GERMAN - MONGOLIAN INSTITUTE FOR RESOURCES AND TECHNOLOGY

The present work was submitted to the faculty of Raw Materials
and Environmental Engineering
the German-Mongolian Institute of Resources and Technology

ADOPTION OF THE TOWARD SUSTAINABLE MINING (TSM) STANDARD IN MONGOLIA: RECOMMENDATION BASED ON THE EXPERIENCE OF THE 'ENERGY RESOURCES' LLC

Bachelor's Thesis

By

OYUNGEREL Ganbaatar

Study program: Industrial Engineering

Student ID: B2100463

1st Supervisor/Examiner: Prof.Dr. Enkhzaya Chuluunbaatar

2nd Supervisor/Examiner: Mrs. Batbayasakh Ayurzana

Advisor: Mrs. Sarantsatsralt Batnyam

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Statutory Declaration

Ganbaatar Oyungerel — B2100463

Last Name, First Name — Student ID Number

I hereby affirm in lieu of an oath that I provided the submitted bachelor thesis

YOUR THESIS TOPIC

I did not use any sources other than those stated. In case that the work is additionally submitted on a data medium, I declare that the written and the electronic form are completely identical. The work was not submitted in the same or similar form to any examination authority.

2025.05.28

Place, Date

Signature

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Finally, I thank my family and friends for always supporting me.

Abstract

'Energy Resource' LLC is used as a case study in this thesis to examine the adoption of the Towards Sustainable Mining (TSM) standard in Mongolia and evaluate the opportunities and difficulties of applying global sustainability frameworks to the mining industry in Mongolia. This study investigates awareness levels, operational gaps, and institutional readiness for sustainable mining practices through semi-structured interviews and structured surveys with 'Energy Resource' LLC employees at the Ukhaa Khudag Mine.

Survey results reveal that while 70% of regular employees were unfamiliar with the TSM standard by name, most actively supported sustainability principles in their daily work. Significant difficulties with training, documentation, communication, and resource allocation were found through thematic analysis of interviews. The main challenges were poor comprehension of the TSM criteria, a lack of organized training, inconsistent language, and restricted access to historical data.

The study employs a weighted challenge evaluation system and proposes practical recommendations such as mandatory TSM training, centralized document management systems, standardized terminology, and dedicated TSM implementation teams. The findings underscore that companies with existing ISO certifications were better prepared for TSM adoption, highlighting the value of integrated management systems.

Ultimately, this thesis provides policymakers and mining companies in Mongolia with practical advice on conforming to global sustainability standards. It concludes that Mongolia can establish its status as a regional leader in responsible mining by strategically investing in internal capacity and stakeholder engagement.

Key words: Towards Sustainable Mining (TSM), Mongolian mining sector

List of Abbreviations

Abbreviation	Full Form
TSM	Towards Sustainable Mining
ESG	Environmental, Social, and Governance
ISO	International Organization for Standardization
MNMA	Mongolian National Mining Association
MAC	Mining Association of Canada
EITI	Extractive Industries Transparency Initiative
GHG	Greenhouse Gas
CEP	Coal Enrichment Plant
COI	Community of Interest
IFC	International Finance Corporation
SDGs	Sustainable Development Goals
MCDA	Multi-Criteria Decision Analysis
CSR	Corporate Social Responsibility

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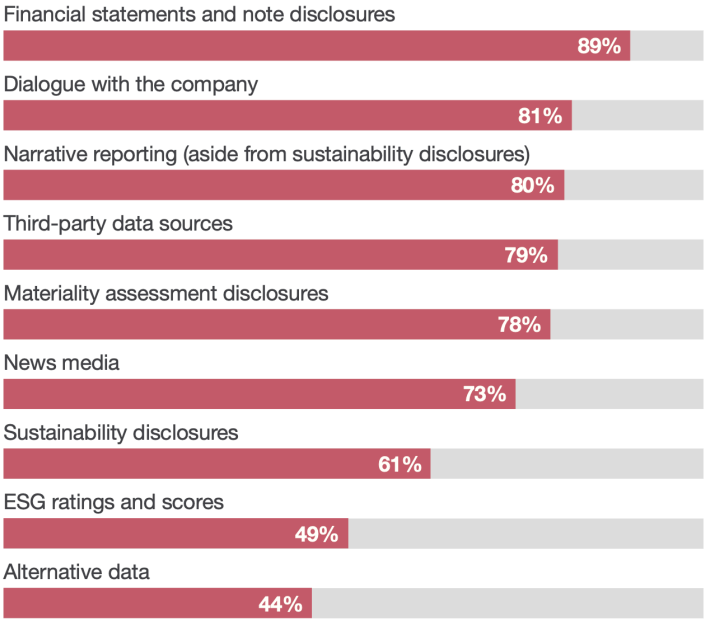
1. Introduction

1.1 Background Study

One of the key standards for mining companies to ensure their sustainability is environmental, social, and governance (ESG) standards, which guide how companies act responsibly towards the world and people. ESG is important as socially conscious investors increasingly use these criteria when evaluating and selecting potential investments [1].

Figure 1: Pergecentage of respondents who use the source to a moderate, large, or very large extent in assessing how companies manage risks and opportunities



Source: PwC Global Investor Survey 2022.

In 2023, Mongolia's mining sector contributed approximately 28.7% of the country's GDP, accounted for 92.1% of export earnings, and generated 31.6% of fiscal revenue. This significant reliance underscores the critical importance of sustainable practices within the industry to ensure long-term economic stability [2]. While mining continues to drive economic growth and employment, it also generates significant social and environmental challenges, such as land degradation, water pollution, and conflicts with local communities [3]. A local example is the '*Khalzan Burgedei*' project, which faced community opposition that escalated into the demolition of worker housing, underscoring the need for better community engagement and environmental safeguards [4]. Such incidents stress the importance of strengthening community

engagement and environmental stewardship. In response to these concerns, initiatives like the Responsible Mining Code, developed by the Mongolian National Mining Association (MNMA), and the Towards Sustainable Mining (TSM) standard, offer structured pathways to improve accountability and sustainability across the mining sector[5], [6].

Figure 2: Public Opposition to the Khalzan Burgedei Project

Source: Mongolian National News Agency

In Mongolia, the Mongolian National Mining Association (MNMA) has been implementing the 'Responsible Mining Code', which covers more than 50 companies, since 2018, to promote responsible mining. It is based on the Toward Sustainable Mining (TSM) standard, an initiative developed by the Mining Association of Canada (MAC), and adapted to the Mongolian context [6]. At the request of the Mongolian National Mining Association member companies, the aim was to implement it in a more international manner. As a result, the TSM standard was officially implemented in Mongolia in October 2024, following a cooperation agreement signed between the Mining Association of Canada (MAC) and the Mongolian National Mining Association (MNMA) [7].

A notable example of TSM application is 'Energy Resources' LLC, a leading mining company in Mongolia, which began implementing the TSM program at its Ukhaa Khudag mine in 2023. This case presents valuable insights into the opportunities and difficulties of introducing sustainability standards in Mongolia's mining industry [8].

This study is significant because it addresses Mongolia's urgent need for sustainable mining operations. By analyzing Energy Resources LLC's experience, the research

aims to provide actionable recommendations for the broader adoption of TSM across the sector. It seeks to support the development of a balanced approach to economic growth, environmental protection, and social responsibility.

1.2 Problem Statement

Despite the importance of sustainable mining, Mongolia's mining industry has yet to widely adopt the internationally recognized and practically experienced standards, for example, the TSM standard. Challenges include a lack of awareness, limited resources, and insufficient regulatory support. Energy Resources LLC has partially implemented sustainable practices, allowing it to analyze its efforts and identify best practices.

To achieve the goal of promoting TSM adoption in Mongolia, this study will:

- Examine the current state of TSM implementation in Energy Resources LLC.
- Identify barriers and opportunities for broader adoption.
- Provide recommendations for policymakers, industry leaders, and stakeholders.

1.3 Research Questions

To achieve this goal, what key questions need to be addressed?

- What specific challenges and opportunities does Mongolia's mining industry face in adopting TSM, as reflected in the experience of Energy Resources LLC?
- How can the insights gained from Energy Resources LLC's implementation inform strategies for broader adoption of TSM across Mongolia's mining sector?

2. Literature Review

2.1 History of Sustainability

The concept of sustainability has evolved over centuries, reflecting humanity's growing awareness of the interplay between environmental stewardship, societal well-being, and economic development.

Ancient and Pre-Industrial Awareness

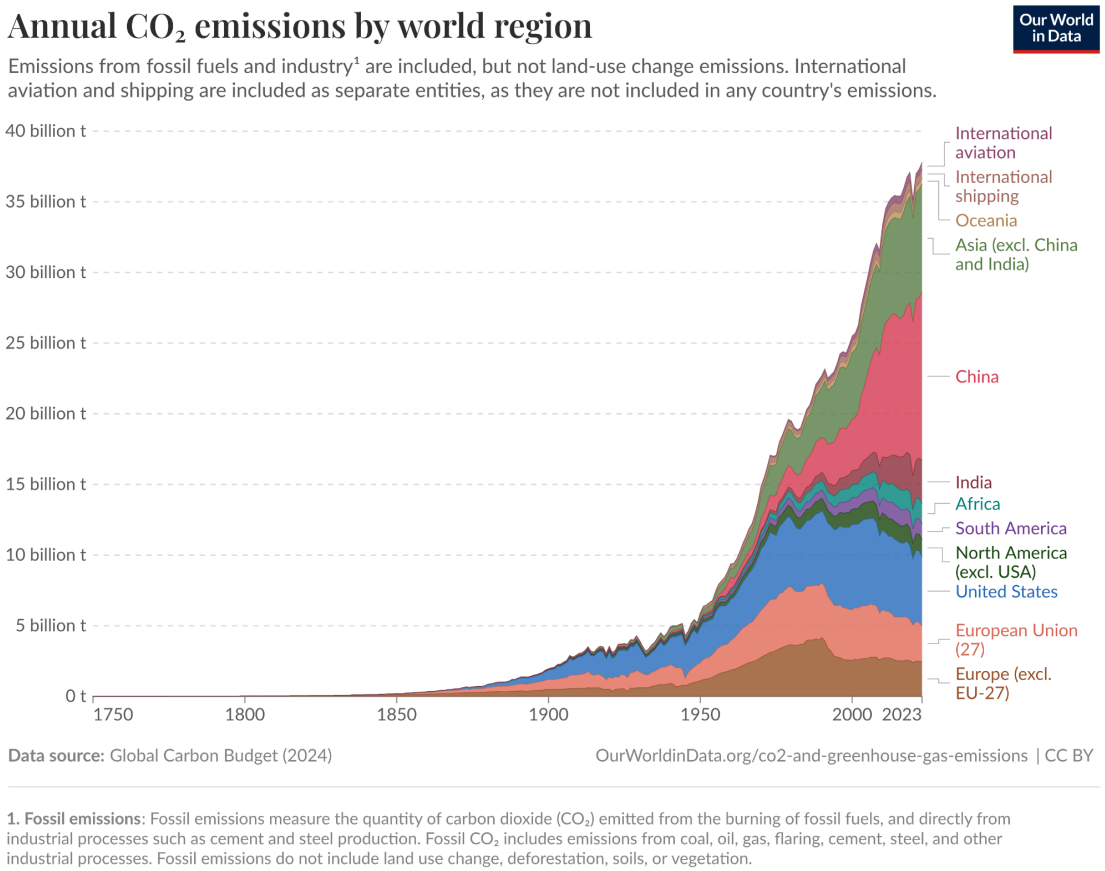
Concerns about environmental degradation date back to ancient times. As early as 500 BC, scholars documented the adverse effects of human activities on nature and advocated for less harmful practices. In pre-industrial Europe, deforestation, air, and

water pollution were prevalent, leading to early discussions on the need for balanced resource management [9].

Industrial Revolution and Emerging Environmental Concerns

The Industrial Revolution marked a significant turning point in human history, characterized by rapid technological advancements and the large-scale exploitation of natural resources. This period witnessed a dramatic rise in greenhouse gas emissions due to the widespread use of fossil fuels in industries, transportation, and energy production. The resulting environmental degradation raised early concerns about sustainability. Notably, emissions began to rise steeply in the mid-20th century, reflecting the acceleration of industrial activities across both developed and emerging economies. China, the United States, and the European Union have been among the largest contributors, though recent growth in emissions is increasingly concentrated in Asia and other developing regions. This historical trend underscores the environmental costs of industrialization and highlights the urgency of adopting sustainable practices to mitigate climate change and promote long-term ecological balance [10].

Figure 3: World CO_2 emissions by world region



Source: Our World in Data, based on Global Carbon Budget (2024).

20th Century Developments and Institutional Responses

The 20th century saw the formalization of sustainability concepts [11]. In 1987, the Brundtland Commission's report, "Our Common Future," provided a widely accepted definition of sustainable development: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." This period also witnessed various environmental organizations' establishment and policies promoting sustainable practices globally [12].

Contemporary Perspectives and Urgency

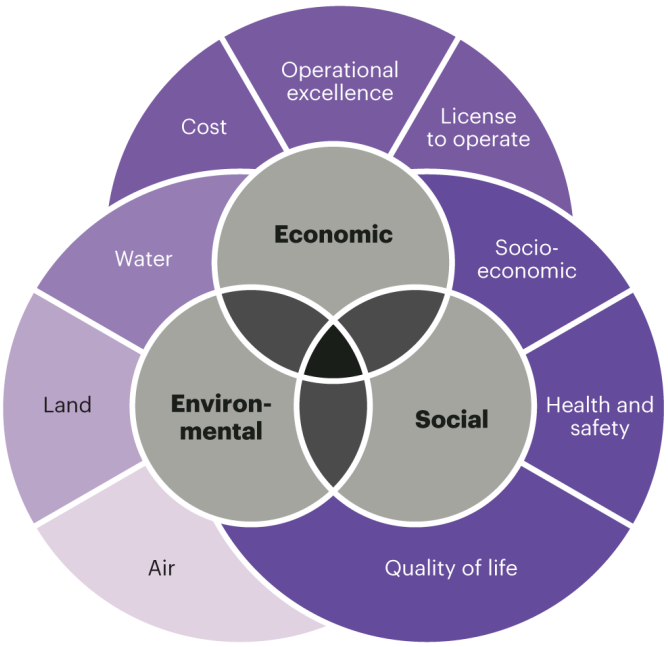
In recent decades, sustainability has become a central theme in global discourse, encompassing environmental, social, and economic dimensions. The urgency to address climate change, biodiversity loss, and social inequalities has led to international agreements like the Paris Agreement and the adoption of the United Nations Sustainable Development Goals (SDGs), aiming to foster a more sustainable and equitable future [13].

2.2 Introduction to Sustainable Mining

Sustainable mining refers to the responsible extraction and management of mineral resources to balance economic growth, environmental protection, and social development. It is a holistic approach that emphasizes long-term value creation rather than short-term gains, aiming to ensure that mining activities today do not compromise the ability of future generations to meet their own needs [14], [15].

This concept is inherently multi-sectoral. Environmentally, sustainable mining focuses on reducing emissions, managing land and water use, conserving biodiversity, and minimizing waste. Socially, it prioritizes local communities' health, safety, and well-being, while promoting stakeholder engagement, indigenous rights, and quality of life. Economically, it targets cost efficiency, operational excellence, and the equitable distribution of benefits across society [16].

Figure 4. Key Dimensions of Sustainable Mining



Source: A.T. Kearney analysis

The importance of sustainable mining has grown in recent decades due to increasing environmental degradation, rising social expectations, and the demand for responsible corporate behavior. Poorly managed mining operations can lead to deforestation, water contamination, social conflict, and economic dependency. In contrast, sustainability-oriented practices contribute to risk reduction, community support, and regulatory compliance, strengthening a company's social license to operate [17] [12].

International financial institutions such as the World Bank and the International Finance Corporation (IFC) have integrated sustainability into their investment and advisory policies in the mining sector. The IFC's Performance Standards on Environmental and Social Sustainability provide a global benchmark for responsible project development, including risk assessments, stakeholder engagement, and environmental management plans [18]. Furthermore, both institutions support global transparency initiatives such as the Extractive Industries Transparency Initiative (EITI), reinforcing accountability and good governance [19] [20]. Through these mechanisms, sustainable mining has become a critical criterion for resource-rich countries' project funding and development planning.

2.3 Current Status and Actions of Sustainable Mining in Mongolia

2.3.1 Existing Frameworks

The Mongolian National Mining Association (MNMA) has developed the Responsible Mining Code, inspired by the TSM standard, to help mining companies implement sustainable practices. Since 2018, 50 Mongolian mining companies have voluntarily implemented it. The Mongolian National Mining Association is monitoring the implementation. The program is based on three main documents: the Voluntary Code of Responsible Mining, the Implementation Guidelines, and the Self-Assessment Methodology [21] The Responsible Mining Code was created to help Mongolian mining companies integrate environmental, social, and governance (ESG) principles into their operations and align more closely with global sustainability expectations..

The Responsible Mining Code outlines five primary areas of scope:

1. Good corporate governance and transparency,
2. Labor relations and human rights,
3. Health and safety,
4. Environmental protection, and
5. Local development and community participation.

It is also guided by key principles of responsible mining, including: transparency and openness, respect for the law, environmental and human safety responsibility, investment in future development, and advanced technology. These principles aim to ensure that mining operations are economically viable and ethically and environmentally responsible.

The program is structured according to 8 principles, five core frameworks, and 29 specific requirements. Participating companies undergo training in the first year, conduct a self-assessment, and submit a report [21].

Responsible mining code has gained traction, with several leading mining companies demonstrating high self-assessment scores. For example, Oyu Tolgoi reported a 100% compliance score, while companies like Boroogold LLC, Erdenet Uildver SOE, and Erdene Mongol also reported strong performance. The selected companies' self-assessment scores are presented in Table 1 below.

Source: Mining Companies Self-Assessment records 2023-2024 (MNMA).

№	Company name	Self-Assessment in 2023 (%)	Self-Assessment in 2024 (%)
1	'Achit Ikht' LLC	Incomplete reporting	86
2	'Badrakh Energy' LLC	Incomplete reporting	89.2
3	'Baganuur' JSC	Incomplete reporting	Incomplete reporting
4	'Boroogold' LLC	Incomplete reporting	96
5	'Energy Resources' LLC	91.6	91.6
6	'Erdene Mongol' LLC	93.4	Incomplete reporting
7	'Erdenes Tavan Tolgoi' JSC	89	Incomplete reporting
8	'Erdenet Mining Corporation' SOE	93.1	Incomplete reporting
9	'Innova Mineral' LLC	Incomplete reporting	90
10	'Khan Altai Resources' LLC	Incomplete reporting	Incomplete reporting
11	'Khangad Exploration' LLC	89.2	Incomplete reporting
12	'Khurgatai Khairkhan' LLC	Incomplete reporting	Incomplete reporting
13	'Mongolrostsvetmet' SOE	Incomplete reporting	Incomplete reporting
14	'Oyu Tolgoi' LLC	100	
15	'Platinum Land' LLC	91.6	93.42
16	'SouthGobi Sands' LLC	83	
17	'Steppe Gold' LLC	91	83.9

Table1. Companies Self Assessment score of the Responsible Mining Code

2.3.3 Mongolia's Strategic Shift Toward the TSM Framework

To strengthen its commitment to sustainable mining, the Mongolian National Mining Association (MNMA) has formally approved the adoption of the Towards Sustainable Mining (TSM) standard, originally developed by the Mining Association of Canada (MAC). The official signing of the agreement is scheduled during Mining Week 2024, positioning Mongolia as the third Asian country, following Australia and the Philippines, to commit to TSM implementation. MNMA also becomes the 12th national mining association globally to join the TSM initiative, reflecting the program's expanding international footprint [22].

Mongolia has already taken preliminary steps toward responsible mining through the implementation of the Responsible Mining Code since 2018. This voluntary standard, adapted from the TSM framework, was designed to fit the specific governance, social, and environmental context of Mongolia. It outlines basic principles and legal guidelines

for responsible mining and has served as a foundational tool to promote sustainable practices within the industry.

However, while both the Responsible Mining Code and the TSM framework share similar values and operational themes, they differ significantly in scope, transparency, and international recognition. The TSM standard offers a more comprehensive and globally standardized approach, providing clearer metrics and evaluation protocols that are aligned with international best practices.

Implementing the TSM framework is therefore a strategic advancement for Mongolia. It not only enhances environmental safeguards but also addresses key limitations of the existing Responsible Mining Code. For instance, while the Code contributes to national ESG efforts, it lacks detailed organizational-level reporting and offers only limited environmental performance assessments through EITI channels. In contrast, TSM promotes public disclosure of performance results, allowing for independent scrutiny and better stakeholder engagement [23].

Another key distinction is the performance evaluation system. TSM employs a graded rating scale from Level C to AAA, enabling companies to track progress and identify areas for improvement. The Responsible Mining Code, by comparison, relies on a binary “yes or no” assessment, which restricts the ability to monitor continuous development or benchmark across companies [23].

The adoption of TSM is expected to bring multiple benefits. It is likely to increase investor confidence, open pathways for Mongolian companies to access international stock markets, and enhance the country's global reputation in the mining sector. Notably, entities like ‘Erdenes Mongol’, which oversees more than 20 companies, have already integrated TSM into their five-year strategic plans, demonstrating strong institutional support [22].

By adopting the TSM framework, Mongolia positions its mining sector to align with international sustainability standards. This move reflects a national commitment to balance economic growth with environmental responsibility and social accountability, and to ensure long-term competitiveness and resilience in global resource markets [22],[23].

2.3.2 Challenges and Future Directions: An Institutional Perspective (MNMA)

The Mongolian National Mining Association is facing several challenges with the implementation of TSM (Toward Sustainable Mining). Since this is the first time TSM is being introduced in Mongolia, workshops must be organized for stakeholders, and TSM documents need to be translated into Mongolian. However, as TSM adoption is voluntary, it is difficult to involve all member companies. Additionally, the agreement requires TSM to be adapted to Mongolian conditions, which means some documents need revision, and a Community of Interest (COI) must first be established to guide these changes [21].

Another challenge is the global shift toward a single mining standard. The Consolidated Mining Standards Initiative (CMSI) aims to unify four major standards Copper Mark, Canadian TSM, the World Gold Council's Principles for Responsible Gold Mining, and ICMM's Mining Principles into one global framework. While a unified standard would reduce complexity compared to implementing multiple standards, Mongolia must consider that TSM may change again shortly after its introduction [24]. Fortunately, the unified standard will be based on TSM, which means Mongolia's experience with TSM will ease the transition to the global system.

2.4 Introduction to Toward Sustainable Mining (TSM) program

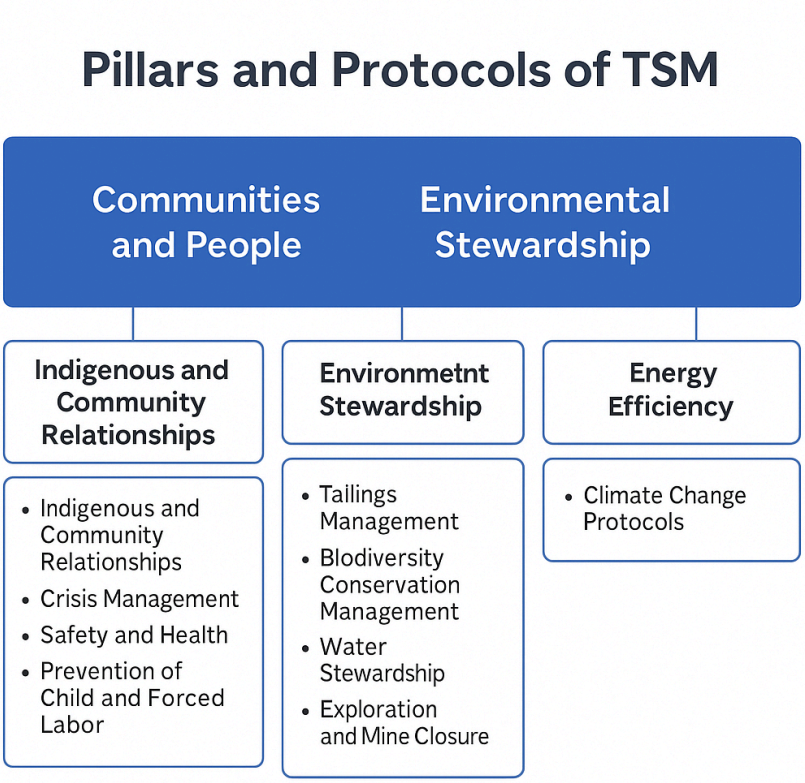
2.4.1 General information about the TSM Program

The Towards Sustainable Mining (TSM) program, established by the Mining Association of Canada (MAC) in 2004, represents a commitment to sustainable and responsible mining. TSM provides a performance-based framework for mining companies to address critical social, environmental, and governance risks while maintaining transparency and credibility. It was the first mining standard in the world to mandate site-level reporting, independent verification, and public reporting. TSM has since become a globally recognized sustainability standard and has been adopted across six continents [25].

TSM aims to ensure that mining companies meet societal expectations for sustainability while addressing environmental, economic, and social responsibilities.

Member companies must adopt the TSM Guiding Principles, committing to continuous improvement and public reporting on sustainability performance [25].

Figure 5. Pillars and Protocols of the TSM Program



Source: Mining Association of Canada, 2023.

Each of these pillars contains protocols and specific indicators that measure sustainability performance at the facility level. Facilities self-assess their performance annually, assigning grades ranging from Level C to Level AAA. These protocols drive companies to implement site-level management systems, measure their performance, and improve sustainability outcomes. Companies undergo external verification every three years to ensure transparency and credibility [25].

2.4.2 TSM Assurance Framework

The TSM assurance process consists of four components

1. Self-Assessment: Facilities conduct annual self-assessments, documenting evidence to support performance.
2. External Verification: Independent verifiers review self-assessments every three years to confirm their accuracy.

3. CEO Letter of Assurance: The CEO or equivalent publishes a letter affirming the verification process and performance.
4. Post-Verification Review: The Community of Interest (COI) Panel reviews selected facilities' verified results and explores performance improvements.

This assurance framework reinforces the program's credibility and ensures continuous improvement [25].

2.4.3 Governance and Stakeholder Involvement

The governance structure of the Towards Sustainable Mining (TSM) program is designed to uphold accountability, transparency, and responsiveness to stakeholder priorities. Oversight is provided by the MAC Board of Directors, which is tasked with setting strategic objectives and approving key decisions that shape the direction of TSM. Supporting this role is the TSM Governance Team, a dedicated subcommittee that offers strategic leadership and ensures the program remains aligned with evolving sustainability expectations [25].

The Community of Interest (COI) Panel is a central feature of the governance framework. This independent, multi-stakeholder group comprises representatives from Indigenous communities, environmental organizations, labor groups, and other relevant sectors. The COI Panel not only reviews facility performance but also advises on the continuous development of the program and facilitates open dialogue between mining companies and affected communities [25].

Public participation is also embedded in TSM governance. Draft protocols and policies are regularly published for public comment, allowing external stakeholders to provide input and contribute to the program's evolution. This inclusive and transparent approach ensures that TSM remains credible and adaptable to diverse societal concerns [25].

2.4.4 Global Adoption and Alignment with International Standards

TSM's international adoption underscores its credibility as a global benchmark for sustainable mining. Mining associations across six continents have implemented the program, customizing it to their national contexts while adhering to TSM's core components [25].

Furthermore, TSM aligns with other global sustainability standards, such as:

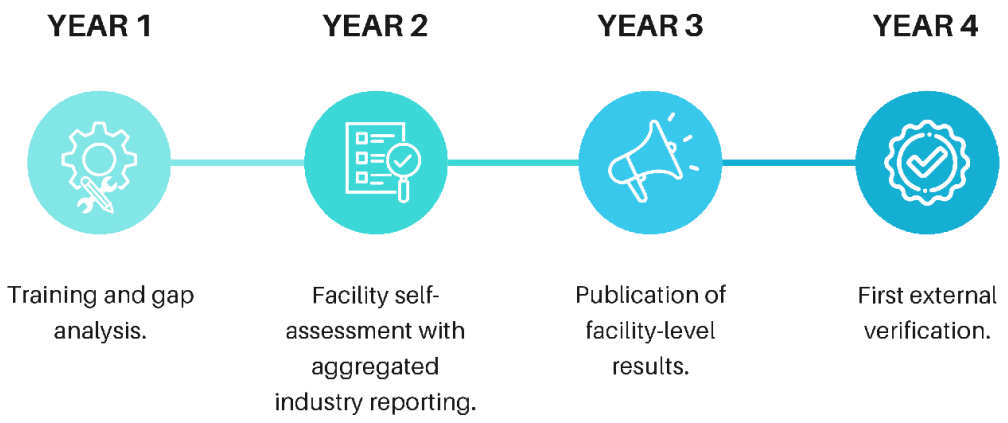
- International Council on Mining and Metals (ICMM) Mining Principles
- World Gold Council's Responsible Gold Mining Principles (RGMPs)
- The Copper Mark standard uses the Responsible Minerals Initiative (RMI) framework.

Through initiatives like the M3 Partnership Integrated Assessment Protocol, TSM enables efficient, streamlined audits against multiple standards, reducing costs while improving alignment.

2.4.5 Performance Reporting and Continuous Improvement

TSM promotes transparency through annual reporting of sustainability performance. The reporting process follows a staged implementation schedule for new members [25].

Figure 6. Four-year reporting cycle of TSM



Source: Mining Association of Canada, 2023.

Each facility's performance is graded based on protocol indicators, with results made publicly available in annual TSM Progress Reports. A key goal of TSM is for facilities to achieve a Level A or higher rating, reflecting effective risk management and adherence to sustainability best practices.

MAC provides training and support to ensure consistent program implementation. Members are expected to demonstrate continuous improvement, and failure to meet expectations may result in corrective action or membership revocation [25].

2.4.6 Challenges and Future Directions

While TSM has achieved global recognition, it faces challenges such as varying regulatory landscapes, emerging technologies, and evolving stakeholder expectations. TSM addresses these challenges through continual protocol reviews, public consultations, and alignment with international standards.

Future updates, including revisions to key protocols like Climate Change and Biodiversity Conservation, ensure TSM remains at the forefront of sustainability practices [25].

2.5 TSM Adoption in Energy Resource LLC

2.5.1 General Information about Energy Resource LLC

Energy Resources LLC is a nationally invested mining company and one of the leading enterprises in the Mongolian mining industry. The company has national financial investments such as M-C-S Group, Petrovis LLC, and Shunkhlai Group. In 2010, Energy Resources was listed on the Hong Kong Stock Exchange, becoming the first Mongolian national company to enter the international stock market successfully.

The company owns a special operating tool 11952A, covering an area of 2,962 hectares, for the operation of the Ukhaa Khudag coking coal deposit in Tsogttsetsii soum, Umnugobi province. Ukhaa Khudag mining operations began in 2009. After 2-3 years of project construction, the plant has developed into a world-class industrial complex with coal enrichment, an 18-megawatt power plant, a water supply system, a residential area, a kindergarten complex, and technical and social infrastructure.

Today, Energy Resources LLC is a leading enterprise that exports coal domestically and continues to increase the value of Mongolian resources and supply them to international markets. Energy Resources LLC has been ranked as one of the TOP 5 enterprises in Mongolia since 2010.

Energy Resources LLC established Mongolia’s first Coal Enrichment Plant (CEP) within the Ukhaa Khudag complex and is currently the leading domestic company exporting coal as a non-raw, enriched product. The plant, which consists of three modules with a total capacity of 5 million tons of coal washing and enrichment per year, was commissioned in 2011, 2012, and 2013.

The Coal Enrichment Plant (CEP) has significantly enhanced the value and competitiveness of Mongolian coal in international markets by producing high-quality, export-ready coking and thermal coal. Its adoption of cutting-edge Australian

processing technology, combined with innovative water reuse systems, demonstrates a commitment to efficiency and sustainability, particularly in the water-scarce Gobi region. The plant has also contributed to the local economy by creating over 150 jobs and pioneering advanced technologies in the region. Since beginning operations in 2011, the CEP has processed 62 million tons of raw coal, resulting in 31 million tons of enriched coking coal and 12.5 million tons of enriched thermal coal. These achievements underscore its vital role in adding value to Mongolia's mining sector and promoting sustainable, resource-efficient practices [26].

2.5.2 Sustainability Practices at 'Energy Resources' LLC

Energy Resources LLC, a Mongolian Mining Corporation (MMC) subsidiary, integrates sustainability as a core element of its business strategy. Through its Sustainable Development and Corporate Social Responsibility (CSR) Policy, MMC seeks to create long-term value for its stakeholders while protecting people, communities, and the environment.

MMC's corporate sustainability approach is anchored on six guiding principles:

- Ethical Governance: Integrating environmental, social, and governance (ESG) considerations into all business decisions, with a commitment to transparency and accountability.
- Health and Safety: Prioritizing the physical and psychological well-being of employees through ISO 45001-compliant safety systems.
- Stakeholder Engagement: Proactively consulting with communities of interest (COIs) to build trust and long-term collaboration.
- Environmental Stewardship: Minimizing ecological impact by implementing pollution control, biodiversity conservation, and resource efficiency measures.
- Community Development: Supporting education, local employment, and infrastructure in host communities to ensure inclusive development.
- Global Standard Alignment: Committing to international initiatives such as the Extractive Industries Transparency Initiative (EITI), ISO standards, and the Towards Sustainable Mining (TSM) framework.

As part of this commitment, Energy Resources LLC implemented the TSM standard at its Ukhaa Khudag (UHG) mine. The company completed its first self-assessment in July 2023, followed by external verification by an independent MAC-accredited auditor, Neil Allen of Envirochem Services Inc., in 2024 [26].

The results confirmed the company's strong sustainability performance across multiple TSM protocols:

Table 2. Verified result of Ukhaa Khudag Mine, Energy Resources LLC (2024)

TSM Protocol Area	Best Sub-Indicator Score	Lowest Sub-Indicator Score	Overall Protocol Rating
Climate Change	AA	C	C
Safety and Health	AAA	B	AAA
Tailings Management	C	C	C
Biodiversity Conservation	AAA	AAA	AAA
Water Stewardship	AA	A	AA
Indigenous & Community Relationships	AA	A	A

Source: MAC TSM Verification Summary Report, 2024

These scores demonstrate the company's effective integration of sustainability into its day-to-day operations and its readiness to meet international expectations for responsible mining. In particular:

- Climate Change: Although the facility received an AA rating for its operational climate change management (e.g., awareness initiatives and process integration), it scored only a C in performance targets and reporting, significantly impacting the overall rating. This indicates that while foundational efforts exist, the absence of long-term emissions reduction targets and consistent reporting limits the score to a Level C.

- Safety and Health: The mine achieved AAA ratings across most sub-indicators (e.g., planning, accountability, training), with only one sub-indicator receiving a B, resulting in an overall rating of AAA. This demonstrates mature and embedded occupational health and safety practices across the organization.
- Tailings Management: All five sub-indicators in this protocol received a C rating, reflecting early-stage or underdeveloped practices in tailings policy, responsibility assignment, OMS (operation, maintenance, and surveillance), and reviews. This area presents a clear opportunity for improvement.
- Biodiversity Conservation: The UHG mine attained AAA ratings across all sub-indicators, highlighting a robust biodiversity strategy that includes planning, implementation, stakeholder communication, and reporting. This indicates complete alignment with global best practices.
- Water Stewardship: With scores ranging from A to AA, this protocol reflects strong but not yet fully optimized practices. The AA rating in watershed-scale planning suggests strong regional water management efforts, while A-level scores in operational controls suggest potential for strengthening internal monitoring or integration.
- Indigenous and Community Relationships: The facility demonstrated effective engagement with Indigenous and local communities, reflected in scores ranging from A to AA. Areas like community impact management and response mechanisms were rated well, though broader community benefit planning may require further enhancement to reach AAA.

This achievement illustrates the synergy between MMC's sustainability policy and the TSM framework. By embedding TSM protocols into internal operations, Energy Resources LLC has strengthened its ESG credibility, enhanced investor confidence, and positioned itself as a national leader in sustainable mining.

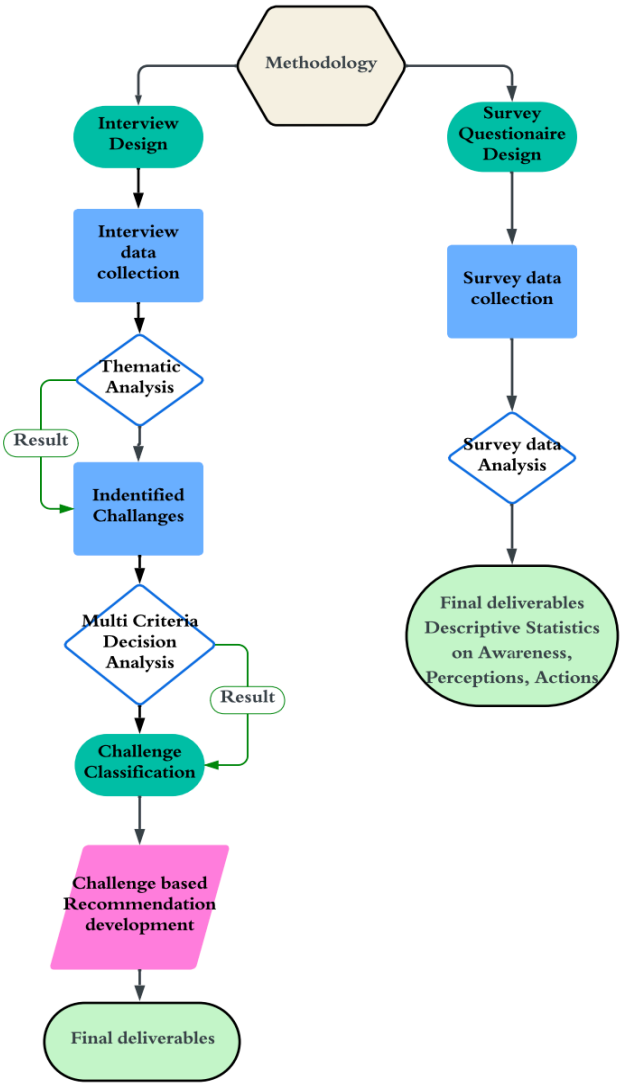
Moreover, the company's transparent participation in external verification reflects its commitment to continuous improvement and stakeholder accountability. It also highlights the feasibility of implementing TSM successfully in Mongolia when underpinned by ISO standards, structured planning, and leadership commitment [26].

3. Methodology

The methodology of this research adopts a mixed-methods design that combines both quantitative survey analysis and qualitative interview-based thematic analysis to provide a comprehensive understanding of the implementation of the Towards Sustainable Mining (TSM) standard at Energy Resources LLC.

As shown in Figure 7, the methodology is structured into two parallel but integrated tracks: one focusing on employee-level awareness and perception (quantitative survey), and the other addressing operational-level implementation challenges and strategies (qualitative interviews).

Figure 7. Methodology Work Flowsheet



3.1 Survey design

A structured survey questionnaire was developed to evaluate the level of awareness, understanding, and perception of the Towards Sustainable Mining (TSM) framework among employees at 'Energy Resources' LLC. This survey aims to collect both quantitative and qualitative data on employees' exposure to TSM, their sustainable practices, and how they perceive the company's sustainability-related initiatives.

The survey is strategically designed to include participants from various departments and operational levels, from field workers to administrative and technical staff to ensure a representative cross-sectional sample [27]. This approach will enable a more comprehensive understanding of the internal dissemination and practical integration of the TSM framework within the company.

To maximize participation and accessibility, the survey was distributed electronically via company email systems and physically in person during departmental meetings or shift turnovers. This hybrid distribution method ensured broader coverage, particularly in cases where employees may have limited digital access due to operational roles.

Sample size determination

Sample size determination: $$n = \frac{N \times Z^2 \times p \times (1-p)}{(E^2 \times (N-1) + (Z^2 \times p \times (1-p))}$$

$n = Sample\ size$

$N = Population\ size$

$e = margin\ of\ error$

$Z = Z\ score\ corresponding\ to\ the\ confidence\ level$

$p = estimated\ proportion\ (0.5\ used\ to\ when\ variability\ is\ unknown)$

If the Ukhaa Khudag mine of Energy Resources operates at full capacity, it is estimated to require around 2000 regular employees. With a margin of error of 10%, the statistically significant sample size needed for the survey is 65 participants.

3.1.1 Survey Instrument

The questionnaire consists of seven questions, a mix of open-ended and multiple-choice formats, designed to extract factual and perceptual data.

1	What is your job position? *(Open-ended response)*
2	How long have you worked at Energy Resources LLC? *(Less than 1 year/1–3 years/ 3–5 years/ More than 5 years)*
3	Have you heard about the 'Towards Sustainable Mining' (TSM) standard? (*Yes/ No)*
4	If yes, where did you first hear about the TSM standard? *(Check all that apply.) (Company training/ Senior management or supervisors/ Colleagues/ Internal communications (email, posters, meetings)/I have not heard about it)*
5	In your opinion, how important is it for your company to have a policy or plan for sustainable mining? *(Mark only one) (1 (Not important)/ 2/ 3 / 4/ 5 (Very important)*
6	Have you ever engaged in any of the following actions at your workplace? *(Check all that apply.)* *(Properly sorting and recycling waste/ Reporting safety and environmental issues/ Following energy and water-saving measures/ Participating in community support initiatives/ I have not done any of the abov.e)*
7	Were you aware that the above actions contribute to the company's sustainable mining efforts? *(Yes, I was aware/ No, but it makes sense now/ I still do not understand how these are related)*

Table 3. Survey Questionaire

3.2 Interview Design

3.2.1 Interview Introduction

The interviews were conducted on-site at the Ukhaa Khudag (UHG) mine, the operational base of Energy Resources LLC, for one week. Participants were purposefully selected based on their roles in the TSM implementation process, ensuring comprehensive coverage of strategic, managerial, and operational perspectives.

To capture a wide range of experiences, participants were categorized into two distinct groups:

- Group 1: Senior Management
  This group included executives and department heads responsible for strategic planning, policy-making, and high-level coordination. They provided insights into why the TSM standard was adopted and how decisions were made at the corporate level.
- Group 2: Site Managers
  Site-level managers were interviewed to understand how TSM protocols were interpreted and implemented within individual departments. These interviews explored the practicalities of documentation, internal audits, team coordination, and readiness for external verification.

This categorization enabled the research to compare and contrast strategic intent with practical execution, highlighting the alignment or gap between management and workforce-level understanding.

Qualitative data was collected using semi-structured, open-ended interviews, allowing for flexibility in response while maintaining consistency in the core topics discussed. This format also enabled spontaneous elaboration on relevant themes that emerged during interviews.

The qualitative responses were analyzed using Thematic Analysis (TA), following Braun and Clarke's six-step methodology (2006) [28]. The iterative coding process allowed the researcher to identify key patterns, group them into overarching themes, and link these themes to the research objectives.

3.2.2 Interview procedures

Interviews will be conducted in person or online and will be recorded and archived. The recordings will then be transcribed. After the transcript is written, it will be read and analyzed, and the results will be presented using thematic analyses to determine which areas to focus on and to what extent.

3.2.3 Interviewee Groups

To gather comprehensive insights, participants are divided into two key groups:

1. Group 1: ESG team members (1–3 participants) involved in initiating TSM at the company level.
2. Group 2: Department managers and employees (10–15 participants) directly responsible for implementing TSM protocols.

3.2.4 Interview Questions

Table 4. Interview Questions– Group 1 (TSM Initiators and ESG Team)

Questions for Group 1: TSM Initiators and ESG Team
1. General Background and Role in TSM Implementation
What is your current job title and department? What are your main responsibilities? How long have you worked in the organization? Why was the TSM standard adopted, and what were the initial motivations? In what ways have you been involved in implementation?
2. Implementation Process
When and how did the TSM implementation begin? Who oversees the TSM implementation process? What portion of the company's annual budget is allocated to TSM-related activities? Was a formal agreement or approval process required before implementation? What is the estimated cost of external verification? Did you receive training at the outset? What topics were covered? How effective was the training in preparing for assessments? Were external consultants involved? If so, from where and at what cost? What was your role during the external audit? What challenges emerged during the verification process? What documentation was required? How difficult was it to compile? Are corrective actions or policy changes implemented based on audit feedback?
3. Evaluation and Reflections
What would you have done differently to improve implementation? Who were the key supporters throughout the process? What significant changes occurred after implementation?
4. Impacts and Recommendations
How has TSM affected relations with the government and communities? What advice would you offer to other companies considering TSM?
5. Reflections and Lessons Learned
What would you do differently? Who supported you the most? What changes followed the implementation? Who else contributed to the TSM assessment?
6. Impacts and Recommendations
How did TSM influence your engagement with external stakeholders? Should TSM be adopted nationwide in Mongolia? Why or why not? Any final reflections?

Table 5. Interview Questions – Group 2 (Department Managers and Employees)

Questions for Group 1: TSM Initiators and ESG Team
1. General Background and Role in TSM Implementation
What is your job title and department? What are your responsibilities? How long have you worked here? How were you involved in TSM?
2. Implementation Process
Which protocol(s) were you responsible for? How did you approach implementation? Did you receive TSM training? What did it include? Was the training helpful? Why or why not? Who conducted the internal assessments? Were they trained? What challenges did you face? Were external consultants involved? If so, at what cost? Were you present during the audit? What was your role? What documents were needed, and how difficult were they to prepare?
3. Evaluation and Reflections
Was an improvement plan developed after the audit? If not, what is its cause? What are your suggestions for future assessments? How was TSM communicated across the company? Were other stakeholders involved? In what way?
4. Impacts and Recommendations
What were the main implementation difficulties? Were there external constraints (laws, funding, etc.)? What helped you overcome them? What management tools worked best?
5. Reflections and Lessons Learned
What would you do differently? Who supported you the most? What changes followed the implementation? Who else contributed to the TSM assessment?
6. Impacts and Recommendations
How did TSM influence your engagement with external stakeholders? Should TSM be adopted nationwide in Mongolia? Why or why not? Any final reflections?

3.3 Analysis Methodology

3.3.1 Interview Data Analysis: Thematic Analysis

Thematic Analysis (TA) was used to analyze interview transcripts systematically. Following Braun and Clarke's (2006) six-step framework, the analysis involved [31].

1. Familiarization: Reading transcripts multiple times for deep understanding.
2. Initial Coding: Identifying significant statements and assigning short descriptive codes.
3. Theme Identification: Grouping similar codes to form broader themes.
4. Reviewing Themes: Refining and validating themes to ensure they accurately represent the data.
5. Defining Themes: Formulating clear, detailed definitions for each theme.
6. Producing the Report: Summarizing key findings with illustrative quotes from participants.

Thematic analysis allowed the identification of common patterns of challenges experienced during TSM implementation.

3.3.2 Challenge Evaluation Criteria

To assess and prioritize the various implementation challenges identified during interviews, a structured Multi-Criteria Decision Analysis (MCDA) framework was employed. MCDA is a well-established analytical tool used in decision-making and program evaluation, particularly when multiple factors must be balanced to assess complex scenarios [29]. In this research, MCDA allowed for a transparent, replicable, and weighted scoring of each challenge identified during the thematic analysis phase.

Defining the Evaluation Criteria and Weights

The selection and weighting of criteria were informed by:

- TSM protocol requirements,
- Insights from the Mining Association of Canada (MAC) performance audit reports,
- Expert feedback from ESG professionals and managers at Energy Resources LLC, and

Five criteria were chosen, reflecting both technical feasibility and strategic significance. Weights were assigned based on a combined stakeholder expert judgment method, whereby decision-makers scored the importance of each criterion from 1 (least important) to 5 (most important). The normalized average scores were then converted to percentage weights.

Table 6. Expert-Driven Weighted Criteria for TSM Challenge Evaluation

Criteria	Weight (%)	Definition
Impact on TSM Goals	30	How much does the challenge affect sustainability goals?
Frequency of Occurrence	20	How often was this mentioned by respondents?
Difficulty of Resolution	20	How complex is it to solve? (policy changes, funding needs)
Stakeholder Involvement	15	How many groups (employees, management, external) are affected?
Resource Requirement	15	How much time, budget, or personnel is needed to resolve it?

Each challenge was scored on a scale from 1 to 5 for each criterion, with higher numbers indicating greater severity or impact. The weighted scores were then summed to yield a total score out of 100. Challenges were classified into one of three categories.

Table 7. TSM Challenge Classification Thresholds Based on Total Weighted Score

Challenge Category	Total score range
Major	>3.5
Moderate	2.5-3.5
Minor	<2.5

3.5 Development of Recommendations

Following the challenge evaluation described in Section 3.3.2, a structured and iterative process was used to develop actionable, evidence-based recommendations that address the root causes of the major and moderate challenges identified during TSM implementation at Energy Resources LLC.

The recommendation development process was guided by the Challenge-Based Recommendation Development (CBRD) method. This approach is frequently applied in

sustainability assessment and continuous improvement frameworks (e.g., ISO 14001, TSM, and ICMM Guidelines) and emphasizes tailoring solutions to specific organizational contexts (Azapagic, 2004; ICMM, 2015). It ensures that each recommendation is:

- Rooted in actual operational evidence (via interview data),
- Strategically aligned with TSM performance improvement,
- Feasible given the resource and policy constraints, and
- Linked to measurable outcomes relevant to sustainability performance indicators.

3.5.1 Recommendation Development Framework

The development of each recommendation followed these structured steps:

1. Root Cause Analysis: Thematic codes from the interview transcripts were revisited to extract detailed explanations of the barriers underlying each challenge.
2. Contextual Feasibility Review: Recommendations were filtered based on operational realities (e.g., resource availability, organizational structure, and workforce capacity).
3. Action Definition: A clear, specific, and actionable solution was defined for each challenge.

4. Results/ Analysis

4.1 Survey Results on the Perception of Regular Employees Regarding Sustainability

To assess how sustainability principles, specifically those aligned with the Towards Sustainable Mining (TSM) standard, are understood and appreciated by regular employees, a structured questionnaire was distributed to 69 non-managerial staff at the Ukhaa Khudag mine of ‘Energy Resources’ LLC. The results provide a dual perspective: one focused on formal awareness of the TSM program, and the other on the broader perception of sustainability in mining operations.

As illustrated in Figure 8, the results show a significant awareness gap. When asked, *“Have you received any information about the Towards Sustainable Mining (TSM) program?”*, only 30.4% of respondents (21 out of 69) indicated that they had heard of

the TSM standard. In contrast, a majority, 69.6% (48 out of 69), had not received any formal information.

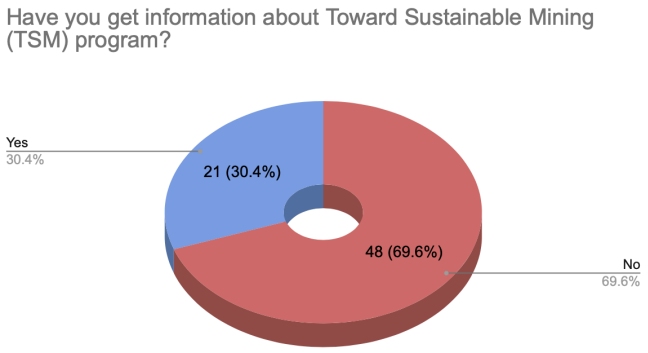


Figure 8. Awareness of TSM Among Regular Employees

This finding suggests that internal communication and training efforts regarding the TSM framework have not sufficiently reached the general workforce. Since TSM is a site-level standard requiring facility-wide engagement, this represents a critical gap in employee inclusion and capacity building. Lack of familiarity with the TSM framework can hinder accurate internal assessments, reduce protocol compliance, and limit the effectiveness of sustainability initiatives at the ground level.

Despite the limited recognition of TSM as a formal standard, employees strongly appreciated the values embedded in sustainable mining. When asked, *"How important do you think sustainable mining practices and policies are to your company's operations?"*, 65.2% of respondents selected "5, Most Important", while another 24.6% chose "4", indicating a strong overall belief in the importance of sustainability.

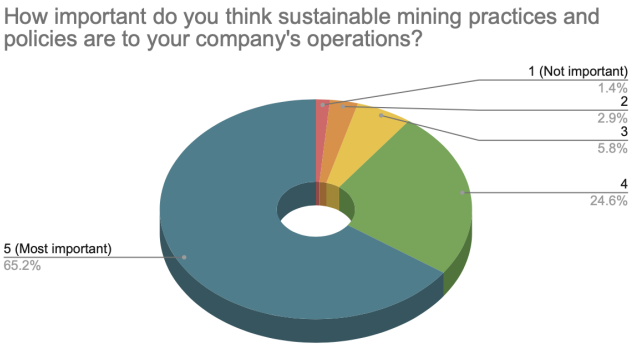


Figure 9. Importance of Sustainable Practices: Employees' Perception

Figure 9 reveals that only a small minority (less than 10%) perceived sustainability as being of limited importance (ratings of 1–3). This disparity between awareness of the TSM naming and belief in sustainability goals suggests that while the program may not be well known by name, the workforce widely embraces its underlying principles.

4.2 Interview Result Analysis

Semi-structured interviews were conducted with 11 participants from various departments involved in TSM implementation. Thematic analysis of the transcripts revealed several recurring patterns, which were consolidated into major themes and interpreted as key challenges.

4.2.1 Identified Themes and Challenges

Table 8. Thematic Categories and Associated Challenges Identified from Interview Analysis

№	Theme	Challenges Identified
1	Training and Knowledge Gaps	- Lack of practical TSM training - Difficulty understanding scoring criteria and evaluation processes
2	Documentation and Data Management Issues	- Poor organization of documents - Difficulty retrieving historical data - Non-standardized document naming practices
3	Communication and Language Barriers	- Translation inconsistencies between Mongolian and English - Poor communication among teams about documentation
4	Resource Constraints	- Budget constraints for training and documentation activities
5	Evaluation Process Issues	- Confusion over applicable indicators
6	Policy and Strategy Gaps	- Absence of formal policies for certain sustainability practices already informally followed
7	Positive Observations	- Departments with existing ISO certifications (ISO 9001, 14001, 45001) reported fewer challenges

4.2.2 Challenge evaluation based on interview results

The challenges identified through thematic analysis (Section 4.2.1) were prioritized using the weighted scoring method previously described in the methodology (Section 3.3.2). That model applied a Multi-Criteria Decision Analysis (MCDA) framework that evaluates each challenge based on five weighted criteria: impact on TSM goals, frequency of occurrence, difficulty of resolution, stakeholder involvement, and required resources.

To avoid redundancy, the rationale and weighting process, including the expert-informed percentages assigned to each criterion, are detailed in Table 9 and Section 3.3.2. This section presents the actual application of that framework using data from the interview results.

The weighted scoring results presented in Table 9 reveal various implementation challenges that vary in impact and complexity.

Major challenges included issues related to limited training and understanding of TSM protocols (Themes 1 and 3), resource constraints impacting evaluation readiness (Theme 4), and communication problems contributing to documentation inefficiencies (Theme 3).

Moderate challenges were associated with disorganized document storage, inconsistent data access (Theme 2), and confusion around TSM evaluation indicators and processes (Theme 5).

Minor challenge was identified in the absence of formalized sustainability policies for practices already in place (Theme 6), which, while noted, had a lower operational impact and could be resolved more easily.

These insights provide a data-driven basis for targeted improvements and inform the recommendation strategies discussed in subsequent sections

Table 9 below summarizes how each challenge was scored based on interview feedback and classified into major, moderate, or minor categories according to their total weighted score.

Table 9. Weighted Scoring Criteria for TSM Challenge Evaluation

№	Theme	Impact (30%)	Frequency (20%)	Difficulty (20%)	Stakeholder (15%)	Resources (15%)	Total (100%)	Category
1	Training and Knowledge Gaps	5	5	3	4	4	4.3	Major
		1.5	1	0.6	0.6	0.6		
2	Documentation and Data Management Issues	3	4	3	3	4	3.2	Moderate
		0.9	0.8	0.6	0.45	0.6		
3	Communication and Language Barriers	4	4	3	3	3	3.5	Major
		1.2	0.8	0.6	0.45	0.45		
4	Resource Constraints	5	4	4	3	5	4.3	Major
		1.5	0.8	0.8	0.45	0.75		
5	Evaluation Process Issues	3	2	3	3	3	2.8	Moderate
		0.9	0.4	0.6	0.45	0.45		
6	Policy and Strategy Gaps	3	2	2	2	2	2.3	Minor
		0.9	0.4	0.4	0.3	0.3		

The evaluation results in Table 9 provided a practical roadmap for intervention, allowing the research to transition smoothly into recommendation development. The structured scoring system ensured that prioritization was transparent and grounded in both employee experience and strategic sustainability goals.

During the implementation of the Towards Sustainable Mining (TSM) standard at the Ukhaa Khudag mine, several themes were identified by the employees who participated in the self-assessment. These themes were analyzed and ranked using a scoring system that considered each issue's seriousness, how often it occurred, how hard it was to solve, how many people it affected, and how much time or resources were needed to fix it.

One of the biggest problems was that many employees did not attend any training before they started the self-assessment. Because of this, most of them said they spent much time just trying to understand what the TSM standard was asking for. Many parts of the protocol were new and unclear to them, and without training, they had to figure everything out by themselves.

Several people also said that the documentation was incomplete or confusing. This happened because teams didn't talk enough with each other and didn't know exactly what documents were required. Some even struggled to find older data or didn't know how to organize the documents properly. There were also many translation problems, which made it harder to understand the criteria clearly. In some cases, Mongolian translations did not match the original English version, leading to misunderstandings.

Furthermore, the biggest reason for these difficulties was the lack of training. If employees had been trained before the self-assessment began, they would have had a clearer understanding of what to do and how to work together. This experience shows that training is a key step in preparing for future TSM assessments.

4.3.3 Recommendations Based on Themes

Major challenges, due to their high impact on TSM performance, frequency of occurrence across departments, and difficulty of resolution, represent systemic weaknesses that can compromise the success of the entire implementation process. These issues, such as training deficits, resource shortages, and communication breakdowns, often serve as root causes for moderate and minor challenges. For instance, inadequate training not only reduces self-assessment accuracy but also increases confusion around documentation, evaluation criteria, and inter-team collaboration.

Therefore, addressing major challenges first is not only logical, it is essential. Doing so enables the organization to remove foundational barriers, unlock capacity, and create enabling conditions for smoother resolution of moderate and minor issues. It also ensures that TSM-related activities are embedded into organizational routines rather than treated as isolated or reactive tasks.

Table 10. Root causes of the Themes

№	Theme (Challenge)	Category	Root cause
1	Training and Knowledge Gaps	Major	Lack of structured TSM training and unclear understanding of protocol requirements
2	Documentation and Data Management	Modorate	Translation mismatches between English and Mongolian; poor inter-departmental communication.

	Issues		
3	Communication and Language Barriers	Major	Translation inconsistencies and poor communication
4	Resource Constraints	Major	Limited budget, staff, and time allocated for TSM preparation
5	Evaluation Process Issues	Modorate	Confusion over scoring logic and indicator applicability.
6	Policy and Strategy Gaps	Minor	Practices were informally done but not formally reflected in company policy.

The analysis of interview data revealed six major and moderate challenge themes encountered during the implementation of the Towards Sustainable Mining (TSM) standard at Energy Resources LLC. These challenges, ranging from training gaps and resource constraints to documentation, communication, and policy issues, highlight the systemic barriers that mining companies in Mongolia may face when adopting TSM. Each theme is associated with a root cause that sheds light on the underlying operational or organizational limitation. The following recommendations have been developed to support effective and scalable implementation across the sector. These are directly aligned with the identified root causes. They are designed to provide actionable, context-specific guidance for other Mongolian mining companies aiming to integrate TSM into their sustainability strategy. The recommendations emphasize capacity building, structured planning, policy alignment, and cross-departmental coordination to promote sustainable and verifiable mining practices.

Figure 10. Key Recommendation Areas Based on Interview Themes and Root Causes

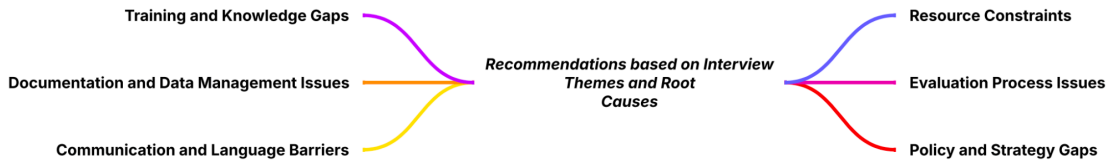


Table 11. Key Recommendation Areas Based on Interview Themes and Root Causes

Key Recommendation
1. Training and Knowledge Gaps
Developing and institutionalizing mandatory TSM training programs tailored to different departmental roles is essential. These should include practical exercises that simulate the evaluation process and clearly explain scoring mechanisms. Additionally, integrating TSM training into new employee orientation and conducting annual refreshers before self-assessments will strengthen organizational capacity. Collaboration with the Mongolian National Mining Association (MNMA) to develop certified, Mongolian-language training materials is also recommended.
2. Documentation and Data Management Issues
Companies should implement a centralized digital documentation management system with standardized naming conventions, version control, and defined responsibilities for each department. Designating document custodians and conducting regular internal audits will help ensure that all relevant evidence is organized and readily available for assessment and external verification.
3. Communication and Language Barriers
All TSM-related documents should be translated into Mongolian with technical accuracy and validated by sustainability professionals. Cross-departmental working groups should be established to ensure shared understanding of protocol requirements. At the same time, regular inter-departmental meetings can be used to align expectations and resolve ambiguities prior to assessments.
4. Resource Constraints

Organizations should establish a dedicated TSM implementation team with an independent operational budget. Resource requirements should be clearly outlined and incorporated into the annual operational and strategic plans. Where feasible, companies can seek external financial support from donor organizations and international partnerships.
5. Evaluation Process Issues
Pre-assessment training sessions should be organized to clarify the TSM scoring system, audit expectations, and everyday challenges. Developing a TSM interpretation manual, including sample evidence and examples tailored to Mongolian operations, will support consistent and accurate protocol evaluation across departments.
6. Policy and Strategy Gaps (Minor Issue)
A comprehensive policy review should be conducted to identify and formalize undocumented practices. All sustainability-related procedures, particularly those aligned with human rights, biodiversity, and community engagement, should be codified and regularly updated. Aligning internal policies with TSM and ISO standards will strengthen credibility and facilitate external assessments.

These recommendations are designed not only to address the root causes of implementation challenges but also to create a strong foundation for continuous improvement. By proactively resolving these barriers, Mongolian mining companies can enhance their operational efficiency, achieve higher performance ratings under the TSM framework, and solidify their position as responsible and sustainable operators in the global mining sector.

4.3.4 Additional Insights

ISO Experience Advantage: Departments with prior ISO certifications (such as ISO 9001, ISO 14001, or ISO 45001) found TSM implementation significantly easier. This highlights the advantage of already having integrated management systems before adopting TSM.

Cost Considerations: The initial external verification for TSM exceeded $50,000 USD. The cost could rise to $200,000 USD for broader scopes or larger operations. Companies lacking existing ISO certifications could face additional expenses ranging from $100,000 to $200,000 to establish the necessary foundational systems, emphasizing the importance of thorough internal preparation to avoid rework.

Timeframe and Process: Full internal preparation, including developing documentation, conducting self-assessments, and aligning practices, took approximately three years. Although TSM did not introduce fundamentally new concepts, it helped systematize and structure existing sustainability efforts, leading to more coherent and consistent practices across departments.

Evaluation Dynamics: TSM evaluations depend heavily on auditor interpretations. An “A” rating generally indicates that formal plans and frameworks are in place, while a “AA” rating confirms that plans have been practically implemented. Understanding these nuances was critical for successful external audits.

Environmental Outcomes: Implementation of TSM spurred new initiatives, including biodiversity conservation projects and endangered species protection programs. Public awareness campaigns and stakeholder engagement activities were also strengthened, demonstrating broader environmental and community benefits.

Strategic Alignment: Through the TSM process, the company was able to better align its operations with broader ESG (Environmental, Social, and Governance) objectives and sustainable development goals. This alignment reinforces the company's commitment to responsible mining and builds credibility with both local and international stakeholders.

5. Discussion

5.1 Implications of findings for Mongolia's mining sector.

The findings of this study reveal significant implications for the Mongolian mining sector. The experience of Energy Resources LLC demonstrates that while Mongolia has made initial progress through the Responsible Mining Code, fully adopting the internationally recognized Towards Sustainable Mining (TSM) standard requires considerable internal capacity development.

Companies with prior ISO certifications, such as ISO 9001, ISO 14001, and ISO 45001, found the TSM implementation process notably easier, suggesting that integrated management systems can be a strong foundation for sustainable mining practices. This highlights the need for broader promotion of ISO and management system standards across the Mongolian mining industry to facilitate smoother transitions toward international frameworks like TSM.

Moreover, the challenges identified, including training gaps, document management deficiencies, resource constraints, and language barriers, underscore the urgent need for strategic investment in capacity building and internal systems improvement. Addressing these barriers will be critical for successful TSM adoption and enhancing Mongolia’s reputation in global mining markets, attracting sustainable investments, and improving stakeholder trust.

Additionally, the findings reinforce that TSM implementation can catalyze broader environmental and social initiatives, such as biodiversity protection projects and stakeholder engagement programs, thereby strengthening corporate social responsibility practices in Mongolia’s mining sector.

5.2 Challenges and opportunities to implement TSM in Mongolia.

Implementing the Towards Sustainable Mining (TSM) standard in Mongolia presents considerable challenges and significant opportunities for the mining sector. A key challenge is the lack of widespread understanding of TSM among mining companies. Many organizations lack sufficient internal capacity, including trained staff, structured documentation systems, and the financial resources needed to meet TSM’s rigorous requirements. Language and translation inconsistencies between English-based protocols and Mongolian operational practices also create barriers to effective

implementation. Additionally, the voluntary nature of TSM adoption poses difficulties in achieving sector-wide participation without stronger incentives or regulatory support.

Despite these challenges, TSM adoption offers significant opportunities for Mongolia's mining industry. By aligning with an internationally recognized framework, Mongolian companies can enhance their credibility in global markets, improve access to sustainable investment, and strengthen their social license to operate. Companies with ISO certifications and sustainability practices will find it easier to integrate TSM protocols. Furthermore, TSM provides a clear roadmap for continuous improvement in environmental management, community relations, and workplace safety. With strategic investment in training, resource planning, and governance systems, Mongolia has the potential to position itself as a leader in responsible and sustainable mining in Asia.

6. Conclusion and Recommendations

6.1 Conclusion

This study explored the implementation of the Toward Sustainable Mining (TSM) standard at Energy Resources LLC's Ukhaa Khudag mine to understand how Mongolia's mining sector can effectively adopt international sustainability frameworks. The research combined employee surveys and in-depth interviews to evaluate awareness levels, operational readiness, and challenges encountered during TSM adoption.

The findings reveal a pronounced gap between employee engagement in sustainable practices and their awareness of the TSM framework itself. While 70% of surveyed employees were unfamiliar with the TSM standard by name, the majority actively engaged in sustainability-related actions, indicating a strong but unformalized alignment with TSM principles. This underscores the importance of structured communication and training.

Through thematic analysis, six core challenges were identified, including lack of training, documentation inefficiencies, resource constraints, language barriers, evaluation complexity, and policy misalignment. The challenge evaluation showed that insufficient training and internal coordination were the most critical barriers, as they affected all other aspects of implementation.

Despite these difficulties, the study highlights that departments with prior ISO certifications experienced smoother implementation, suggesting that integrated

management systems provide a robust foundation for adopting TSM. The implementation also led to broader benefits such as enhanced biodiversity initiatives and improved stakeholder engagement.

Overall, the research concludes that the successful adoption of TSM in Mongolia requires a proactive, systematized approach tailored to local capacities. With dedicated investment in internal systems, training, and cross-departmental collaboration, Mongolia's mining companies can not only meet TSM standards but also enhance their long-term environmental and social performance. These findings offer practical lessons for other Mongolian firms considering TSM and position Energy Resources LLC as a model for responsible mining in the region.

6.2 Practical Recommendations

Drawing from the findings of this study, several practical recommendations emerge to guide the successful adoption of the TSM standard within Mongolia's mining sector. First, it is essential that companies invest in developing comprehensive training programs. Many of the difficulties encountered during Energy Resources LLC's implementation were rooted in a lack of understanding of the TSM protocols. Organizing systematic, practical training sessions that simulate real assessment scenarios would greatly enhance employees' preparedness and confidence.

Another critical step is to establish a centralized document management system. Throughout the study, poor organization and difficulties in retrieving information were major obstacles. Implementing a digital platform with clear naming conventions, classification systems, and internal audit mechanisms would ensure that all required documents are easily accessible during self-assessments and external verifications.

The study also highlights the need for mining companies to allocate dedicated human and financial resources specifically for TSM activities. Establishing specialized TSM implementation teams, supported by independent operational budgets, would alleviate pressure on existing staff and ensure that sustainability activities are properly resourced.

Cross-departmental collaboration emerged as another area needing improvement. Regular workshops and joint evaluations would help departments develop a unified understanding of TSM requirements and foster a shared ownership of the sustainability goals.

Given the translation challenges encountered, companies should also produce official bilingual (Mongolian-English) versions of all TSM-related documents. Harmonized translations would minimize misinterpretations and ensure consistent communication throughout the organization.

Importantly, TSM adoption should not be treated as an isolated objective but should be integrated into the company's broader environmental, social, and governance (ESG) strategy. Companies that position TSM as part of their long-term sustainability vision, including setting specific climate change mitigation targets, will be better positioned to meet international expectations.

Furthermore, mining companies must be proactive in preparing for the ongoing global consolidation of mining sustainability standards. Embedding flexibility and international best practices into their TSM implementation from the outset will ensure a smoother transition if and when global standards are harmonized.

Finally, financial planning should account for the significant costs associated with external verification and potential system upgrades. Early budgeting for these expenses would help companies avoid unexpected financial strain during verification.

By following these recommendations, mining companies in Mongolia can achieve higher performance in their TSM evaluations and strengthen their position as leaders in responsible and sustainable mining practices.

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Appendix

Table 12. Transcript records of Interviewees

Transcript of the Interview Results
1. After attending the training, they conducted an evaluation. However, studying and understanding the TSM standards on their own still took a lot of time. During the training, they practiced how to conduct an actual evaluation. If more employees had attended that training, the work would have progressed more quickly. This training was organized by the Mongolian National Mining Association (MNMA). Within the team, they discussed and agreed on which documents would meet specific TSM criteria. Some language-related issues also arose. There were cases of incomplete documentation — employees with fewer years of experience were unsure whether certain documents existed, whereas those with longer experience knew about the missing documents. This issue was mainly caused by a lack of proper communication among team members. It is very important for everyone to share what they know with each other and to ensure that those participating in the evaluation are well-informed. We attended the training in September 2024. During the external audit, interviewees were selected, and general knowledge about the TSM standard was assessed. During the inspection, a third-party verification was required, and verification was conducted by SGS, an audit group that measures GHG emissions. An environmental audit is conducted once every two years by a professional environmental auditing organization. An annual action plan is developed, and its implementation is regularly monitored. In the TSM assessment, it is checked under the "A" level whether the plan is included, and under the "AA" level whether it is being properly implemented. When auditors requested Mongolian documents, we translated and presented the relevant materials. Initially, auditors attempted to review the documents through translation themselves. The TSM standard has not been directly introduced to all employees; however, training sessions covering related topics, such as identifying and protecting biodiversity, have been conducted. After achieving an "AAA" rating, we have started new initiatives to serve as a model, including public volunteer activities like supporting the protection of endangered species. Previously, staff were assigned to these activities, but now more public participation is encouraged.
2. The experience of having already implemented three ISO management system standards was very helpful. Since the company is listed on an international stock exchange and maintains transparency with stakeholders, the process was easier. Additionally, the experience of regularly reporting to international banks was beneficial. Implementing the Responsible Mining Code (RM Code) issued by the Mongolian National Mining Association (MNMA) also proved to be very useful. During the evaluation process, discrepancies were found between the internal self-assessment and the external audit assessment. It became clear that more detailed and thorough evaluation was needed during the TSM assessment. This led to the realization that it was necessary to improve the quality and

documentation of existing materials.
It was difficult to find older information, and in some cases, data had been lost over time.
The lack of a unified understanding among team members also slightly affected the completeness of the documentation.
We realized that when disseminating information in the future, it is crucial to prepare supporting documents and evidence properly.
Having organized and clearly named archive folders is also very important.
If other companies plan to implement the TSM standard, it would be necessary for them to participate in proper training.
In our company's case, we already had experience compiling various types of documents, but for newer companies, attending good training would help them understand and implement the standard much faster.
When developing an annual plan, if compliance with multiple standards is considered from the beginning, it will make final reporting much easier.
Since the company is listed on the stock exchange, operations have been conducted according to international standards.
I participated in the assessment by compiling and submitting the existing materials.
The TSM process was not entirely new; it mainly involved aligning our existing activities with the TSM questionnaire.
I did not attend TSM-specific training, but when filling out the protocols, I provided proof that relevant documents existed for each criterion.
I also participated directly in the external assessment process.

We are now planning to develop a new policy that will better define stakeholder relationships and illustrate interconnections.
There were few challenges regarding document preparation because we were simply evaluating activities that were already being done.
Thus, there were no major difficulties.

One key takeaway from the TSM experience was that it helped us identify more detailed opportunities for improvement.
It encouraged us to store the correct files more systematically and promoted greater responsibility.
In reality, there was nothing fundamentally new; only the names and terms were different.
The evaluation results sometimes depended on how the auditor interpreted the situation.
Even if some information was missing, if the auditor asked for certain documents during the audit and we had them available, it was possible to adjust the evaluation accordingly.
Reducing misunderstandings was extremely helpful for the process.
If employees truly understood why TSM is important, the implementation would be even more effective.
When preparing annual plans, considering compliance with multiple standards from the beginning makes final reporting much easier.

3. For our team, since we have already implemented the ISO 45001 Occupational Health and Safety standard, there were fewer instances of missing documents during the protocol completion process. There were some difficulties in understanding the TSM requirements. I believe that if an organization has clear sustainable development goals from the beginning, it will have a significant positive impact. Since the overall management system was strong, the process was relatively easy.
After implementing the TSM standard, we began exploring the possibility of introducing the ISO 45003 standard, which focuses on the psychological health and

well-being of workers engaged in labor-intensive activities. Implementing this standard primarily helps in receiving recommendations; however, it is not a major factor for achieving higher scores in TSM assessments. No new major adjustments were needed because the company's existing policies and regulations were already well established, which greatly supported the implementation process.
4. It was necessary to understand how to align the existing information with the requirements. Although we do not employ individuals under the age of 18 in practice, we realized that it was a shortcoming not to have this formally stated in our policy. We also learned that it is necessary to further improve the overall awareness of employees. Since we were mainly being evaluated on the activities we had already completed, the process was relatively easy. We had not participated in specific TSM training. In response to areas where lower scores were received, this year we are focusing on increasing the percentage of female employees from 5% to 10%, and have included this goal in our annual objectives. For example, we are planning to organize training sessions aimed at increasing the number of female operators. There were no major changes; we were evaluated based on existing practices. However, through the TSM process, we realized the importance of having a well-defined human resources policy. Our company already had risk assessment frameworks and corresponding mitigation measures in place, which helped us achieve higher scores. Additionally, certain national regulations require third-party verification by external evaluators, which also contributed positively to the TSM document preparation process. Although no major structural changes occurred after implementing TSM, the process provided many insights into potential improvements and ways to strengthen existing practices.
5. There were no major difficulties in document preparation, as most processes were already regulated through internal procedures. In some cases, agreements were used instead, and these were attached accordingly. A positive aspect was that the implementation of the Responsible Mining Code had already provided a solid foundation of experience for us. The TSM standard places strong emphasis on human rights and minority rights, so companies need to pay greater attention to these areas. For sites planning to implement the TSM standard, it would be very beneficial to first implement the Responsible Mining Code (RM Code). Since our reporting and documentation were already well-organized, the process became much easier. During external audits, if the company clearly defines the scope — in other words, specifies what aspects will be evaluated — it will have a major positive impact on future assessments. With this clarity, conducting evaluations becomes much easier. The TSM evaluation did not require the involvement of many people. Since TSM places strong emphasis on human rights and minority rights, companies need to pay greater attention to these areas. Following the evaluation, recommendations were made, but an official improvement plan has not yet been developed. It is expected that the TSM team responsible will later issue a consolidated action plan for improvements. I did not attend any specific training; instead, I familiarized myself directly with the materials and completed the forms. No external consultants were involved for human resources support.

There were no major challenges regarding document preparation, as most requirements were already regulated through internal procedures.
In some cases, agreements were attached to cover specific requirements.
The most likely next step will involve developing and implementing an improvement plan, although no clear directives have been received yet.
The team members who participated in the TSM evaluation were introduced to each other and worked together.
We gained a deeper understanding of the importance of human rights and gender equality.
I believe that it is important to report activities as they truly are, rather than focusing solely on obtaining a high score.
If companies genuinely integrate sustainable practices into their operations, it will bring about significant positive changes.

6. Since ISO 9001 involves extensive monitoring and auditing, it made the implementation of the TSM standard much easier. There were also some issues related to the naming of existing documents, mainly due to language differences.
For example, there was some confusion between the terminology used in national-level inspection checklists and international terminology.
It was felt that having clear, standardized terms would make the process much easier.One new suggestion was that having a unified, consolidated report would be helpful.
It was challenging to prepare one report for national-level submission and then create another version with a different title for local-level submission. Since we completed the process as a team, it was much easier.
For other companies planning to implement the TSM standard, it is important to use correct terminology and phrasing.
For example, it would be very helpful if each document clearly summarized what information it contains. We reviewed the TSM evaluation questions and aligned the available materials accordingly.
At the beginning of the implementation, I had not attended any training sessions.
However, two days before the 2024 evaluation, I attended a training session that provided a general overview of what TSM is and why it should be implemented.
Since the water supply operations are regularly inspected by government authorities, the existing documentation was helpful during the evaluation.
During the external audit, we explained and described our operational processes.
Through the document preparation process, we identified areas where some tasks had not been fully completed.
The understanding of TSM was mainly provided at the engineering level.

7. Since we had already implemented the ISO 14000 Environmental Management standard, we were able to build on that foundation and conduct our own evaluations.
Additionally, under the legal framework, we had already included the study and protection of biodiversity in our planning, which greatly contributed to achieving a higher score. It would have been better if all the relevant information had been consolidated, prepared, and categorized before the external audit.
Since we did not do this, we felt that a lot of time was wasted. One thing that could be improved is better preparation in advance.
It is important to thoroughly understand the criteria, plan and complete any outstanding tasks, and properly document everything.
It was much easier because we already had experience implementing the Responsible Mining Code or similar standards before starting TSM implementation.
I believe that if companies manage their resources and allocation well, they will be more successful in implementing the TSM standard. Every year, external experts conduct surveys to count and document the number and species of plants and

animals, and this work contributes directly to meeting the requirements of the TSM standard and related standards.
For the areas where we received lower scores, we planned specific activities and included them in our annual plan.
One issue raised during the evaluation was whether meetings, research, and studies related to biodiversity conservation were being actively conducted.
This feedback gave us the idea that we need to strengthen such activities.
The TSM standards were mainly introduced to senior employees, but responsibilities related to protecting biodiversity were also explained to the workers.
However, it was not specifically stated to them that it was part of the TSM standard; rather, it was presented more broadly as part of environmental protection efforts.
During the initial evaluation, all activities from previous years were reviewed to assess whether a solid system for environmental and biodiversity protection was already established.

8.Since we implement different standards, the monitoring and audit documents from those standards could also be used for the TSM process, which made it much easier.
The integrated management system provided a strong foundational understanding.
Having a unified understanding was considered very important during the implementation of the TSM standard. It played a crucial role that all senior management shared a unified understanding, clearly defined it in the company's policies and goals, and allocated resources accordingly. It provides an opportunity for continuous improvement.

9.In document preparation, having a strong management foundation was very important.
Since previously collected data had been well preserved, the process became much easier.
Additionally, because ISO standards have been implemented since 2011, there was sufficient documentation and evidence available, which was a major help. The information was based on materials and activities carried out in the past, and it became clear that those activities needed to be continued and updated.
As the scope of work expanded, issues related to resource limitations also started to emerge. For other companies planning to implement the TSM standard, it is most important to clearly define the scope of implementation.
Once the scope is clearly set, it will be easier to carry out activities and actions accordingly. We compiled and provided the necessary and relevant information.
Since the contents of these standards were quite similar, we reviewed the required sections and completed the protocols ourselves.
One important realization from working with the TSM standard was that sharing knowledge and understanding with others is crucial.
For example, it is important to introduce key stakeholders to environmental protection methods.

10. Since Mongolia has domestic laws such as the Disaster Protection Law and the Fire Safety Law, we developed our plans in compliance with these regulations, which supported our efforts.
Relevant elements were also incorporated under Clause 8.2 of the ISO 45000 standard.
There were no major new changes introduced during the process. For companies aiming to implement the TSM standard, I would recommend maintaining well-organized and properly archived documentation.
If this is done, the process will be much faster and easier. Under the Disaster Protection Law, it is required to conduct disaster risk assessments and to develop corresponding mitigation plans.

We supported the TSM process by locating and providing the relevant materials.
For the areas where lower scores were received, it is expected that a consolidated improvement plan will be issued.
Since our existing activities were already aligned with the TSM requirements, the process was relatively easy.
Additionally, by implementing the TSM standard, we realized that activities would be carried out in a much more organized and systematic manner.

11. Being a publicly listed company is extremely important.
The Hong Kong Stock Exchange, by its regulations, requires compliance with many standards, which has played a critical role for us.
Since we issue bonds and stocks on international markets, and investment organizations closely scrutinize our operations, our company has long been accustomed to maintaining high standards.
Because of this, implementing the TSM standard was relatively easier.
Additionally, having ISO certifications in place reduced the number of questions and documentation required, which was an advantage, particularly in the areas of environment and occupational health and safety. Regarding climate change, our company has calculated greenhouse gas emissions across all stages of the operation — from initial extraction to final combustion — and has verified the results according to GHC and ISO standards.
However, a major challenge remains: setting clear targets is extremely important and currently requires an estimated 3–5 years to develop properly.
This is a much broader task than what is required under the TSM standard alone; it demands large-scale planning efforts.
We have already completed 2–3 years' worth of greenhouse gas calculations, identified potential data gaps, and defined the boundaries that we can manage. Based on this, we must now develop a reduction plan.
For example, BHP Billiton took seven years and worked with three of the world’s leading consulting firms to create their Net Zero by 2050 plan.
For our company, preparing such a long-term plan is a major challenge.
Due to the absence of a clear climate action plan, we received a "B" rating under the Climate Change protocol in the TSM standard.
Without establishing targets soon, we will not be able to improve this rating It is important to thoroughly familiarize yourself with the protocol from the beginning.
It is also necessary for the organization's leadership to actively support the process.
Moreover, it is critical to understand that the goal is not just to achieve a good evaluation score, but to genuinely contribute to sustainable development.
The focus should not be on creating a false image for the public, but on establishing a proper internal system within the organization.
Only with the right understanding will this work produce meaningful results.
Additionally, ensuring strong coordination and alignment across different areas is very important. The reason for initially implementing TSM was because we were already participating in programs like CDP, MCI, and Bloomberg reporting.
Within the ESG framework, our "G" (Governance) aspect was lacking, so we aimed to improve our evaluation by adopting the TSM standard.
Normally, TSM provides a three-year preparation phase to build a basic understanding of sustainability. However, we skipped this phase, conducted our self-assessment in the first year, and entered external verification in the following year.
Initially, we completed an online training session, which explained what the TSM standard is and how the scoring works.
For someone unfamiliar with the TSM questionnaire, it appeared very broad; for someone with prior knowledge, it appeared very detailed.
In the year of the external verification, the auditing cost exceeded $50,000.

During the first year, we paid a membership fee of about $10,000, but now, as a member of the Mongolian National Mining Association (MNMA), this fee no longer applies.
In our case, since no major internal changes were needed, only the external verification cost was incurred.
Depending on the selected auditor, the total verification cost can go up to $200,000.
If a company does not already have a Health and Safety (OHS) standard in place and wants to adopt ISO standards, they would need to allocate an additional $100,000–$200,000 in their budget.

In our situation, because we had already implemented ISO standards, some TSM questionnaire requirements, particularly in Health and Safety (OHS) and Environment, were reduced.

Regarding TSM scoring:
Even if all the requirements for an AAA rating are met, if a single criterion under the "A" level is not satisfied, the overall score is capped at "A".
Where we received lower scores, we have developed and are implementing improvement plans.
External auditors do not provide improvement plans.
Therefore, if other companies need help with improvements, they must separately hire consultants — but those consultants cannot act as auditors for the same evaluation.
In some cases, scores were lower due to the lack of formalized company policies.
In 2023, ISO standards were officially incorporated into the TSM Climate Change protocol.
Regarding climate change, our company has calculated greenhouse gas (GHG) emissions across all stages — from initial extraction to final combustion — and verified them according to GHC and ISO standards.
However, a major challenge remains: setting specific emissions reduction targets.
Developing such targets is a large-scale task requiring about 3–5 years of effort.
This goes beyond TSM requirements and demands broader strategic planning.
For instance, BHP Billiton spent seven years and collaborated with three of the world's leading consulting firms to develop their Net Zero 2050 plan.
For our company, creating such a long-term plan is a major challenge.
Because we currently lack a clear emissions reduction target, we received a "B" rating under the TSM Climate Change protocol.
Without establishing a target soon, we will not be able to achieve a higher rating.
Regarding document preparation, pre-preparing draft templates for the audit would reduce the real purpose of the evaluation.
Since TSM assessments are intended to reflect what has actually been done each year, document submissions must genuinely represent the activities undertaken.
If draft templates simply prepare fake or generalized documents, it undermines the integrity of the evaluation process.
Therefore, we believe there is no need to pre-prepare drafts — instead, continuous real improvement based on actual activities is essential.