to follow the plan proposed to the government without impact to the environment. Subsequently, stakeholders expect reclamation to finish according to the plan Affected stakeholders expect that if they raise a concern about reclamation, the company will listen and act. The first expectation is direct dialogue to resolve issues (for instance, re-planting an area that was not done properly or compensating for a delay). They also expect the company to have a clear process for complaints (e.g., a community hotline or liaison officer). If those discussions do not yield results, stakeholders expect an impartial third party to step in. This might mean government officials mediating, or in some cases, they might desire a formal arbitrator. Unaddressed grievances can quickly erode trust and may lead to protests or legal action.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
5. Company undertaking an ESIA for a project will include social impacts that may occur during closure and post-closure phases in the ESIA Terms of Reference and Scope of Work	Legal requirements partially conform with good practice: • Thailand EIA requirements explicitly encompass social impact assessments for the application for a mining licence which include mine reclamation and mine closure but there is no assessment for post-closure. • During mining operation, the mine conducts Corporate Social Responsibility (CSR) activities.	Central and local government authorities have the mandate to review and assess EIA documents, including the social impact sections. The employment of social specialists by central and local government authorities may be limited.	- Assessing closure social impacts requires baseline socio-economic data (employment levels, community dependence on the mine, alternative livelihoods, etc.) and forecasting models. Assessing closure-related social impacts requires baseline socio-economic data, which should be collected as part of a project's detailed EIA. Information related to economic diversification and local development initiatives to be implemented during the operational phase helps to: • Establish the context for closure and the impact of retrenchment and reduced local procurement of goods and services on the local economy and livelihoods. • Define likely post-closure scenarios and options to manage post-closure social impacts. Data such as the number of local jobs tied to the mine, local business linkages, and government revenue from the mine are needed to predict post-closure scenarios. Also required are community input data – what do locals fear or hope for post-closure? ESIAs should incorporate consultation feedback regarding social well-being after mine life. In practice, data gaps often exist and detailed demographic and economic studies may be lacking in the EIA, limiting the analysis of closure impacts. Better data from national statistics and development plans can enhance this section.	Communities and local officials expect that the EIA will not only focus on environmental issues but also address "people issues" related to mining operations.
6. Scoping of health and safety risks and potential impacts will consider closure, reclamation and post-closure activities.	Legal requirements do not conform with good practice: • Occupational, health and safety (OHS) in Thailand are basis for almost every activity, including all works in mining operation. • However, there is no specific description of scoping of health and safety risks and potential impacts including consideration of closure, reclamation and post-closure activities.	EGAT has Institutional capacity to do all necessary works in respect to government sector to regulate OHS for closure, reclamation and post-closure activities.	A thorough OHS risk scoping for closure needs technical data: geotechnical surveys for stability, inventories of dangerous materials (explosives, chemicals) to be removed, and predictions of potential hazards (like water contamination affecting human health). Companies must gather these data during operations (e.g., slope angles, tailings properties) to inform closure risk mitigation. Additionally, data on community health and safety concerns should be collected through engagement – local people can identify site-specific risks (e.g., an unsecured open pit near a village path). Monitoring data (such as ground movement or water quality trends) are also required to manage closure-phase risks proactively. Without such information, some community health and safety issues might emerge unexpectedly.	Both workers and nearby communities expect that closure will be executed safely and that the activities will not pose health or accident risks afterward. For example, mine workers expect that during demolition and site clean-up, their safety will be protected with proper procedures, just as during regular operations. Local residents expect things like mine shafts to be sealed, pit highwalls to be stabilised, and any hazardous materials to be removed so that post-closure, the area is safe for public use. There is also an expectation of communication: stakeholders want to be informed about any risks that might affect them during closure (blasting, heavy equipment transport, etc.) and how those are being managed. If the area will have lingering dangers (like a pit lake), communities expect warnings or restrictions to prevent accidents. Essentially, stakeholders assume the company will apply the same rigor to closure health and safety as it did during mining, leaving no harmful legacy conditions.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
7. Company will draft a closure and reclamation plan before construction of the mine commences	Legal requirements partially conform with good practice: • The Minerals Act clearly mandates the mine to propose a reclamation plan at the time of application for a mining licence. • An appropriate reclamation plan has to be prepared and approved as part of the mining licence issued by the government. • A closure plan is not mandated by the Minerals Act.	Central and provincial government authorities have established processes to review the detailed EIA, including reclamation-related information and provisions. The introduction of closure plans would likely stretch existing institutional capacity, and might need to be reinforced with additional resources to reflect the increased workload.	Information to prepare a concept level closure plan should be available as part of a comprehensive feasibility study (generally considered an essential precursor to raising funding for a mining project). For a conceptual closure plan prepared as part of the detailed EIA, general data on the geological, geographical, hydrological, socio-economic, and mining context are required. Before construction of the mine commences, detailed closure planning may not be possible. Nevertheless, closure options should already be assessed at this stage in order to avoid long-term negative im-pacts and to enable potential post-mining land uses to be considered from the outset.	Some stakeholders expect a well-prepared closure and reclamation plan.
8. Company will have an up-to-date closure and reclamation plan that addresses environmental, social, economic and governance aspects.	Legal requirements do not conform with good practice: • The Minerals Act does not have provisions addressing the need to update periodically a closure and reclamation plan. • However, if there are issues related to environmental, social, economic and governance aspects, a mine can address those issues through approval of corresponding government sector	Current institutional capacity is focused on review of closure plans developed in the later stages of a mine's life. The introduction of earlier and periodic reviews of detailed and updated closure plans would likely stretch existing institutional capacity, and would need to be reinforced with additional resources to reflect the increased workload.	Closure plan updates require the regular influx of new information: • Monitoring results (e.g., environmental data such as water quality trends, rehabilitation success rates). • Updated mine plans (e.g., changes in mine life, new pits, new waste disposal areas). • Evolving socio-economic data (e.g., workforce changes, community development indicators). • Institutional changes (e.g., new regulations or company policies). A robust data management system is needed to feed into each plan revision.	Overall, stakeholders may not take this issue seriously as long as they do not experience negative impacts as a result of the failure to consistently update the closure and reclamation plan.
9. Company will prepare and keep up to date a contingency closure plan for temporary or sudden closure that identifies the key areas of the site closure plan that will require modification in the event of a sudden closure.	Legal requirements do not conform with good practice: • The Minerals Act does not have provisions addressing temporary or sudden closure. • Mining operation may have a contingency closure plan for temporary or sudden closure but normally it was not disclosed to public nor related government sectors.	Current institutional capacity is focused on review of closure plans developed later in a mine's life. The introduction of periodic reviews of contingency closure plan for temporary or sudden closure would likely stretch existing institutional capacity, and would need to be reinforced with additional resources to reflect the increased workload.	A contingency closure plan needs to identify "what if" scenarios related to temporary or sudden closure. Information required includes: • Critical areas of the mine that would need immediate attention (e.g., dewatering systems, tailings dam monitoring). • Definition of the minimum workforce needed for care and maintenance. • Details of contractors likely to be available on short notice. Financial data is key – knowing the cost of implementing sudden closure measures for a few months or years helps ensure readiness. Companies also need trigger criteria data (indicators that a temporary closure is looming, such as commodity price thresholds or conflict escalation) so they can activate the plan. Collecting and updating this information ensures the contingency plan is practical and not just theoretical.	Stakeholders – especially employees and nearby communities – expect that the company has an emergency plan if the mine stops operations unexpectedly. Workers want clarity on what it means for their jobs and safety, and communities want assurance that the site will not be abandoned in a dangerous state. There is an expectation that, even in a sudden shutdown, the company will keep managing environmental controls (treating water, securing open pits, etc.) to prevent accidents or pollution. Transparency is also expected: stakeholders would want to be promptly informed if a sudden closure were to happen and how the company will address immediate impacts. Stakeholders implicitly expect the company to prepare for temporary or sudden closure scenarios to the extent necessary to fulfil its environmental and social management and protection responsibilities.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
10. Company will develop and regularly update a Closure Execution Plan (CEP) that identifies specific actions and lines of authority and responsibility to be carried out during the life-of-mine, closure and reclamation.	Legal requirements do not conform with good practice: • The Minerals Act does not require a "Closure Execution Plan (CEP)".	Current institutional capacity is focused on review of closure plans developed as a mine nears the end of its operational life. The introduction of periodic reviews of a CEP would likely stretch existing institutional capacity, and would need to be reinforced with additional resources to reflect the increased workload.	A CEP needs detailed information, including: • An inventory of all closure tasks (down to, say, "dismantle processing plant equipment X"). • Timelines for each task. • Details of personnel or department responsible for each task. This requires prior collection of data on all mine facilities, quantities of materials to remove, areas to rehabilitate, etc. and essentially is a compilation of all closure knowledge into an actionable plan. The CEP also requires tracking data – as closure progresses, information on completed tasks versus. schedule, budget spent versus allocated, and arising issues. To keep the CEP updated, companies need a management system that captures these data points. Integration of this information with company project management software or reports ensures the CEP remains current and is a useful tool rather than a one-off document.	Stakeholders (especially regulators and potentially local communities) expect a well-organised closure execution. Regulators want to see that the company has a structured plan so that nothing is left out and timelines are met, providing confidence that closure commitments will be honoured. Communities and workers expect a smooth, coordinated closure process with clear lines of command and responsibilities. Stakeholders may assume there is a "masterplan" for closure execution. If the closure phase appears disorganised this can severely damage trust between stakeholders, the company and regulators.
11. The current version of the closure and reclamation plan will be published by the company or made available to stakeholders on request, along with non-confidential financial surety reviews.	Legal requirements do not conform with good practice: • The Minerals Act does not mandate the disclosure of a closure or reclamation plan or non-confidential of financial surety reviews.	Government sectors have the authority to obtain and review closure plans and cost estimates. However, they do not currently have a system to share these documents widely with the public, aside from possibly via information requests.	For companies to publish current closure plans, they need to produce stakeholder-friendly versions of what is usually a technical document (e.g., a non-technical summary). This might entail extracting key information (planned closure dates, activities, post-mining land use, etc.) and excluding confidential details (like proprietary cost estimates or sensitive environmental data). The data needed should already be available in the closure plan; it is more a matter of format and willingness to share. Financial surety data would include closure cost estimates, any funds set aside (in accounting reserves or trust accounts) or guarantees/insurance policies obtained.	There is a growing expectation among stakeholders for greater transparency in closure planning. Communities and civil society often want to see the closure plan to understand what the future of the site will look like. However, the plan may be not available without request.
13. Company will undertake progressive closure when: a. Technically and economically feasible.	Legal requirements partially conform with good practice: • Minerals Act B.E.2560 does not require the mine to undertake progressive closure.	Reviews of progressive restoration could be undertaken as part of routine environmental monitoring and due diligence audits / assessments by central and local government authorities. This may extend the	Implementing progressive closure requires up-to-date operational data and forecasting. Mine planners must understand when an area will be free of any further operational activities, so rehabilitation can be scheduled. Monitoring data from early rehabilitation trials can be	Stakeholders appreciate seeing disturbed land being reclaimed as the mine goes, rather than all at the end. Visibly progressive closure (like concurrent replanting) serves as a sign of good faith and reduces the mine's footprint impact

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
12. Based on robust information, the closure and reclamation plan will describe at a minimum: a. Site location, facilities and context. b. Relevant legal requirements. c. Relevant corporate requirements. d. Risks and opportunities relevant to closure, reclamation and post-closure. e. Relevant obligations to stakeholders. f. Implications of temporary and sudden closure scenarios. g. Potential for adverse soil- and water-related impacts during and following closure. h. Proposed mitigation measures to maximise opportunities, reduce risks and prevent or limit adverse impacts. i. Progressive and final closure and rehabilitation activities (including demolition and removal of hazardous materials). j. Final proposed land form and post-mining land use and facility use. k. Schedule for all activities. l. Long-term maintenance and post-closure environmental and socio-economic monitoring plan. m. Inputs from stakeholders (including affected communities) related to aspects a – e noted above. n. Role of the community in long-term monitoring and maintenance (if any).	Legal requirements partially conform with good practice: • The Minerals Act does not specify what the contents of a closure and reclamation plan should describe. • However, Department of Primary Industries and Mines (DPIM) has published a guideline for closure and reclamation plan which includes most of the aspects noted.	Central and provincial government institutions have the capacity to review closure plans against the legal requirements. However, extending the requirements for minimum content of a closure and reclamation plan may require development of institutional capacity and expertise in the new area.	Covering the aspects required by good practice demands extensive information, but much of this is already collected during closure planning.	It can be anticipated that stakeholders expect a closure plan to be holistic and specific. Affected communities want to see tangible plans and assurance that identified impacts (like soil contamination or loss of livelihoods) have corresponding mitigation actions. They also expect recognition of their rights and inputs – for instance, that the plan reflects agreements made with them (such as preserving certain areas or providing post-closure community projects).
13. Company will undertake progressive closure when: a. Technically and economically feasible. b. Aligned with and integrated into the life-of-mine planning and closure planning	Legal requirements partially conform with good practice: • Minerals Act B.E. 2560 does not require the mine to undertake progressive closure.	Reviews of progressive restoration could be undertaken as part of routine environmental monitoring and due diligence audits / assessments by central and local government authorities. This may extend the duration of such activities in the field. Alternatively, the review process could be completed as a desktop exercise (e.g., via review of company reports on environmental compliance), reducing the incremental increase in workload for government staff.	Implementing progressive closure requires up-to-date operational data and forecasting. Mine planners must understand when an area will be free of any further operational activities, so rehabilitation can be scheduled. Monitoring data from early rehabilitation trials can be used to assess the performance of a range of restoration options. Economic data (cost-benefit analyses) help demonstrate feasibility, which can be shared with central and local government institutions to justify selection of specific options.	Stakeholders appreciate seeing disturbed land being reclaimed as the mine goes, rather than all at the end. Visibly progressive closure (like concurrent replanting) serves as a sign of good faith and reduces the mine's footprint impact during operations, which communities expect if feasible. Progressive rehabilitation also reassures workers and local residents that the company is serious about closure. Early reclamation can provide immediate environmental benefits (like dust reduction) that local / affected communities welcome.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
14. Company will partially or completely backfill open pits when this is economically viable and required for socioeconomic or environmental reasons.	Legal requirements conform with good practice: • The Minerals Act includes a requirement to consider backfilling of open pits as an option for closure.	Central and provincial government institutions have the capacity to review partial or complete backfilling of open pits, but may be less able to assess whether backfilling is economically feasible (and in this, is likely to be reliant on calculations and arguments for/against backfilling provided by the mining company).	Determining the viability of backfilling needs robust information: including: • Pit geometry and volume. • Quantity and type of available fill (waste rock, tailings, etc.). • Geochemical data and assessment of backfill as a potential source of contaminants. • Hydrogeological models (if the pit intersects aquifers or will be a lake). • Economic analysis comparing backfilling and other closure methods. • Valuation of environmental/social benefits achieved by backfilling. • Engagement with communities and other stakeholders regarding preferences or future land use plans that could be enabled by backfilling (e.g., land for agriculture or development). Gathering this information allows a balanced decision. Without data, companies often default to leaving a pit as a lake on the assumption that it is cheaper; with data, regulators and stakeholders can better weigh if the benefits of backfill justify the costs	Communities near open pits primarily expect that whatever is left is safe and not a source of ongoing pollution. Many assume pits will become lakes; some see that as acceptable (if water is clean and area fenced), others worry about drowning risks or loss of land. Stakeholders that have a strong desire to use the land, post-closure (e.g., return it to farming) may expect backfilling to at least a partial degree. In socio-economic terms, provincial authorities may favour backfilling if it enables future development on that land. Environmental groups may push for backfilling to restore original landscapes or prevent a pit lake from affecting groundwater. However, stakeholders also understand viability – if explained that backfilling is technically or financially impractical, they may accept alternatives but expect other protections (like treating the water, creating a recreational lake, etc.). Ultimately, stakeholders expect the company to seriously evaluate backfilling in the closure options and justify the chosen approach in socio-environmental terms, rather than dismissing it purely on cost.
15. Company will backfill underground mine workings if this is technically viable and subsidence is predicted	Legal requirements do not conform with good practice: • The Minerals Act does not include requirements to consider backfilling of underground mine workings.	Central and provincial government institutions have the capacity to review backfilling of underground workings, but may be less able to assess whether backfilling is economically feasible (and in this, is likely to be reliant on calculations and arguments for/against backfilling provided by the mining company).	Key information needed includes: • Subsidence prediction data (detailed geo-mechanical models, surface geology, and monitoring data from ground movement surveys). • Data on infrastructure, communities and/or land at risk of subsidence. • If subsidence is likely, the viability of alternative backfilling methods (material properties, injection techniques, cost) should be assessed. • Technical design data for backfill (e.g., slurry mix if paste fill, or placement methodology if dry fill) Forecast effectiveness in preventing subsidence. Forecast adverse environmental impacts arising from backfilling (e.g., degradation of groundwater quality or availability) should be assessed.	Stakeholder expectations specifically related to the backfilling of underground mine working were not noted.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
16. Company will undertake closure and rehabilitation using measures that address soil contamination and enable continued access to water and reduce the risk that long-term post-closure water treatment will be required.	Legal requirements partially conform with good practice: • Thailand environmental laws (including the National Environment Protection and Promotion Act BE 2535) hold polluters responsible for restoring contaminated sites. • During mine closure, companies are required to address soil contamination.	Central and local government institutions have the capacity to enforce cleanup of soil and water related contamination.	Soil and water quality thresholds must be defined, to assess what is consider contaminated (or not). Hydrogeological data is needed to ensure communities' water sources will be unaffected or to design new sources if needed. A thorough assessment of soil and water contamination is needed: soil sampling data for heavy metals or hydrocarbons, and water monitoring data for parameters like ph, metals, sulfates. These data guide what remediation techniques are required.	Communities expect that once the mine is closed, the land and water are left clean and usable. They want soils to be free of toxic residues so that farming or other land uses can continue. Any known contamination should be fully remedied. Stakeholders expect closure to avoid long-term burdens for the environment or local communities, especially regarding fundamental needs like clean soil and water.
17. Company will ensure that waste storage facilities are designed, constructed, operated, maintained and closed in a way that provides structural stability and minimises post-closure geotechnical risks and environmental and health and safety impacts.	Legal requirements partially conform with good practice: • Design and stability: Thailand regulations require that waste storage facilities (e.g., waste rock piles, tailings dams,) comply with safety and environmental standards throughout their life cycle. The mining plan has to include the design and approval by all pertinent government sectors. • Post-closure care: after closure for a certain period of time, land is handed over to relevant government sectors (mainly the Department of Forestry) at which point the licence holder must demonstrate there is no impact associated with waste storage facilities.	Thailand may not have the institutional capacity at present to assess the conformance of design, construction, operation and maintenance of waste storage facilities with that required to minimises post-closure geotechnical risks and environmental and health and safety impacts.	Detailed geotechnical data (slope angles, material properties, seismic stability analysis) are required to ensure structural stability. Engineering studies like slope stability analyses, factor of safety calculations, and dam breach models feed into closure design. Environmental data on waste chemistry is needed to plan covers or treatments to minimise leaching. Health and safety risk assessments data (like who might be exposed if something failed, downstream population maps) inform the level of precaution needed. Monitoring data (both operational and closure monitoring) on things like pore pressures in dams, drainage water quality, and dump settlement rates are crucial to verify that the closed facility performs as expected and to identify any intervention needed.	Communities expect that tailings dams and waste dumps will not pose threats after closure and expect companies to reinforce or remediate these facilities to be safe for the long term. Health and safety wise, people living nearby expect no dust blowing from waste dumps, no contaminated runoff, and no Physical instability (like landslides) that could endanger them. They also often express interest in how those sites will look post-closure – expecting them to be shaped and covered with soil/vegetation so they blend into the environment rather than remaining as bare surfaces.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
18. Company will coordinate with a wide range of stakeholders throughout the project lifecycle to: a. Undertake inclusive engagement. b. Define post-closure land use. c. Develop activities that will reduce the adverse impacts of closure for workers, affected communities and artisanal and small-scale mining (ASM) operations.	Legal requirements partially conform with good practice: • Thailand law requires public participation various types of projects, including mining. However, continuous engagement "throughout the project lifecycle" is not a strict legal requirement. • After the licensing stage, ongoing engagement (e.g., closure planning discussions) occurs at the authorities' or company's initiative. • No specific regulation compels forming stakeholder committees for closure.	Government agencies (environmental, mining, local governments) do facilitate stakeholder engagements in some cases.	Effective stakeholder coordination needs information flow in both directions. Companies should provide accessible information about project timelines, closure plans, and potential impacts to stakeholders, and gather stakeholder input (surveys, meeting minutes, feedback on land use preferences). Data on stakeholder identities (who are the affected groups, including often-overlooked ones like ASM) and their interests is needed to ensure inclusive engagement. For defining post-closure land use, information is needed on environmental suitability (what uses the reclaimed land can support), community development plans, and economic analyses of alter-natives. Data on stakeholder identities (who are the affected groups, including often-overlooked ones like ASM) and their interests is needed to ensure inclusive engagement. Data on worker skills and local economic conditions are required to formulate programs to reduce closure impacts (e.g., what retraining would be effective, which economic sectors could absorb laid-off workers). In the case of ASM, information about the scale and nature of ASM activities is crucial to incorporate their needs. For defining post-closure land use, information is needed on environmental suitability (what uses the reclaimed land can support), including community development plans, and economic analyses of alternatives.	Stakeholders expect to be involved, not just informed. Inclusivity means communities (including vulnerable groups) expect outreach in their language and culturally appropriate ways throughout the mine's life – not only when legally required. They want continuous dialogue where they can raise concerns and co-create solutions, such as what the land will be used for after closure. Provincial Ministry of Mining staff noted that the ministry engages with communities in terms of responding to problems raised by communities, with issues generally raised with the Provincial Governor first and then passed to the company and Provincial Ministry of Mining.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
19. Company will give stakeholders the opportunity to comment on the draft (pre-construction) and final (pre-closure) closure and reclamation plan.	Legal requirements partially conform with good practice: • To get a mining license, mining companies have to conduct public participation/hearing on mine plan and mine reclamation. • Public can make comments for the government agencies to further consider. • A closure plan is not required and not disclosed, so stakeholder engagement on this is not possible. • Access to reclamation plans, EIAs other documents at the provincial level is possible: EIAs are available online, but need to register to get access via website; documents can be reviewed in printed version in person at relevant provincial government offices, but still need to fill out forms (to check person / request is bona fide).	By law, the mine has to include stakeholder input in final closure planning. In practice, the input will be collected during public hearing, specifically during the EIA study, which relates to reclamation rather than closure. Central and local government institutions may not have the capacity to routinely oversee and assess the extent to which companies have provided stakeholders the opportunity to comment on draft and final closure plans.	Stakeholders need the closure plan in clear, non-technical form (maps, actions, timelines), highlighting any updates that have been made. Companies should show how earlier feedback was addressed and keep a record of concerns. Without this, communities and other stakeholders may feel ignored or raise past issues and concerns again.	Early in the project, communities rarely focus on closure, but by the end they expect a forum to discuss final measures (e.g. land safety, handover of infrastructure). If closure plans are finalised only with authorities, stakeholders are likely to be concerned and feel excluded. They expect at least transparency and a chance to ask questions, and ideally some influence. Without this, dissatisfaction and mistrust can arise.
20. Company operating in an internationally or nationally recognised protected area will develop the mine closure and rehabilitation plan in conjunction with the protected area sponsors / managers.	Legal requirements partially conform with good practice: • Direct mining in nationally protected areas (like national parks) is generally prohibited in Thailand. • However, mining can occur in buffer zones or certain regional protected areas under strict conditions.	In Thailand, it is impossible to undertake mining in protected area, unless cabinet approval is received (which is unlikely to happen).	Closure planning in these contexts requires ecological data specific to the protected area: species inventories, habitat requirements, conservation targets. The company must gather and share data on how mining affected those values and what rehabilitation is needed to restore them. Protected area managers bring data from their monitoring (e.g., wildlife presence, vegetation regrowth rates) that is crucial for setting realistic closure criteria. Data exchange is key: the company's environmental impact data plus the protected area's baseline data form the basis of the closure plan.	Environmental stakeholders (protected area authorities, NGOs, local communities who value the protected area) expect the highest standard of closure in such areas. They expect the company to closely collaborate with conservation experts to, for example, re-establish native ecosystems, remove any invasive species, and ensure no lasting damage remains. If an area sponsor (say an NGO co-managing a reserve) exists, they anticipate being deeply involved in decisions like what to reforest and how to monitor recovery.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
21. Company will have a retrenchment plan that has been developed in consultation with employees, workers' organisations (and where appropriate, the government) to reduce the impacts of retrenchment on employees.	Legal requirements partially conform with good practice: • Thailand labour legislation provides certain protections for workers in mass layoffs (e.g., if a company is laying off a large number of workers, it must seek approval from the Ministry of Labor and pay legally required severances), but it does not require a comprehensive "retrenchment plan" with stakeholder consultation. • Often, large mines have unions and thus any layoffs due to closure would be subject to negotiation under the collective bargaining agreement. This provides some de facto consultation (unions will negotiate packages, timing, etc.), but this is an industrial relations process rather than a statutory requirement for a mitigation plan. • Government involvement typically is limited to oversight to ensure labour laws (payments, benefits) are honoured.	The Ministry of Labor can mediate closures with major layoffs and connect workers to general retraining or job placement, though none are closure-specific. Large companies may voluntarily design retrenchment plans, but this is not required by law. Sudden layoffs can overwhelm local institutions. Mitigation is feasible with advance planning (e.g. training some years before closure), but success depends on company initiative and coordination.	A retrenchment plan needs detailed human resources data: • The number of employees, their ages, skills, and how many years before closure each position will be needed. • Understanding of the local job market. • Data from employee surveys or meetings on their preferences (e.g., do workers want training in new skills, early retirement packages, relocation assistance). • If unions are present, their proposals become part of the data to integrate. • Engagement with government agencies provides data on available support programmes.	Workers expect fairness and support when a mine closes. They anticipate severance pay as per law, but beyond that, many hope the company will help cushion the transition – perhaps through job fairs, training in new trades, or even transferring some to other company operations. If there is a union, workers expect the union and company to negotiate a closure agreement that might include enhanced benefits or re-skilling programs. Provincial government and communities also share this expectation because a sudden mass unemployment event can harm the regional economy. Generally, stakeholders believe a responsible mining company should not only think about the environmental closure but also the human aspects and consequences of closure.
22. Company will implement social transition planning throughout the life-of-mine and closure to manage local dependence on the mine in alignment with government-led development plans for the host region.	Legal requirements do not conform with good practice: • There is no specific Thailand law requiring companies to implement socio-economic transition plans for communities as part of mine closure.	Social transition plans require coordination between companies, government agencies, and communities. However, in Thailand, there kind of activity has not yet been initiated. Central and provincial government institutions may not have the capacity or internal expertise to oversee social transition planning throughout the life-of-mine and closure.	Long-term socio-economic data is needed: • Definition of the local economy's structure and the mine's share in it. • Potential sectors for growth. • Data from government development plans (like identified strategic projects for the region) should be integrated. • Demographic data (population trends, skill levels) help tailor transition projects (e.g., if many young people, focus on education for new industries). • Throughout the mine's lifecycle, data on community development indicators (education, health, income diversification) should be tracked to see dependency levels. Continuous socio-economic monitoring data combined with planning documents from government provides the foundation for a sound transition plan aligned with public initiatives.	In one-company towns, people may expect companies to support a "just transition" by investing early in alternative livelihoods (tourism, agriculture, training youth). Efforts should align with and complement town, city and/or local / provincial development plans, emphasising long-term over short-term activities. Joint projects with government (e.g., parks, industrial or agricultural initiatives) reassure communities; failure risks unemployment and social tensions.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
23. Company will define closure objectives and measurable and achievable success criteria early in the closure planning process, considering: a. Legal constraints. b. Input from stakeholders. c. Technical and economic feasibility. d. Environmental aspects. e. Socio-economic aspects. f. Post-mining land-use and facility use, including site relinquishment. g. The need to monitor and evaluate the effectiveness of closure activities against the objectives and criteria. h. The need to refine the success criteria as the closure and reclamation plan is updated.	Legal requirements partially conform with good practice: • Thailand law requires mining companies (all minerals, including coal) to prepare a mine reclamation plan and it must be got approval before mining start. • However, regulations do not explicitly require a closure plan or the establishment of closure objectives and measurable and achievable success criteria.	In Thailand, the law mainly mentions Mine Reclamation or Rehabilitation. The law does not describe much about mine closure processes. Central and local government institutions may not have the capacity or internal expertise to currently assess and approve the selection of closure objectives and success criteria by the company	To set realistic closure objectives and criteria, companies need robust baseline data on legal constraints, environmental conditions, and socio-economic context.	Communities and other stakeholders expect to be consulted on closure outcomes such as future land use and socio-economic transition.
25. Conservative financial surety instruments will be in place to pay for closure, reclamation and activities required in the post-reclamation period, including post-closure site monitoring, maintenance, and water treatment.	Legal requirements partially conform with good practice: • Thailand law does impose financial surety requirements for mine closure, but the instruments are limited. • Typically, a mining company must secure a performance bond or insurance policy to cover closure and reclamation costs. • There is no legal requirement to use more "conservative" instruments beyond these sureties (e.g. trust funds or over-funded bonds to cover unforeseen events); the surety amount is generally based on expected costs, which may or may not account for worst-case scenarios.	Regulators do ensure that a bond or policy is in place, but there is no framework to evaluate whether the chosen financial instrument is sufficiently conservative or diversified. The current approach is one-size-fits-all (often a bank guarantee or insurance bond).	- Determining an adequate surety requires detailed cost data and risk assessment. Companies must provide information on all closure activities and their costs; however, without clear guidelines on factoring contingencies, the data used might assume optimistic scenarios. Determining an adequate surety requires detailed cost data and risk assessment. Companies must provide information on all closure activities and their costs. Clear guidelines on factoring contingencies are r equired to avoid the generation of overly optimistic cost scenarios	Communities, environmental groups, and government auditors expect that the financial assurance will be sufficient to prevent mines from becoming a public burdenhttps://ccs.org.co/wp-content/uploads/2024/01/Ley-de-pasivos-ambientales-PS-412.pdf. They would prefer conservative coverage that errs on the side of caution. In practice, because the law only mandates a basic guarantee, stakeholders sometimes question whether the amount is truly enough, especially for large mines with long-term impacts.
26. Company will engage with stakeholders on the adequacy of the financial surety for mine closure and reclamation.	Legal requirements do not conform with good practice: • There is no explicit requirement in Thailand law for mining companies to engage stakeholders (such as local communities or public interest groups) regarding the adequacy of mine closure financial sureties.	Under the current framework, institutional processes for setting and reviewing financial surety do not include a role for stakeholders.	For meaningful stakeholder engagement on financial sureties, companies and regulators would need to share information about estimated closure costs, funding mechanisms, and worst-case scenarios. Currently, such financial details are usually contained in technical documents (like environmental impact studies) and are not presented in an accessible way to the public.	While there is no formal process, stakeholders (especially communities near mining projects and civil society organisations) have an expectation of transparency regarding mine closure. They want assurance that the company has set aside enough money to clean up the mine.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
27. Release of the financial surety will consider public comments and be subject to confirmation of successful reclamation.	Legal requirements do not conform with good practice: • There is no explicit requirement in Thailand law for release of the financial surety to consider public comments and be subject to confirmation of successful reclamation.	Central and local government institutions may not have the capacity or internal expertise to engage with the public on the release of the financial surety.	For meaningful stakeholder engagement on financial sureties, companies and regulators would need to share information about estimated closure costs, funding mechanisms, and worst-case scenarios. Currently, such financial details are usually contained in technical documents (like environmental impact studies) and are not presented in an accessible way to the public.	Stakeholder expectations specifically related to consideration of public comments on release of the financial surety were not noted.
28. Post-closure monitoring and maintenance should be undertaken to identify and address issues related to: a. Legal (compliance) requirements. b. Objectives and success criteria. c. Geotechnical stability and contamination from surface and underground working and mine waste facilities. d. Impacts on aquatic and terrestrial fauna and flora. e. Pit lake water quality.	Legal requirements partially conform with good practice: • Thailand environmental regulations acknowledge post-closure monitoring, but they do not comprehensively detail all aspects listed. • Typically, an approved closure plan will include a program of post-closure monitoring and maintenance for a limited period.	During the bonded post-closure period, environmental authorities conduct oversight (e.g., reviewing monitoring reports, site inspections). However, institutional capacity for long-term monitoring is limited. Once the official post-closure period ends and the site is relinquished, government agencies might not have dedicated programs (or funds) to continue checking issues like geotechnical stability or water quality at former mine sites. This raises feasibility concerns in addressing issues that persist beyond the short term.	Effective post-closure management requires ongoing data collection on multiple fronts: • Legal compliance (are standards being met). • Achievement of closure objectives (have success criteria like vegetation cover been met) • Geotechnical and chemical stability (e.g., tailings or underground workings stability, acid drainage), ecological recovery (health of aquatic/terrestrial life), and pit lake or groundwater quality. Monitoring may need to continue for an extended period (e.g., >5 -10 years).	Local communities and stakeholders expect that even after a mine is closed, someone (the company or the government) will have an oversight role to identify (at an early stage) and address any emerging problems.
29. Government should have a clear process for reviewing closure plans, including timeframes, the basis for rejection and revision, and resubmittal of an improved plan.	Legal requirements do not conform with good practice: • Thailand's current framework does not spell out a dedicated mine closure plan review process with specific timeframes and procedures separate from existing licensing processes.	There is no single "one-stop" closure plan review body, which can lead to fragmented feedback or even contradictory requirements. This makes it harder to have a clear timeline	Authorities require comprehensive information to review closure plans effectively, including technical engineering details, environmental impact mitigation measures, socio-economic transition plans, and cost estimations.	Stakeholders expect the government to diligently review closure plans to ensure they protect the environment and community interests. They would anticipate that if a plan is insufficient, the government would reject it and demand improvements swiftly.

Synthesised benchmark requirements	Regulatory alignment	Institutional capacity / feasibility	Information and data required	Stakeholder perspectives / expectations
30.Government should establish a well-resourced, trained and dedicated inter-departmental mine closure plan review team to minimise gaps and overlaps between different government departments.	Legal requirements do not conform with good practice: • Thailand mining governance does not currently have a formal inter-departmental team dedicated to mine closure plan reviews.	The creation of a well-resourced, trained inter-departmental closure review team would require significant changes, although the approach could draw on experience of setting up joint committees (comprising staff from different government departments) for review of EIAs. However, for active mine closure plan reviews, no such permanent team exists. Establishing one would need allocation of resources and training across agencies, which is not yet in place.	An inter-departmental team would need to share and jointly analyse information from various sources (mining plans, EIA community development plans, financial assurance details, etc.).	From a community and public interest perspective, a collaborative government approach is reassuring. Stakeholders expect that all relevant aspects of closure (environmental, technical, social, financial) are being looked at collectively, so nothing is overlooked.
31. Government should ensure the banking and insurance systems have the capacity to introduce and use a variety of financial assurance for mine closure.	Legal requirements do not conform with good practice: • Thailand regulations do not address this requirement.	As of now, there is no government initiative to undertake this aspect.	To expand financial assurance options in the future, detailed actuarial data and risk assessments of mine closure liabilities would be needed so that insurers or banks can price and manage these instruments. The determination of bond amounts should be based on engineering estimates of closure cost, including long-term liability risks.	Stakeholder expectations specifically related to the diversification of financial assurance options were not noted.
32. Government should establish a registry of abandoned sites, prioritise sites and assess and implement options for funding remediation.	Legal requirements do not conform with good practice: • Thailand does not have any registry of abandoned mines or a formal programme to remediate them. • Provincial Ministry of Mining noted that the only legacy mines are from 30-40 years ago, but new abandoned or illegal sites are not currently being created. These old sites are just left – there is no specific fund to address these.	There is no government initiative to undertake the registration yet.	A key aspect of the new registry is data collection. Authorities need to gather detailed information on each abandoned site: • Geographic location. • Extent of environmental damage. • Safety hazards. • Identity of the responsible party (if any / known) • Remediation options.	Stakeholder expectations specifically related to a registry of abandoned sites and funding for remediation were not noted.

Just Energy Transition in Coal Regions