

Green Practices Guideline for Mining Sector

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GREEN PRACTICES GUIDELINE FOR MINING SECTOR

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FOREWORD

The development of green practice guidelines is a continuation of the implementation of the MyHIJAU Program under the Ministry of Environment and Water (KASA) and the Malaysian Green Technology and Climate Change Corporation (MGTC) which is a coordinating agency and secretariat for the program. This program has been approved by the National Council for Green Technology and Climate Change (MTHPI) which was held on 23 October 2012. This is one of the Government's initiatives in the development of Green Technology in Malaysia. It is in line with the implementation of the National Green Technology Policy as well as the direction of Sustainable Consumption & Production (SCP) to encourage local manufacturers, producers and suppliers, especially to companies and Small and Medium Enterprises (SMEs). In addition, it will also focus on the Government's initiatives and direction in the development of the country's SMEs.

The development of Green Practice Guidelines is to provide guidance to the green industry in implementing green practices at the preliminary stage, during and after construction is implemented. These guidelines also have an implementation direction to ensure that these Guidelines will continue to be referred to and used by all parties, especially industry players to help achieve the government's goal of implementing green development in Malaysia. This green practice can help the industrial sector to have the potential to venture into the field of green technology, especially in the production of green products and services, as well as increase the encouragement of producers, manufacturers and suppliers to apply green technology in the premises, production process and operation. These Guidelines are more towards the requirements that need to be put into practice so that industries, companies and organizations have green practice guidelines that can be referred to as well as help companies achieve the government's goal of using green practices in line with SDG 12.6, which is to encourage the industry to use sustainable practices and integrate information sustainability into the reporting cycle.

Referring to the twelfth Malaysia plan under the eighth main focus which is to accelerate green growth, where this green practice development program is able to play a very important role in being a catalyst to ensure that these green practices are more practical and applicable to all parties in the green industry whether directly or indirectly for local companies and businesses to gain exposure to this green industry practice guide.

Therefore, increasing productivity and long-term profits through environmental, social and governance (ESG) elements should be applied in decision-making by ensuring that companies focus on reducing the negative impact on the environment. Although Malaysia only contributes 0.7 percent to greenhouse gas emissions, the Government will continue to fulfil its commitment to reduce GHG emission intensity up to 45 percent to GDP in 2030, based on emission intensity in 2005, in line with the aspiration to become a low carbon country.

It is hoped that this goal can be achieved by focusing on the industry to understand the importance of green practices in business by applying knowledge about the benefits and applications of green technology as well as the implementation strategy of the green practice monitoring mechanism in business management to obtain the recognition of the green industry.

LIST OF ABBREVIATION

ASEAN	Association of Southeast Asian Nations
CEPA	Communication, Education and Public Awareness
EQA	Environmental Quality Act
FMA	Factories and Machinery Act
GDP	Gross Domestic Product
GHG	Greenhouse gases
GTMP	Green Technology Master Plan
IEA	International Energy Agency
MDA	Mineral Development Act
NGO	Non-Governmental Organisation
NGTP	National Green Technology Policy
NMP	National Mineral Policy
OSHA	Occupational Safety and Health Act
R&D	Research and Development
R&D&C	Research, Development and Commercialisation
RMK12	12 th Malaysia Plan
SDG	Sustainable Development Goals
SDI	Sustainable Development Initiatives
SEDA	Sustainable Energy Development Authority Malaysia
SME	State Mineral Enactments
TIM 2021-2030	Mineral Industry Transformation Plan (2021-2030)
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

LIST OF TERMINOLOGIES

These are the terminologies used within this Guideline:

Carbon dioxide equivalent	A metric measure used to compare the emissions from various greenhouse gases (GHG) based on their global warming potential by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.
Carbon footprint	Total GHG emissions caused by an individual, event, organisation, service, place or product, expressed as carbon dioxide equivalent.
Circular economy	A model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible to extend the life cycle of products.
Ecological footprint	A method to measure human demand on natural capital, i.e. the quantity of nature it takes to support people or an economy. Also referred to as environmental footprint.
Environmental footprint	A measure that attempts to consider multiple impacts that a person, company, activity, etc. has on the environment.
Greenhouse gases	The primary greenhouse gases in earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide and ozone, and some artificial chemicals such as chlorofluorocarbons.
Gross domestic product	The total monetary or market value of all the finished goods and services produced within a country's borders at a specific period, normally a year.
Mining value chain	Mining process from extracting raw materials to delivering products to consumers.
Mining life cycle	Includes five stages; exploration, mine site design and planning, production, as well as closure and reclamation.
Water footprint	The total volume of fresh water used to produce the goods and services, that are consumed by the individual or community, or produced by related businesses.

01

INTRODUCTION



1.1 Background of Mining Industry

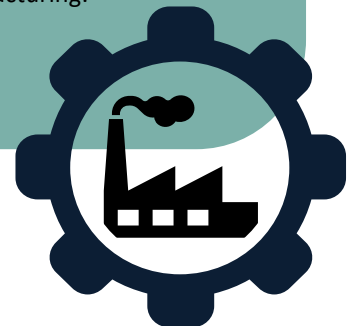
Malaysia has invaluable mineral resources that have the potential to be utilised optimally. Malaysia's mining industry includes metallic and non-metallic minerals as well as energy minerals. These minerals account for a significant portion of the nation's gross domestic product (GDP). In 2021, the Department of Statistics Malaysia reported that, mining and quarrying sectors contributed 6.2% of Malaysia's GDP.



The country may become an important hub for the development of the mineral industry in the future like in the previous centuries, and the mineral industry shall continue to be one of the main contributors to the country's economic advancement.



Mining is among the primary industries that enable other industries to grow. For instance, metallic minerals contribute to the development of metallurgical industries such as iron and steel. These products then become inputs to many industries including construction and manufacturing.



Although the resources are finite, it is important to impose sustainable consumption and production of resources for the future. To sustain the mineral-based industry, it is important to assert more awareness and control, so that it can grow without damaging the environment and the well-being of the society.

Whilst foreign and local investments in the country's mining sector are important for the industry and the economy at large, it must also be ensured that mining activities are done sustainably with a minimum impact on the environment and earth, which are equally important and valuable to our society.



There have been initiatives to streamline the management of the mineral-based industry, to achieve sustainable growth and strengthen the economic fundamentals such as through the introduction of green and sustainable practices for the industry.

Globally, there have been many examples of mining companies that are pursuing a range of adaptive practices to respond to current and potential disruptions due to climate change. These practices are intended to protect the value of existing or potential assets, or creating value through technological innovation, new market opportunities, and collaborative initiatives that address the changing needs of the industry.

Currently, Malaysia contributes 0.7% to global GHG emissions. Energy sector is the largest contributor of emissions, followed by industrial processes and product use, as well as waste sectors (Malaysia BUR3 UNFCCC Report). Malaysia aspires to achieve net-zero GHG emission as early as 2050 (12th Malaysia Plan 2021-2025). The country hopes to reduce GHG emissions by 45% based on the GDP in 2030.



Efforts to implement Paris Agreement goals for reducing carbon emissions and limiting global warming, would require participation from the entire mining value chain. New solutions are required to meet mining operational needs in order to simultaneously reduce the emissions of GHG.

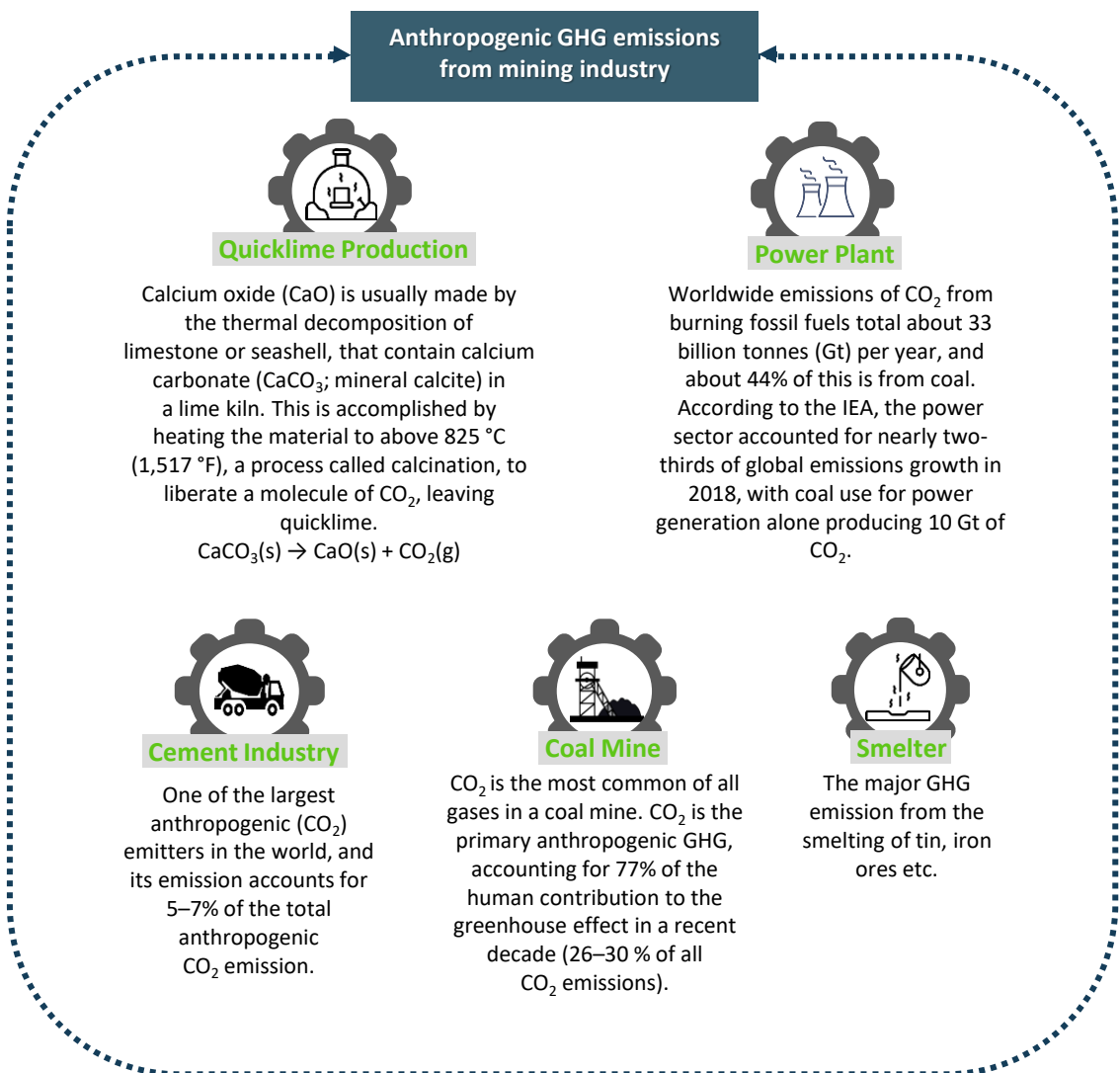


Anthropogenic GHG are emitted directly during the actual mining and indirectly released by the energy-intensive activities associated with mining equipment, ore transport and the processing industry.



Mining, currently accounts for 4-7% of global GHG emissions. The industry contributes to climate change through both direct and indirect GHG emissions. CO₂ emissions from mining operations and electricity consumption total 1%, while fugitive-methane emissions from coal mining are estimated to represent about 3-6%. Indirect emissions such as coal combustion, accounts for a considerable portion of global GHG.

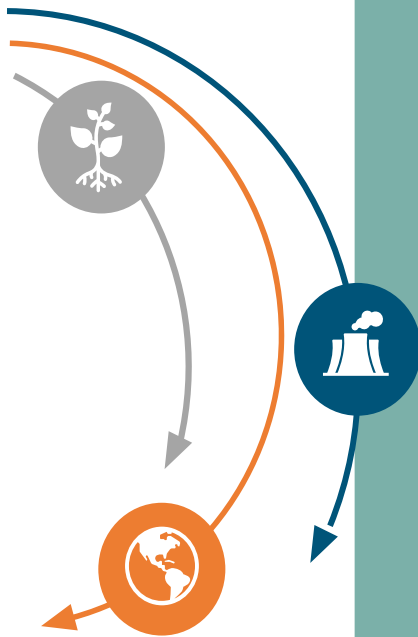
Energy-related GHG emissions account for the majority of all anthropogenic emissions. Energy usage is a significant contributor and the main source of GHG emissions in most mines. Mining, processing as well as transportation require the use of electricity and diesel or other liquid fuels. For instance, fuel is mainly used for the movement of ore and waste rock from pits whereas electricity is leveraged for operating flotation machines, crushing and grinding, pumping water and slurries, extracting metal for oxide ores, etc.





Environmental issues such as air pollution, soil and water contamination, loss of biodiversity, deforestation, and erosion are usually linked to mining activities.

Mining sites are currently utilising a small fraction of the earth's total land surface, however it is using the land at every stage of mining cycle, including exploration, construction, operation, closure and progressive rehabilitation. Although, these stages are planned and designed with proper regulations imposed by the authorities, the release of GHG is impossible to be completely avoided but needs to be regulated.



The Earth desperately needs a transformation away from carbon-based fuel sources. Exploration, mining, processing, extraction, and refining of minerals and metals are often considered environmentally unfriendly and carbon-intensive. Each of these activities carries its environmental challenges. However, it is noted that current mining practices, have evolved and have been much more environmentally friendly. With the advent of science and technology, room for new and environmentally friendly practices are always there.

The environmental impacts due to the mining activities can be seen through a series of mining legacies, from the immediate impact of mine development, the mining and extraction processes, and the soil and water that are displaced, which could extend on the wider ecosystem. Similarly, the impact of mining may also contribute to both air pollution and GHG emissions. Although current regulations and practices have improved by leaps and bounds, there are perhaps opportunities for further improvement.

With a greater focus on the environmental impact of mining operations, there is opportunity to adopt a green growth. Therefore, it is imperative that green mining practices may help alleviate destructive impacts on the environment while ensuring environmentally-sound mining operations, and simultaneously creating sustainable environment, economic and social value for a wide range of stakeholders.



1.2 Existing Acts and Policies Related to Mining

In Malaysia, the two main legislations which govern mining activities are the Mineral Development Act (MDA) 1994 and the relevant State Mineral Enactments (SME), which are enforced by the Department of Mineral and Geoscience Malaysia, and Director of Land and Mines Office in every state, respectively.

The first National Mineral Policy (NMP1) provides the foundation for the development of an effective, efficient, and competitive regulatory environment for the mineral sector. The thrust of the policy is to expand and diversify the mineral sector through optimum exploration, extraction, and utilisation of resources using modern technology driven by research and development.

An updated and revised version of the NMP1 which incorporates the concept of sustainable development is the National Mineral Policy 2 (NMP2). A set of action plans has been drafted consisting of short, medium and long term targets for sustainability.

Other major mining-related regulations that address environmental, safety and health aspects are, the Environmental Quality Act (EQA) 1974, the Occupational Safety and Health Act (OSHA) 1994 and the Factories and Machinery Act (FMA) 1967.

This guideline will help to strategise and provide a framework for the implementation of a green mining industry that is in-line with current related Acts and policies. Several targets and initiatives have been outlined with regard to environmental sustainability. These initiatives may serve as steppingstones for the mining industry to move further into the wider implementation of green initiatives and practices within its operations.



SUSTAINABLE DEVELOPMENT GOALS

Adoption of green initiatives at national level is embedded in Malaysia Productivity Corporation’s Sustainable Development Initiatives (SDI). Environmental or green practices require conducting activities, in ways that could enrich the environment. Waste management, recycling, energy saving, environmental or health and safety measures, process redesign for environmental or health and safety and green supply chain are among the green initiatives adopted by various organisations.

For the mining sector, green initiatives shall be aligned with the United Nations Sustainable Development Goals (SDGs) as shown in Figure 1.



Figure 1. Sustainable Development Goals.

The framework of the UN SDG indicator offers the opportunity to explore how the mining sector can align its actions and reporting. The mining industry has the opportunity and potential to positively contribute to all 17 SDGs. In order to align company’s operations with the SDGs, the goals relating to environmental sustainability, social inclusion, and economic development can be a useful starting point.



Figure 2. Impact of mining on SDGs. (adapted from UNDP)

Mining impacts all the 17 SDGs at varying degrees as depicted in Figure 2. Mining impacts six goals most directly, i.e. SDG 9, SDG 8, SDG 7, SDG 6, SDG 13 and SDG 15.

*Asterisked icons indicate greater relevance for mining sector. (Source: UNDP)

NATIONAL MINERAL POLICY

The NMP2 ensures that activities related to mineral resource development are undertaken in a responsible, effective and efficient manner, to protect the environment through best mining practices for sustainable development, as outlined under the five (5) objectives of the policy:

- 01 To ensure the sustainable development and optimum utilisation of mineral resources.
- 02 To promote environmental stewardship that will ensure the nation's mineral resources are developed in an environmentally sound, responsible and sustainable manner.
- 03 To enhance the nation's mineral sector competitiveness and advancement in the global arena.
- 04 To ensure the use of local minerals and promote the further development of mineral-based industries.
- 05 To encourage the recovery, recycling and reuse of metals and minerals.

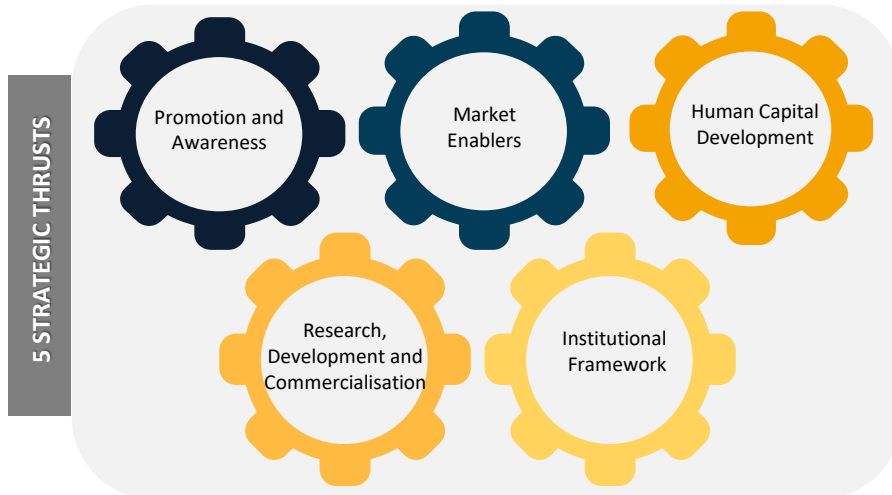
The Policy is supported by nine (9) major thrusts as follows:



GREEN TECHNOLOGY MASTER PLAN 2017-2030

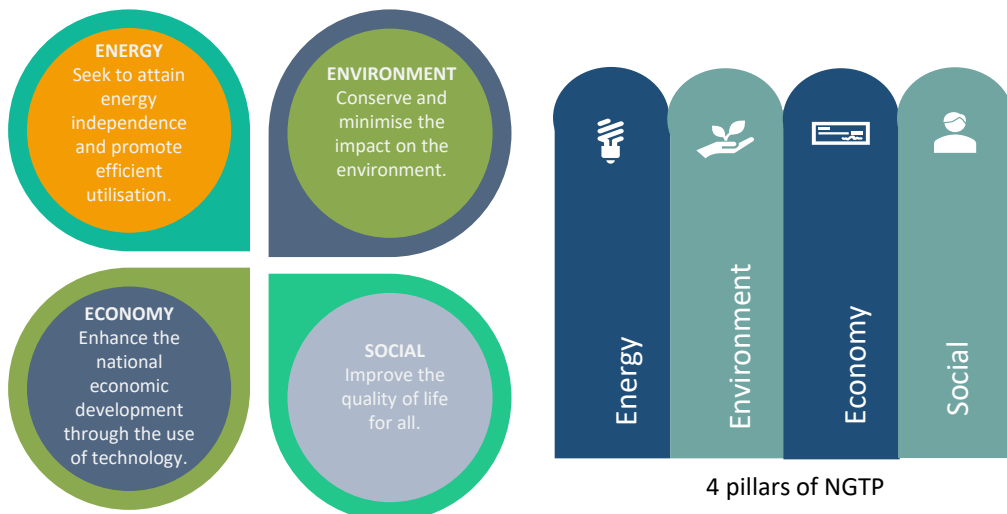
The GTMP is formulated to drive sustainable economic growth through the implementation of green technology, towards achieving environmental sustainability. Key initiatives and strategic directions for identified key sectors have been outlined based on the four pillars of the National Green Technology Policy (NGTP), i.e. energy, environment, economy and social. The GTMP outlines five (5) strategic thrusts that support the green technology development.

The GTMP highlights the country's shift towards a low-carbon economy, with the green technology as an enabler for the transition.



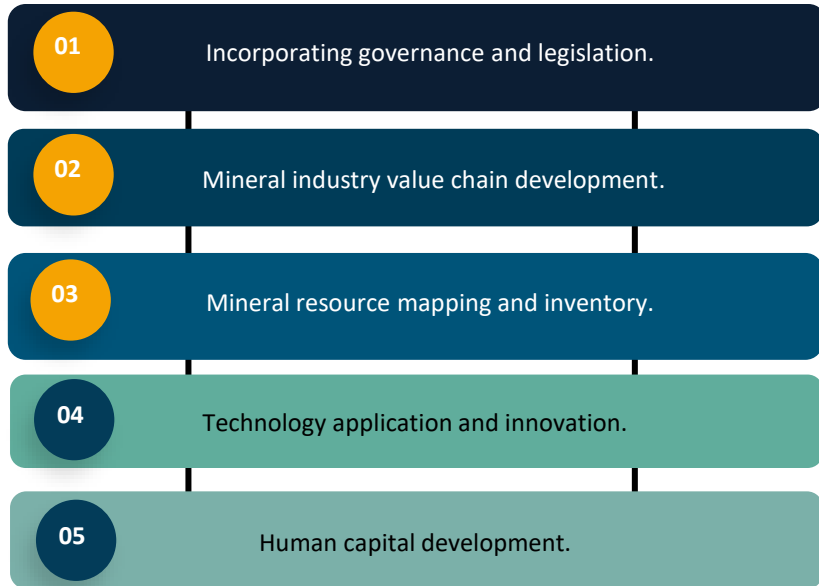
NATIONAL GREEN TECHNOLOGY POLICY

The NGTP embodies elements of economic, environment and social policies, and shall be a driver to accelerate the national economy and promote sustainable development. The Policy defines green technology as the development and application of products, equipment, and systems used to conserve the natural environment and resources, which minimises and reduces the negative impact of human activities. The NGTP is built on four pillars as follows:



NATIONAL MINERAL INDUSTRY TRANSFORMATION PLAN 2021-2030

TIM 2021-2030 aims to enhance the development and management of the mineral industry. The emphasis is on value-added creation, sustainable operations, supporting industry creation and adoption of the latest technology in the era of Industrial Revolution 4.0. The main aim emphasises on the contribution of mineral industry towards economic growth through the entire value chain, which is based on sustainability principles. TIM 2020-2030 is designed based on five (5) pillars, which are:



TIM 2021-2030 is also aimed at growing the Malaysian mineral industry into a complete ecosystem throughout the entire value chain, which is governed by the key target indicators as follows:

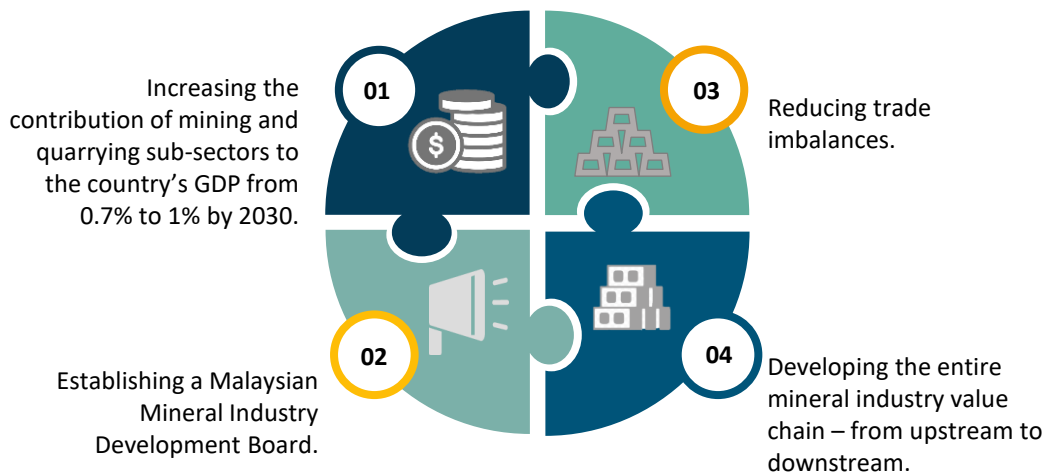




Figure 3. Examples of green mining initiatives across the globe.



1.3 Purpose of Green Mining Industry Guideline

The need to promote environmentally and socially sustainable mining development in the country has been clearly articulated in Thrust 3 of NMP2 and the TIM 2021-2030. Whilst compliance with environmental standards and regulations has been embedded in the Policy, a strategic approach to ensure effective and successful implementation of green practices can be a valuable content support. This guideline is drafted to align all the indicators and strategic action plans in a holistic manner to drive environmental protection actions and strategies for the mining sector.

01

This guideline serves to provide strategic directions for green practices implementation in the country's mining industry with measurable performance.

02

This includes identification of leading performance indicators that are reflective of sustainable environmental protection and climate adaptation.



1.4 Scope and Application

This guideline is developed to be general and ‘friendly’ enough, in order to be applicable to all mining sectors from upstream (exploration, drilling, mining, and rehabilitation), midstream (mineral processing, production, storage, transportation, and waste or residue management) and downstream sectors (refining, distribution, value-added, and rehabilitation).

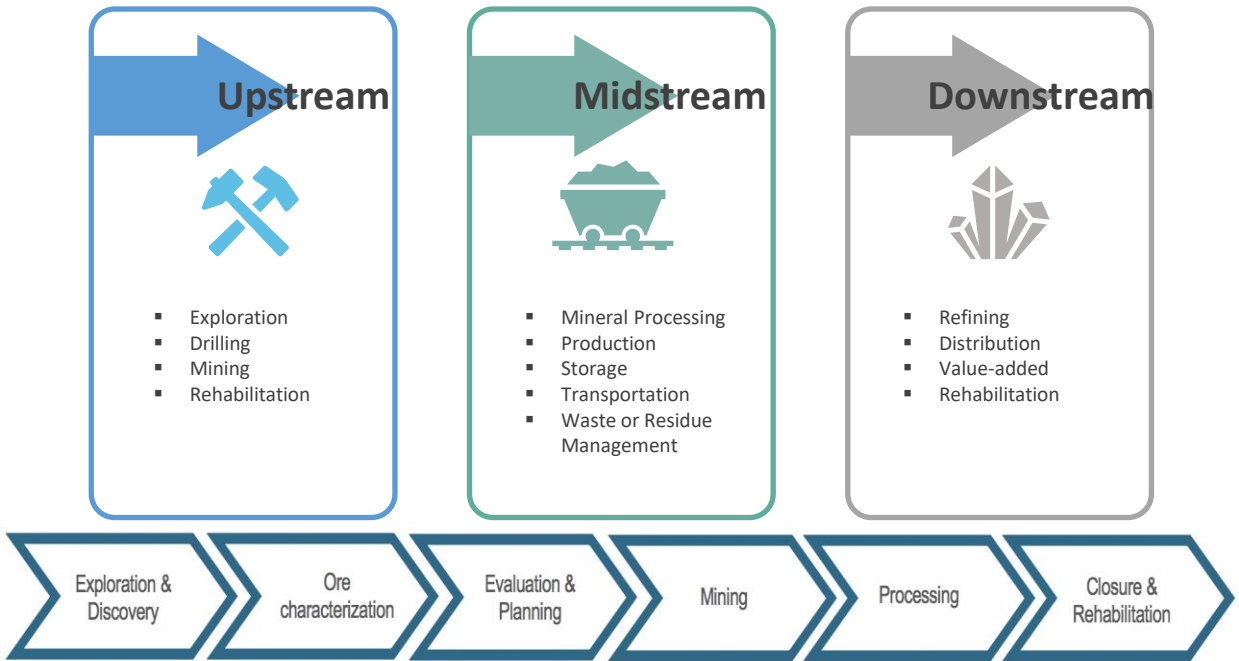


Figure 4. Mining value chain.

The backbone of the mining industry is supported by its mining value chain, which includes everything from exploration of mineral through to distribution of mineral products.

The mining value chain includes various industry players and elements, such as mine operators, suppliers, manufacturers, distributors, regulators, logistic providers, environmental laws and cultural aspects along the value chain.

The adoption of green practices and initiatives encompasses a variety of strategic action plans in every stage of mineral resource development. The guideline will provide a holistic framework to expedite mining industry to move into sustainability-driven operations and become future ready to meet the aspiration of the industry's mineral transformation plan.

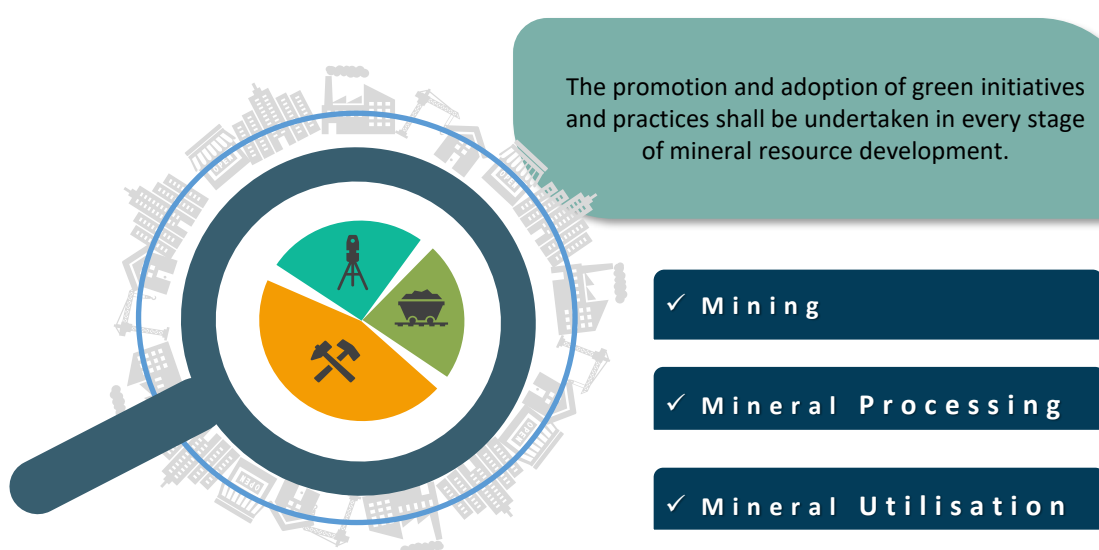


Figure 5. Adoption of green practices necessitates a holistic approach across its mining value chain.

02

DEFINITION



2.1 Definition of Green Mining

The term green mining used in this guideline is defined as follows, which reflects the adoption of sustainable environmental practices within the industry.

DEFINITION

Green mining is defined as the combination of best practices and technological advances to achieve the goals of minerals extraction and mineral resources development while mitigating the environmental and climate impacts of the processes along its value chain.



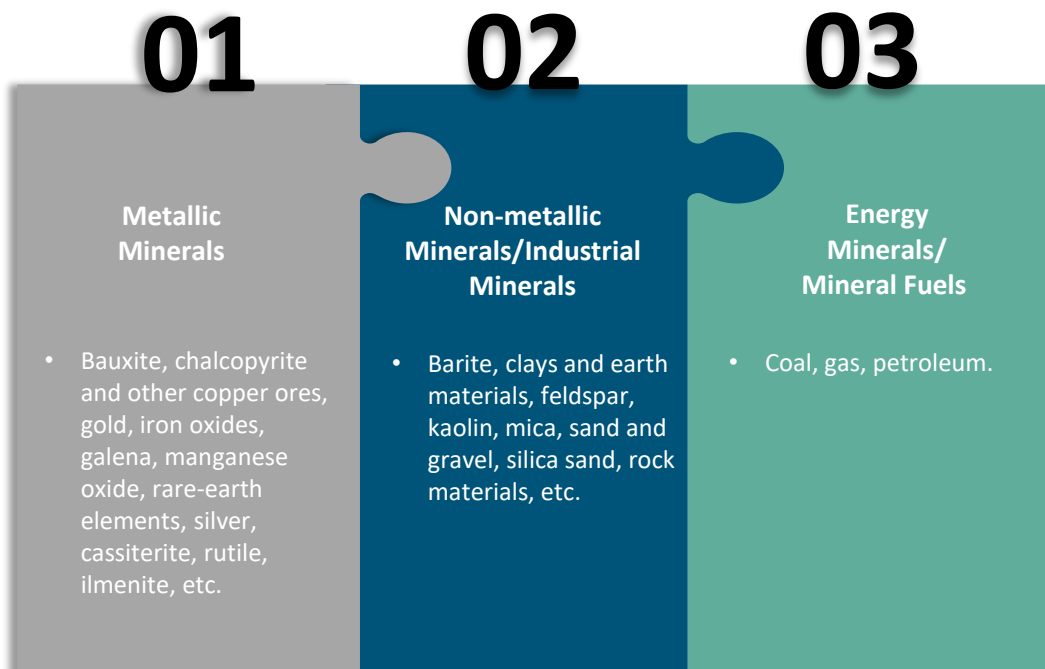
Green mining industry encourages operations that are more environmentally sustainable and friendly.

The aim should focus on the reduction of ecological footprints and GHG emissions.



2.2 Categories of Mining Industry

The mining industry can be categorised as metallic mineral industry, non-metallic mineral industry and energy mineral industry, which depends on the types of mineral commodity produced, as follows:



03

GREEN
MINING
PRACTICES



3.1 Introduction

This guideline is designed specifically to enhance mining industry efficiency, resilience and innovativeness. It is integral to innovate and deliver changes across the entire mining value chain. The strategy is underpinned by several critical foundations that form the basis for the operations of the industry as a whole. This is essential to the long-term credibility and success of green and sustainable mining.



3.2 Key Enablers for Green Mining

The green mining practices are driven by the key enabling factors to ensure that the mining industry will deliver sustained performance across all identified focus areas. The key enablers include legislation, environmental responsibility (communication, education and public awareness, CEPA), economic benefits, technologies and financial aspects.

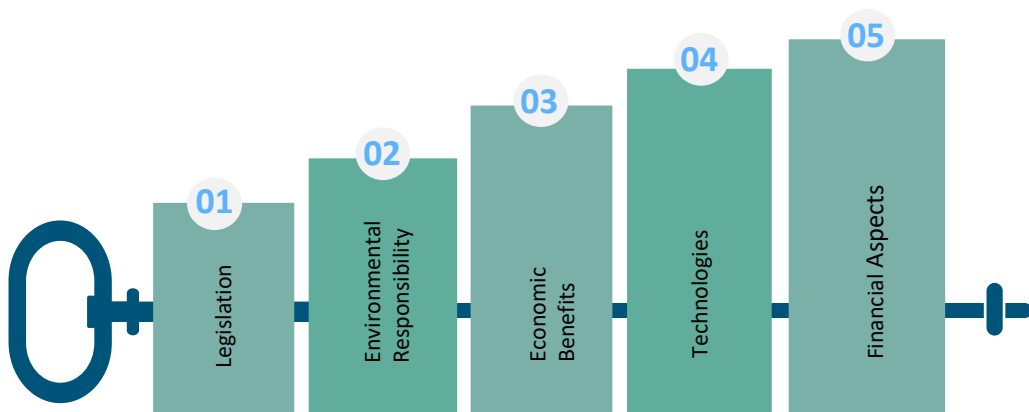


Figure 6. Key enablers for green mining practices.

Legislation

- Clear legal framework has been laid down for its implementation through the Federal and State Governments.
- The main regulatory framework for the exploration and extraction of mineral resources in the country are the MDA 1994 at the federal level and the various state laws and regulations.
- This enables initiatives drive better standards and compliance across the entire mining value chain.

Environmental Responsibility

- Reducing the environmental impacts of mining activities is a key component of sustainable development.
- Mining requires a very diligent compliance with environmental-related regulations.
- The immediate impact of mining on ecosystems and human health, as well as long-term concerns about climate change and global ecosystem sustainability, are shaping focus on the environmental footprint of the mining sector over mining life cycle.
- Having continuous and integrated CEPA is integral to foster sustainable adaptation across nations.

Economic Benefits

- Connecting the mining sector to the economy can significantly influence its entire value chain.
- The industry should look into strategic partnerships between the mining key players to combine capital and source of technologies from foreign investors.
- Implementing a circular economy approach will provide direct benefits of reduced costs due to reductions in the utilisation of raw materials, disposal costs, profit gains from recycling and revenue from incorporating waste materials into new materials.

Technologies

- Technology holds the key to reducing the environmental impacts of mining.
- Green technologies offer superior performance with respect to energy efficiency, GHG emissions and the use of materials and resources.
- Technology advancement ensures better environmental performance through pollution control and management as well as optimising resources that lessen material inputs and the shift towards renewable energy.

Financial Aspects

- With stronger financial and strategic planning, there is great potential for the industry to excel in the future.
- The Malaysian government is encouraging local and foreign investors to venture into the development of the mineral industry.
- The active participation of the investors will ensure the limited resources available would be exploited optimally.

The steps outlined in Figure 7, can be applied to develop action and implementation plans in implementing green practices in existing and future operations, based on current capabilities and strategies.

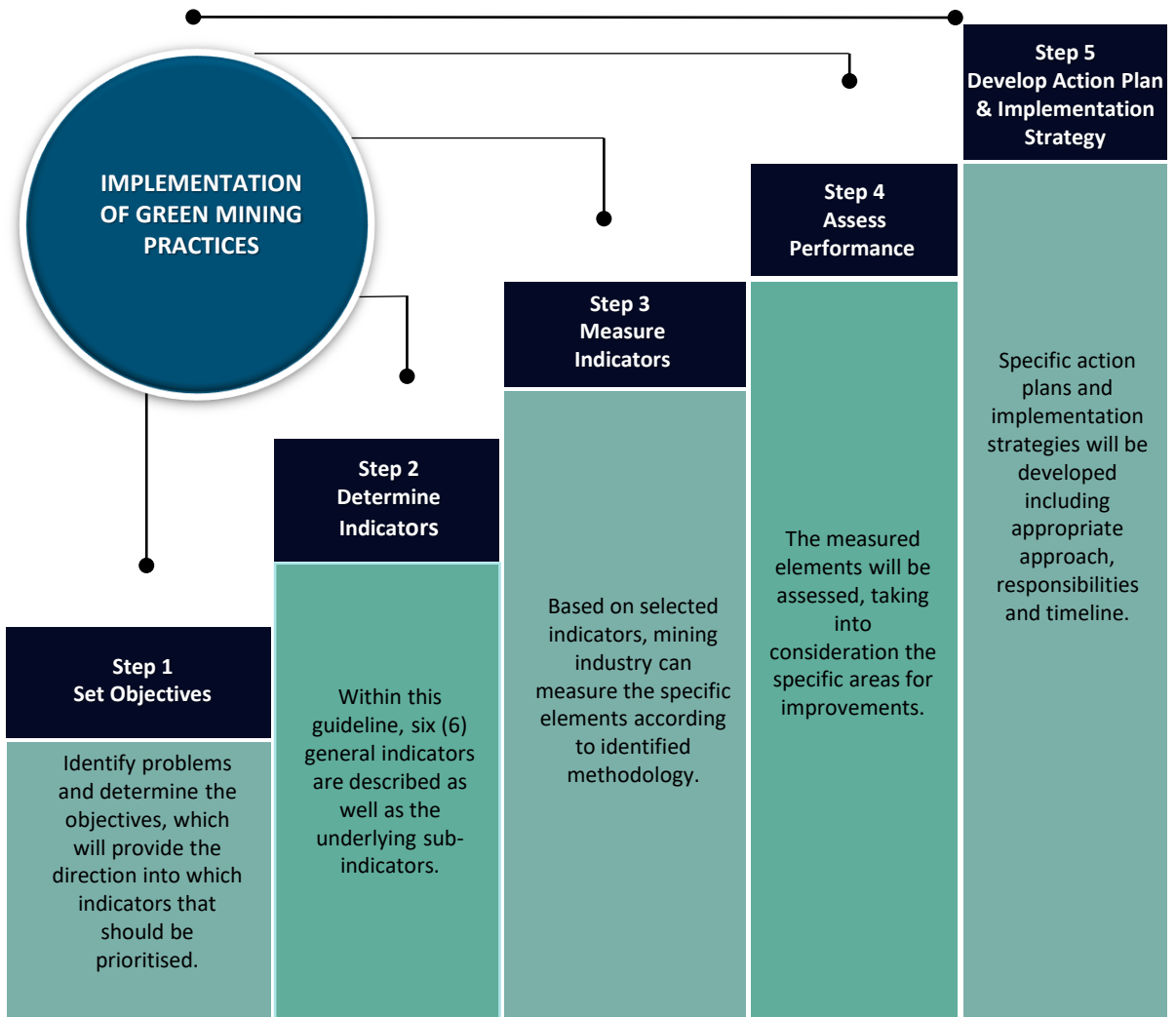


Figure 7. Implementation plans for green mining

04

GREEN
MINING
INDICATORS



4.1 Introduction

To drive the implementation of strategic approach, a list of identified indicators have been outlined to help the mining industry thrive by adapting green practices while safeguarding the environment. The leading indicators cover a range of environmental consideration, which include materials and resources, waste, water, energy, operational management, innovation and technology, as portrayed in Figure 8. The leading indicators are supported by the underlying sub-indicators to facilitate measurement of sustainability performance. The target for each indicator has been aligned with the GTMP targets as outlined in the following sub-sections.

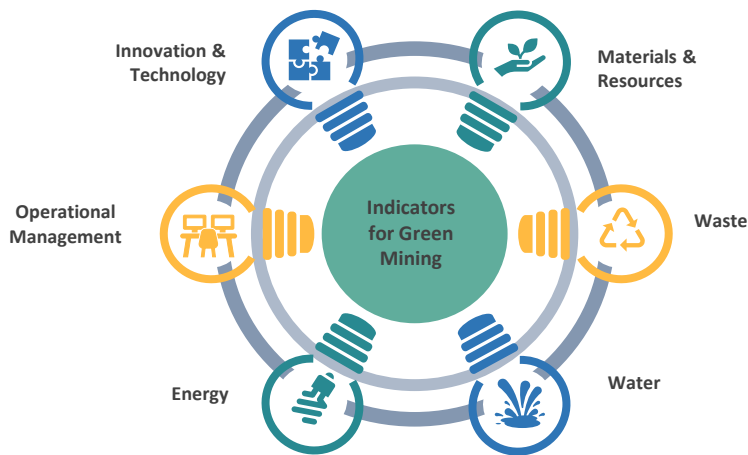


Figure 8. Indicators for green mining.

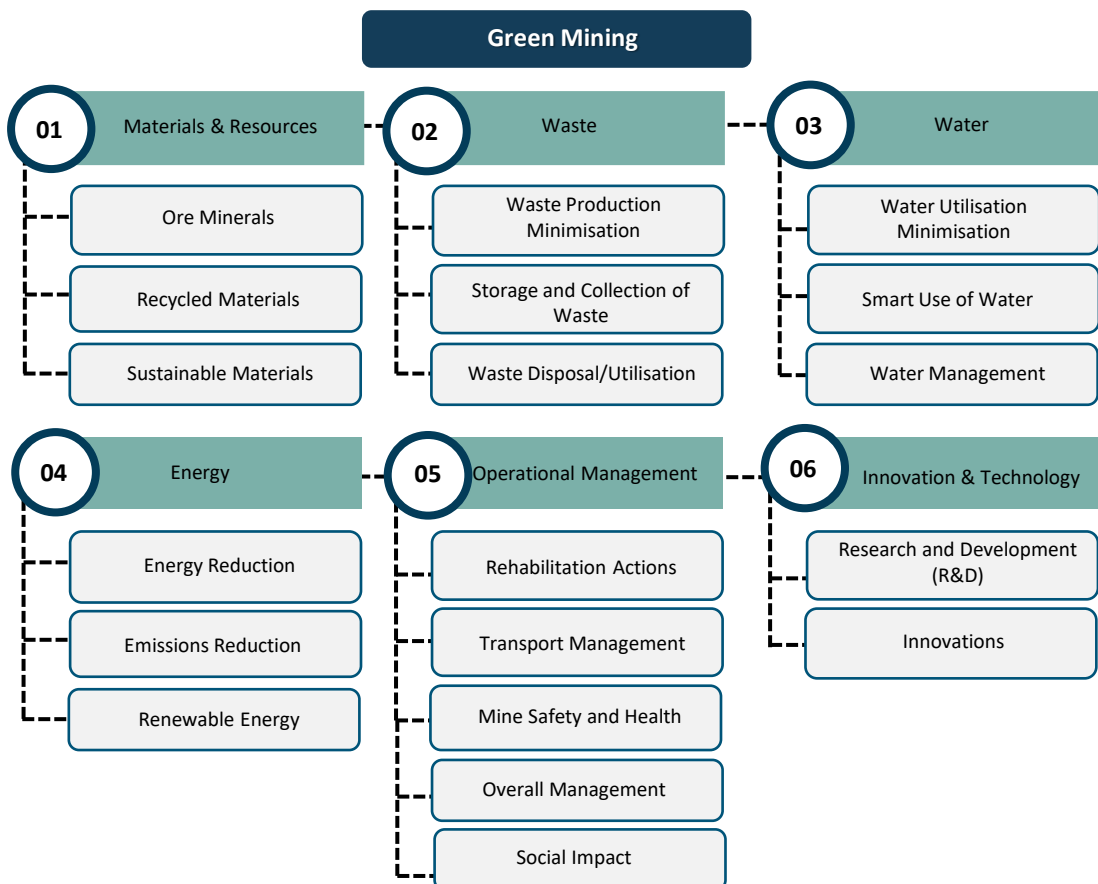


Figure 9. Leading and sub-indicators for green mining.

4.1.1 Materials and Resources

INTRODUCTION

This indicator reflects the need to ensure optimum resource usage along the mining value chain. This includes realigning conventional pattern of materials use, i.e. raw materials supply, use, production and disposal to zero waste production (materials reused, repurposed or recycled at every stage) which has the potential to impact the mining sector. The mining value chain involves the mining and extraction of minerals and coal, disposal of tailings and wastes, discharge of pollutants, environmental management, and ecological restoration. Efficient management and use of resources may reduce environmental risk of materials and promote more environmentally friendly mining operations.

GOAL SETTING

T A R G E T



- Ensure efficient use of materials and resources to increase productivity or process efficiency that leads to reduction in ecological footprint.
- Achieve 30% use of recycled or sustainable materials.

SDG 12: Ensure Sustainable Consumption and Production Patterns

12.2: By 2030, achieve the sustainable management and efficient use of natural resources.

12.5: By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

Source: SDG.

By 2030, 28% recycling rate must be achieved.

Source: GTMP Malaysia.





Materials and Resources

Sub-Indicator	Area of Assessment for Materials and Resources (MR)
MR1	Ore Minerals
	<ul style="list-style-type: none"> ▪ Using mineral processing techniques/approaches or extraction methods that requires minimal use of raw materials. ▪ Avoiding usage of materials that require high energy demand. ▪ Minimising or reusing ore minerals where possible to reduce the creation of waste. ▪ Reprocessing low-grade ore as raw material or into other usable materials.
MR2	Recycled Materials
	<ul style="list-style-type: none"> ▪ Incorporating the use of recycled materials or resources into the processing phase, as per reduce, reuse, and recycle. ▪ Using waste as raw material, as per waste to wealth initiatives. ▪ Reutilising wastes, tailings, and residues.
MR3	Sustainable Materials
	<ul style="list-style-type: none"> ▪ Using long-lasting materials or resources to reduce the need for new materials. ▪ Applying best management practices (BMPs) to enhance material life.

4.1.2 Waste

INTRODUCTION

Waste management indirectly reflects environmental protection by means of managing, recycling, and utilising mining wastes. This will reflect industrial practices to recycle, recover, treat, and utilise wastes in achieving waste minimisation objectives. Mining wastes include solid, liquid or gaseous outputs, which can vary significantly in their composition and potential for generating environmental contamination. Waste processing and utilisation need to be practiced not only to maintain the state of the environment and save energy and raw materials, but also to compensate for resource shortages, which will have economic, environmental, and social benefits.

GOAL SETTING

T A R G E T



- Initiate BMPs that are environmentally-sound through reduction of waste in a holistic manner.
- Achieve 28% of recycling rate by 2030.

SDG 12: Ensure Sustainable Consumption and Production Patterns

12.4: By 2020, achieve the environmentally sound management of chemical and all wastes throughout their life cycle.

12.5: By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

Source: SDG.

By 2030, 28% of recycling rate must be achieved.

Source: GTMP Malaysia.





Waste

Sub-Indicator	Area of Assessment for Waste (WS)
WS1	Waste Production Minimisation
	<ul style="list-style-type: none"> ▪ Minimising the production of waste within the operation. ▪ Optimising processes to recover, reuse and recycle minerals or mining wastes that lead to overall waste reduction. ▪ Increasing the use of recyclable materials. ▪ Minimising the generation of gaseous emissions.
WS2	Storage and Collection of Waste
	<ul style="list-style-type: none"> ▪ Providing appropriate storage facilities or methods for non-toxic and toxic waste. ▪ Providing a proper and systematic collection of waste.
WS3	Waste Disposal/Utilisation
	<ul style="list-style-type: none"> ▪ Ensuring safe disposal of waste for non-toxic and toxic wastes. ▪ Practising waste-to-energy.

4.1.3 Water

INTRODUCTION

This indicator reflects water efficiency and preservation of its quality. It also includes opportunity for clean water utilisation by recycling water. Sustainable water use can be reflected by the concept of sustainable water footprint, which is to ensure sustainable, fair and efficient fresh water resources. Water is used in various applications at mine sites or mining operations, and at the mineral processing plant. By diverting surface water and pumping groundwater, mining operations can reduce both the quantity and quality of water available downstream for aquatic ecosystems and other industrial and municipal water users.

GOAL SETTING

T A R G E T



- Reduction of water footprint through minimisation of water consumption and water conservation.
- Improve water efficiency through smart use of water.
- Achieve 20% reduction in Non-Revenue Water by 2030, and 30% treated effluent recycling by 2030.

SDG 6: Clean Water and Sanitation

6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion on untreated wastewater and substantially increasing recycling and safe reuse globally.

6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater.

6.5: By 2030, integrated water resource management at all levels.

Source: SDG.

By 2030, 33% treated effluent to be recycled.

Source: GTMP Malaysia.





Water

Sub-Indicator	Area of Assessment for Water (WT)
WT1	Water Utilisation Minimisation
	<ul style="list-style-type: none"> ▪ Minimising potable water consumption. ▪ Promoting the use of Rainwater Harvesting System (RWHS). ▪ Ensuring mining activities/operations are designed to minimise impact on environment through water conservation, restoration or reuse. ▪ Operating water recycling and recirculation within operations. ▪ Strategising on Non-Revenue Water (NRW) (water conservation or reduction programme.)
WT2	Smart Use of Water
	<ul style="list-style-type: none"> ▪ Improving water usage efficiency. ▪ Using energy-efficient water fittings. ▪ Using any efficient/smart devices or systems to monitor water consumption.
WT3	Water Management
	<ul style="list-style-type: none"> ▪ Ensuring wastewater effluents are treated sufficiently to meet regulatory guidelines. ▪ Monitoring of effluent quality. ▪ Reusing wastewater effluent. ▪ Managing quality of natural water (groundwater and streams) ▪ Routine checking of natural water quality within the project vicinity.

4.1.4 Energy

INTRODUCTION

This indicator reflects the need to reduce non-renewable energy consumption in mining industry. This includes practices to minimise fuel-based energy sources and using renewables energy in mining processes. Mining and mineral processing can involve energy-intensive processes. The extraction of minerals and the development of infrastructure have their own environmental impacts, including the production of GHG and increased risk of environmental contamination along the mining value chain.

GOAL SETTING

TARGET



- Develop sustainable mechanism for energy reduction.
- Reduce carbon footprint within mining operations.
- Achieve 35% energy efficiency (use of renewable energy), and 15% reduction in electricity consumption by 2030.

Malaysia intends to reduce 45% GHG emission by 2030, and further reduction of 60% in 2035.

Source: SEDA.

SDG 7: Affordable and Clean Energy

7.1: By 2030, ensure universal access to affordable, reliable and modern energy services.

7.2: By 2030, increase the share of renewable energy in the global energy mix.

7.3: By 2030, double the rate of improvement in energy efficiency.

SDG 13: Climate Action

13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters.

13.2: Integrate climate change measures into national policies, strategies and planning.

Source: SDG.

The government will no longer build new coal-fired power plants and a comprehensive National Energy Policy will soon be introduced.

Source: RMK12.

Increase to 31% renewable energy mix by 2025.

Source: SEDA.





Energy

Sub-Indicator	Area of Assessment for Energy (EG)
EG1	Energy Reduction
	<ul style="list-style-type: none"> ▪ Reducing energy and electricity consumption within operations. ▪ Reducing reliance on external energy sources. ▪ Managing system to monitor energy consumption and performance. ▪ Controlling systems or devices to optimise energy savings.
EG2	Emissions Reduction
	<ul style="list-style-type: none"> ▪ Adopting of clean/smart technology that minimises carbon emission. ▪ Minimising energy usage that leads to emissions release. ▪ Minimising use of fuel-intensive equipment/machineries.
EG3	Renewable Energy
	<ul style="list-style-type: none"> ▪ Integrating renewable energy into mining operations.

4.1.5 Operational Management

INTRODUCTION

This indicator covers the management of other aspects within mining and processing operations. This includes aspects relating to mine rehabilitation actions, mineral and materials transportation and overall mine safety and health issues. This is to ensure issues pertaining to mining operations such as land management, emissions reduction, pollution and safety and health aspects can be tackled more efficiently.

GOAL SETTING

TARGET



- Achieve efficient post-mining restoration and rehabilitation.
- Ensure sustainable land use management to reduce land use impacts of mining.
- Maintain ecological, human and diversity balance.
- Achieve 10% reduction in closure costs and environmental risks through progressive rehabilitation.

SDG 11: Sustainable Cities and Communities

11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

SDG 15: Life on Land

15.5: Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and protect and prevent the extinction of threatened species.

15.9: Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts.

SDG 3: Good Health and Well-being

3.9: By 2030, substantially reduce the number of deaths and illness from hazardous chemicals and air, water and soil pollution and contamination.

3.13: Strengthen the capacity for early warning, risk reduction and management of health risks.

SDG 1: No Poverty

1.4: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.



Source: SDG.



Operational Management

Sub-Indicator	Area of Assessment for Operational Management (OM)
OM1	<p>Rehabilitation Actions</p> <ul style="list-style-type: none"> Ensuring safe and effective closure of mine. Developing appropriate post-mining rehabilitation and reclamation plans. Planning for progressive rehabilitation as mining operations are ongoing. Conserving ecological biodiversity.
OM2	<p>Transport Management</p> <ul style="list-style-type: none"> Minimising the use of fuel-intensive transport mechanism for raw or processed minerals or any materials or resource transportation. Optimising the use of cleaner and safer vehicles.
OM3	<p>Mine Safety and Health</p> <ul style="list-style-type: none"> Ensuring safe environment for mine workers. Ensuring good health of workers. Ensuring excellent environmental practices.
OM4	<p>Overall Management</p> <ul style="list-style-type: none"> Carrying out environmental audits at regular intervals.
OM5	<p>Social Impact</p> <ul style="list-style-type: none"> Avoiding damages or high impacts on surrounding communities. Implementing continuous Social Impact Assessment. Conducting communication, education and public awareness (CEPA) programmes.

4.1.6 Innovation and Technology

INTRODUCTION

This indicator entails innovative approaches toward achieving sustainable future in mineral resource development. This includes strategies and efforts to venture into new technologies through investment in related R&Ds and innovations. Depending on production scale, companies may have adopted some innovations within its processes and operations that improve its productivity. This can be adapted into in-house standards, BMPs or even as structured documents that ease the production and promote the sense of innovativeness in management.

GOAL SETTING

T A R G E T



- Ensure sustainable mineral resource development for the future.
- Achieve future smart mining.
- Achieve core level of innovation, which is to optimise existing products or services for existing customers or consumers.

SDG 9: Build Resilient Infrastructure, Promote Inclusive and Sustainable Industrialization and Foster Innovation

9.4: By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increase resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes.

9.5: By 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending.

SDG 8: Decent Work and Economic Growth

12.9: Achieve higher levels of productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labor-intensive sectors.

SDG 12: Ensure Sustainable Consumption and Production Patterns

12.9: Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production.



Source: SDG.



Innovation and Technology

Sub-Indicator	Area of Assessment for Innovation and Technology (IT)
IT1	Research & Development (R&D)
	<ul style="list-style-type: none"> ▪ Supporting R&D that allows new technologies to be adopted to improve existing operations. ▪ Using IR4.0 components in operations of mining.
IT2	Innovations
	<ul style="list-style-type: none"> ▪ Implementing process or operational innovations or technological adoption to optimise productivity. ▪ Production or innovative use of by-products. ▪ Applying new developments within digitalisation. ▪ Employing In-house standards, BMPs, documentations etc.

05

IMPLEMENTATION OF
GREEN MINING
PRACTICES



5.1 Preparation and Target Setting

5.1.1 Targets for Green Mining Practices

Adoption of green mining practices can be driven by sustainability performance, which is indicative of its environmental performance, as supported by the leading indicators. The sustainability performance could be measured in terms of its accomplishment targets or key focus areas, as shown in Figure 10. The specific target for each performance indicator has been aligned with the GTMP targets, as outlined in Section 4.

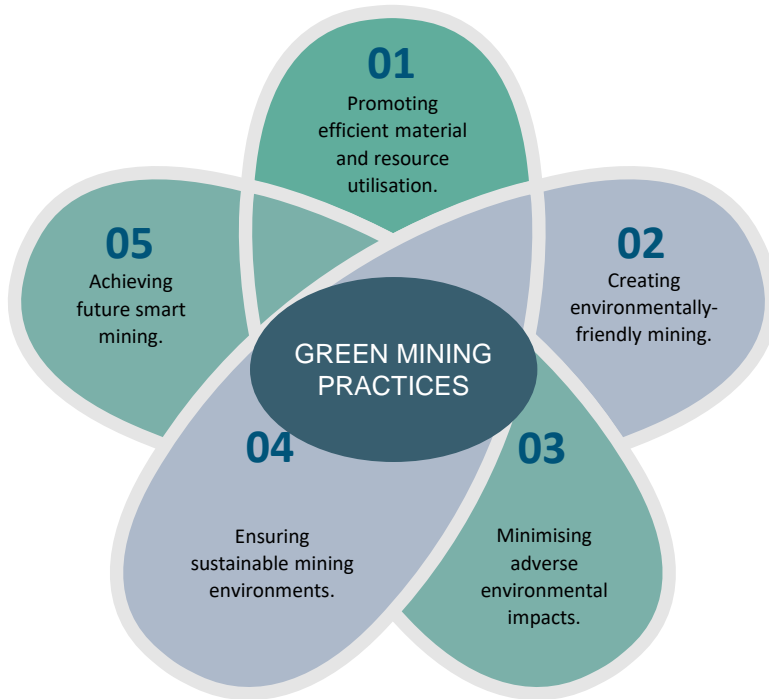
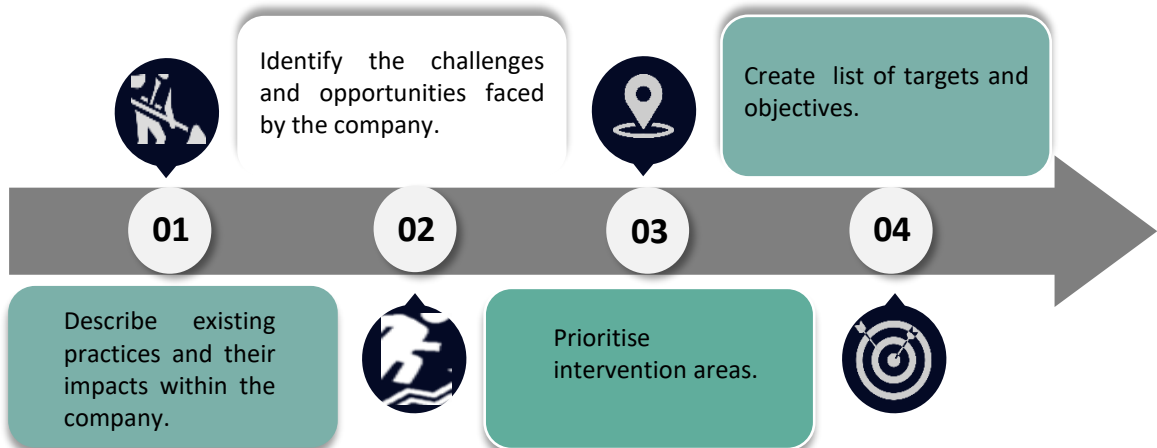


Figure 10. Targets for green mining practices.

A strategic action plan is formulated to promote the involvement of all stakeholders in the mining industry to ensure successful implementation of the green mining practices in the short, medium and long terms. The aim is to apply the concept of sustainable development in mineral resource development for the country, to ensure that sustainable practices are undertaken at every stage of mineral development.





5.2 Implementation and Action Plan

The overall implementation and strategic action plan for green mining practices can be summarised as follows, which encompasses two main phases, i.e. industry preparation and its target setting, as well as monitoring and evaluation of green performance. This shall be supported by relevant legislations that drive the target and implementation plan towards achieving environmental sustainability. The strategic action plan is underpinned by the key focus areas spanning a list of broadly identified initiatives.

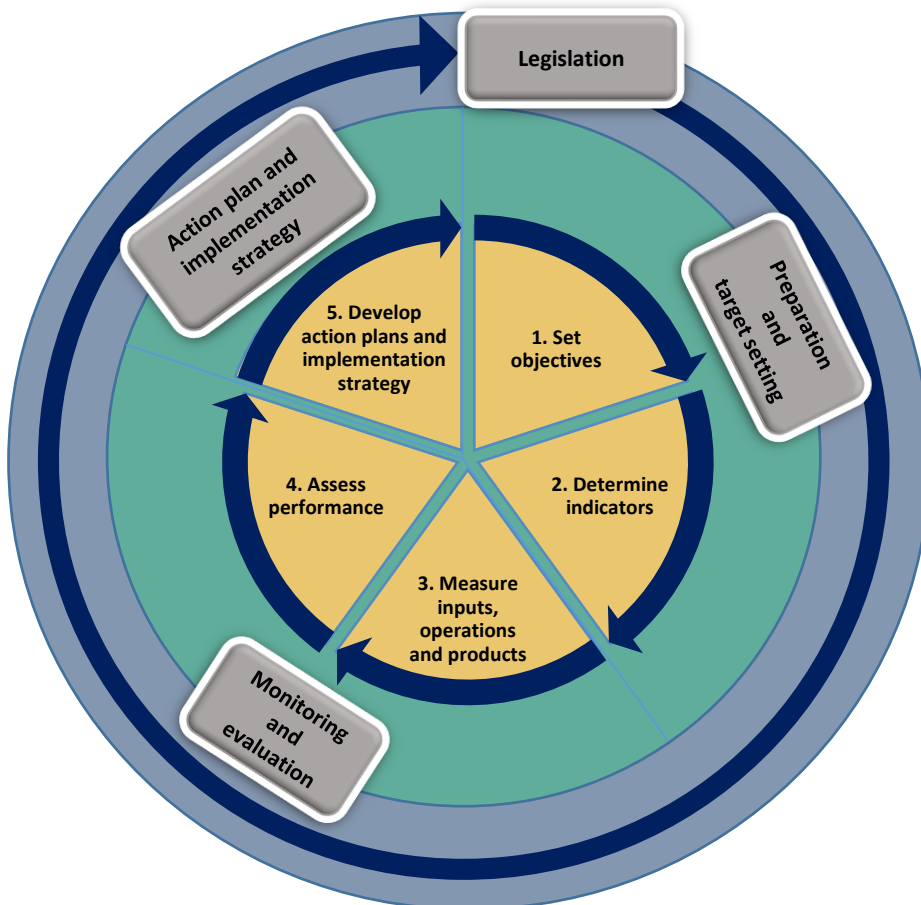


Figure 11. Summary of implementation and action plan for green mining practices driven by related legislations.

The action plan focuses on environmental protection and climate-friendly approaches in mining industry, ensuring that all mining activities are conducted sustainably along its value chain.

5.2.1 Strategic Action Plans for Green Mining Practices

Indicator	Action Plan	Outcome
<p>Materials and resource management.</p>	<ul style="list-style-type: none"> ▪ Plan for a proper management of raw materials and resources. ▪ Introduce the use of more sustainable materials. ▪ Reprocess low-grade ore/waste as raw material. 	<ul style="list-style-type: none"> ▪ Reduction of ecological footprint. ▪ Increased productivity. ▪ Efficient use of resources.
<p>Waste production.</p>	<ul style="list-style-type: none"> ▪ Recover, reuse and/or recycle mining wastes. ▪ Increase the use of recyclable materials. ▪ Apply waste-to-energy practices. ▪ Design appropriate storage facilities. 	<ul style="list-style-type: none"> ▪ Reduction of wastes throughout mining and processing activities.
<p>Water utilisation.</p>	<ul style="list-style-type: none"> ▪ Ensure mining activities are designed to avoid or minimise impact of water usage on environment through water conservation, restoration and/or recycling. ▪ Adopt innovative water conservation practices. ▪ Conduct water conservation program. ▪ Manage effluents efficiently. ▪ Protect the quality of natural water resources. 	<ul style="list-style-type: none"> ▪ Reduction in water consumption. ▪ Conservation of natural water resources.



Indicator	Action Plan	Outcome
<p>Energy consumption.</p>	<ul style="list-style-type: none"> ▪ Reduce energy consumption within mining and mineral processing plant. ▪ Integrate renewable energy into mining and mineral processing plant. 	<ul style="list-style-type: none"> ▪ Reduction in energy consumption.
<p>Emissions reduction.</p>	<ul style="list-style-type: none"> ▪ Adopt low-carbon growth strategy. ▪ Ensure good air quality at mine site and operations. ▪ Minimise the emissions of carbon dioxide and other GHG. 	<ul style="list-style-type: none"> ▪ Reduction of carbon footprint. ▪ Creation of climate-friendly environments. ▪ Reduction of GHG.
<p>Operational management.</p>	<p>Land management</p> <ul style="list-style-type: none"> ▪ Ensure safe closure of mine. ▪ Develop appropriate post-mining rehabilitation and reclamation plans. ▪ Integrate mine development around existing infrastructure. ▪ Ensure ecological and biodiversity conservation. <p>Health and safety</p> <ul style="list-style-type: none"> ▪ Ensure safe environment for mine workers. ▪ Avoid damages on surrounding communities. <p>Transport management</p> <ul style="list-style-type: none"> ▪ Develop proper transport operations during mining, processing and transportation of minerals and other materials. 	<ul style="list-style-type: none"> ▪ Efficient post-mining restoration and rehabilitation. ▪ Reduced land use impacts of mining. ▪ Ecological, human and diversity balance. ▪ Create social and community well-being. ▪ Lessen air-related pollution.



Indicator	Action Plan	Outcome
<p data-bbox="115 337 425 499">Innovation and technological enablement.</p>	<ul data-bbox="482 337 868 468" style="list-style-type: none">▪ Develop innovations in mining technology and applications.▪ Deploy R&D in green mining and technologies.	<p data-bbox="1019 323 1336 509">Development of sustainable and smart mining for the future.</p>



5.3 Monitoring and Evaluation

Continuous evaluation and review are deemed important to ensure the successful implementation of green mining practices. Mining operators must adhere to the standard operating procedures and undertake self-check themselves to ensure that they are able to comply with the recommended guidelines. Mining industry shall issue periodic progress reports on the implementation of green practices based on this guideline. In the implementation of the green practices, mining industry shall take into account the environmental sustainability-related thrusts stipulated in the NMP2 and TIM 2021-2030 and the pillars in Malaysia's GTMP. The Government and mining sector shall ensure that green mining practices are successfully implemented and monitored within a close working relationship.

Monitoring and evaluation aspects of green mining industry

Target Setting	Monitoring & Evaluation Aspect
Promoting efficient material and resource utilisation.	<ul style="list-style-type: none"> Raw material utilisation. Use of recycled materials. Use of sustainable materials.
Creating environmentally-friendly mining.	<ul style="list-style-type: none"> Control of high energy usage. Use of renewable energy. GHG emission control.
Minimising adverse environmental impacts.	<ul style="list-style-type: none"> Waste minimisation, recovery, reuse and recycling. Waste-to-energy practices. Toxic and hazardous waste treatment. Water consumption minimisation. Wastewater treatment/effluent control. Water and wastewater reuse.
Ensuring sustainable mining environments.	<ul style="list-style-type: none"> Rehabilitation actions. Mine closure and post-mining land management. Transport management. Mine safety and health.
Achieving future smart mining.	<ul style="list-style-type: none"> R&D in mine processes and technologies. Innovations in mineral resource development.



5.4 Green Mining Scenario

5.4.1 Aspiration towards Green Mining

Within South-East Asia, the ASEAN Mineral Awards, which was first introduced in 2017, aspires ASEAN mining companies to apply the concept of sustainable development to their mineral resource industry. The awards are conferred to the ASEAN mining companies based on the Guidelines for ASEAN Mineral Awards on best practices in mining, processing and distribution of metallic and non-metallic minerals.



Categories of Awards

- Best Practices in Metallic Minerals Mining
- Best Practices in Non-metallic Minerals Mining
- Best Practices in Metallic Minerals Processing
- Best Practices in Non-metallic Minerals Processing
- Best Practices in Metallic Minerals Distribution
- Best Practices in Non-metallic Minerals Distribution

The Aspiration



The ASEAN Mineral Awards is a biennial award established to honour ASEAN mining companies that have made outstanding contributions toward the promotion of environmentally and socially sustainable minerals development in the ASEAN region.

In Malaysian context, an example of a detailed guideline to the implementation of green practices in the mining industry has been documented by the Department of Mineral and Geoscience Malaysia. Although it is still in early phase of development, various aspects of best practices are portrayed in the documents, covering the aspects of water, energy and waste management, amongst others.



5.4.2 Suggestions of Green Mining Practices

This section emphasises best practices in the mining sector which are recommended to be in-line with the targets of sustainability performance in the mineral industry. This encompasses examples of best practices in mining, mineral processing, and mineral distribution within the industry. Some examples of best practices that lead to higher efficiency or may be replicable to other companies are presented below. These are adopted from best practices in mining operations in selected mining companies that have received recognition for their green practices and would be replicable within the Malaysian mining industry, wherever possible.

Indicator: Materials and Resource Management



Resource management

- Ensuring the quality of raw materials and desired product quality.
- Designing a proper production plan to control for quality of materials.

Sustainable materials

- Reprocessing low-grade ore or waste into new materials, or creating new products.

Indicator: Waste Production



Waste minimisation/reuse

- Managing waste such as dust from rotary kiln, rotary dryer, and furnace, and sludge from fuel oil.
- Using pelletiser to transform dust into briquettes. Sludge is used in rotary kilns as fuel after water content reduction. Slag is used as a side product smelted into construction products.
- Reprocessing the low-grade ore.

Indicator: Water Management



Reduction of water consumption

- Installing a second return water line from the tailings storage facility to enable more process water to be returned to the plant.
- Using a Rainwater Harvesting System (RWHS).

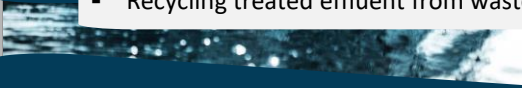
Water recycling

- Recycling of process plant's water requirement, thereby reducing abstraction of water from local catchments, maintaining community access to water sources, and reducing overall operating costs.



Effluent management

- Providing a series of silt traps and sedimentation ponds at a strategic locations to minimise silt being washed directly into the adjacent river.
- Recycling treated effluent from wastewater treatment plant.



Water management

- Collaboration to bring coaching and mentoring to community members, leaders and regulators to advocate the development of a water catchment management plan.



Indicator: Energy Consumption



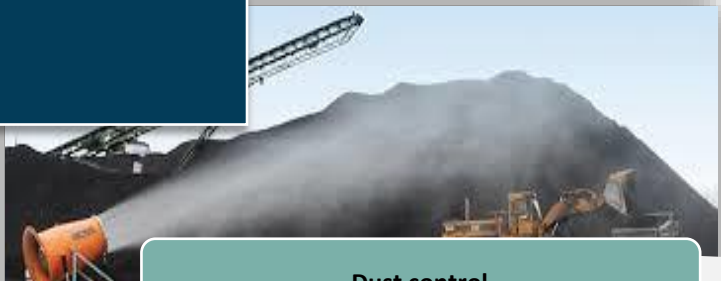
Energy efficiency

- Connecting to the national power grid instead of operating its generator sets as its main power source led to a significant reduction in carbon emissions and diesel fuel consumption.

Renewable energy

- Using solar panels (photovoltaic technology) - Generate more electricity and have a higher return-of-investment.

Indicator: Emissions Reduction



Dust control

- Alternative ways to use quarry dust by reducing, controlling, and recycling at point source and non-point source.

Air quality management

- Regular maintenance for all back-up generator sets and heavy equipment. Dust suppression activities should be carried out regularly.

Carbon reduction

- Adopting low-emission alternatives such as use of renewable energy, fuel switching, combined heat and power, material movement electrification, and recycling of materials, to reduce GHG emissions.
- Establishing a Tree Plantation Programme with government agencies, community groups, schools, and other stakeholders.



Indicator: Operational Management



Environmental protection

- Use of delaying fuse and air deck to reduce blasting materials, communities are informed ahead of the blasting schedule.
- Avoid secondary blasting (use other methods of rock size reduction such as surface miner, rock splitter, breaker, and ripper) to reduce the environmental impact of blasting practice.

Biodiversity conservation

- Stability rehabilitation methods that rapidly help increase biodiversity in the sites being rehabilitated.
- Conducting an annual ecological assessment and biodiversity monitoring.

Environmental conservation and restoration

- Conducting re-vegetation, slope and drainage maintenance, and comprehensive erosion control.
- Planting a particular plant species to create more habitats that could sustain and support a wide variety of birds, insects, and other animals.
- Establishment of appropriate lake ecosystems through aquaculture activities.

Transport management

- Introduction of one-way parking as a safety procedure for trucks, adopting life-saving rules, and speed locks to control speed limits.
- Avoid using fuel-intensive vehicles.

Community Social Responsibility

- Employees are sent into communities to observe environmental impacts.
- Financial support is provided to various community groups for education activities.
- Work closely with the local medical services to promote health within the local community.

Indicator: Innovation and Technology



Machine innovation

- Drilling machines – replace and modify machine parts to suit its operational requirements.
- Modification of diesel generator fuel into a dual fuel system, e.g. marine fuel oil and liquefied natural gas. Flue gas emission and operation costs can be reduced and operational flexibility can be increased.

Mineral recovery improvement

- Froth flotation and gravity recovery circuit - Introducing selective froth flotation and modern gravity techniques have been proven efficient for the concentration of fine and low-grade ore. Modification and improvement of the pumping and instrumentation systems have been integrated into high capacity plants.

Innovation system

- Use specialised techniques, protocols, or software to improve different aspects of innovation.
- Innovating the product system, e.g. production or innovative use of by-products.
- Improvement of product or service performance - Optimise core products or services to a higher quality.



5.5 Framework of Green Mining Practices

The overall strategic approach for green mining practices is illustrated in the Framework of Green Mining Practices for the mining sector as in Figure 12. The framework links all the identified leading indicators, sub-indicators, and strategic action plans in a holistic approach to meet the targets of related SDGs. The leading indicators mirror overall sustainability performance with regard to green mining practices. It gives indication of the effectiveness of mines and mining operations in protecting the environment as a whole and providing directions for future mineral resource development for the country. The framework will aspire the mining industry to apply the concept of sustainable development to the country's mineral resource development with the ultimate aim of protecting the environment.

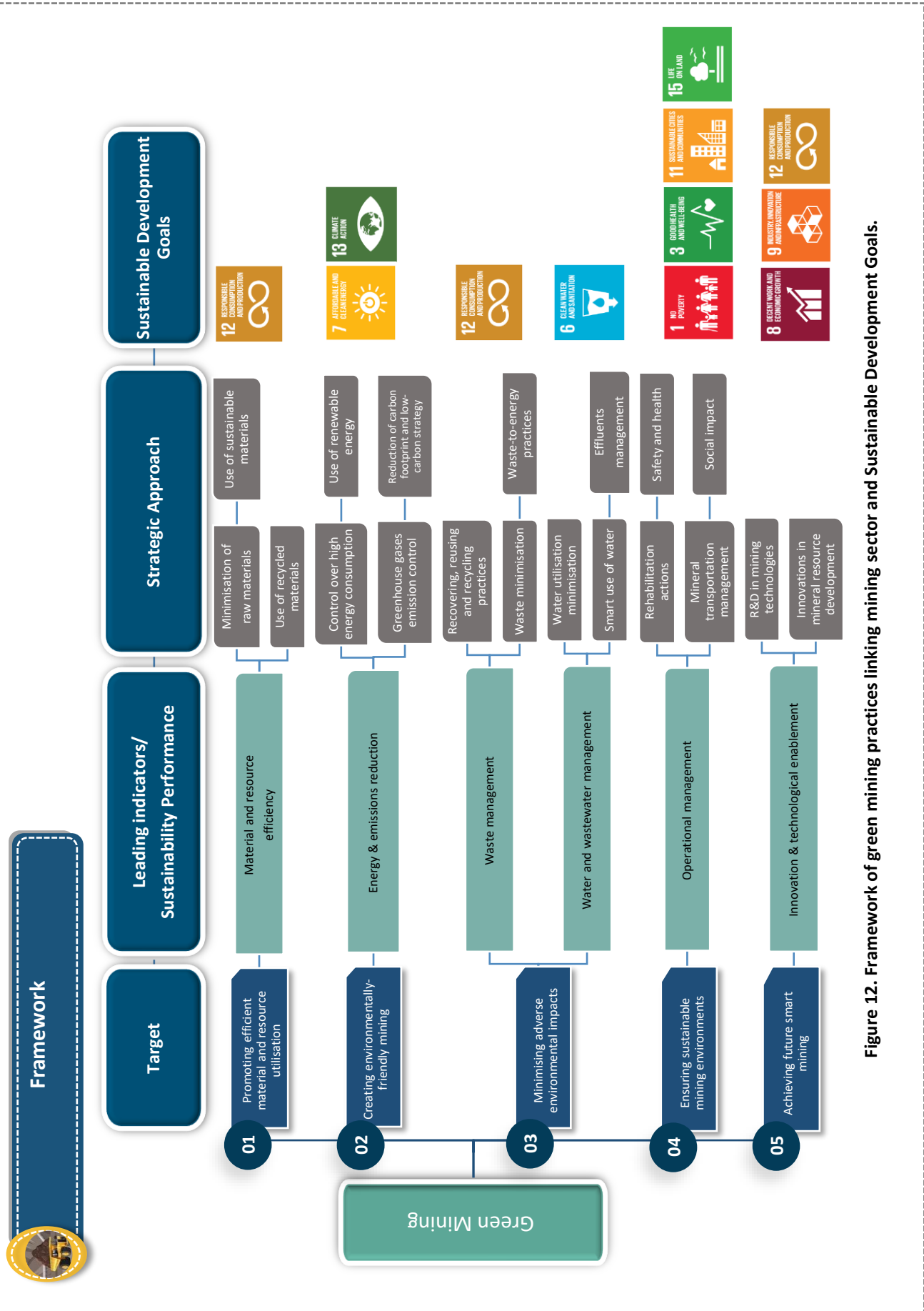


Figure 12. Framework of green mining practices linking mining sector and Sustainable Development Goals.



5.6 Roadmap towards Green Certification

The aim of this roadmap is to provide direction and formulate a holistic approach involving all stakeholders in jointly addressing green mining practices. The overall roadmap of green mining implementation is as illustrated in Figure 13. The figure summarises the directions of green practices in mining sector that will lead to green recognition and certification. The success of this roadmap will require a structured approach from all key industry players in the mining value chain working in a coordinated effort to address green mining practices. More specifically, this roadmap provides guidance to the mining industry on developing sustainable mining aligned with environmental sustainability goals, which include designing and implementing sustainability interventions and reporting performance.

Sector Identification

- This guideline applies to all mining industry sectors, including upstream, midstream, and downstream. This will ensure that green practices can be widely applied across its mining value chain and at every stage of mineral resource development.

Preparation and Target Setting

- The adoption of green mining practices shall be driven by sustainability performance, underpinned by the identified indicators which are indicative of its environmental performance. A list of broadly identified action plans and initiatives has been outlined to help the industry achieve its target for green mining.

Leading and Sub-indicators

- The leading indicators reflect the overall sustainability performance which is supported by the underlying sub-indicators. These indicators will lead and drive the implementation of a strategic approach towards achieving the targets of green mining. The indicators serve as a guide to attaining the ultimate aim of protecting the environment.

Strategic Action Plan and Implementation

- This roadmap will provide opportunities for the mining industry to embrace environmentally-friendly initiatives that could facilitate environmental protection to ensure sustainability and social well-being. Therefore, it is envisaged that the initiatives be streamlined with the identified focus areas through a strategic action plan in a holistic manner.

Self-Monitoring and Reporting

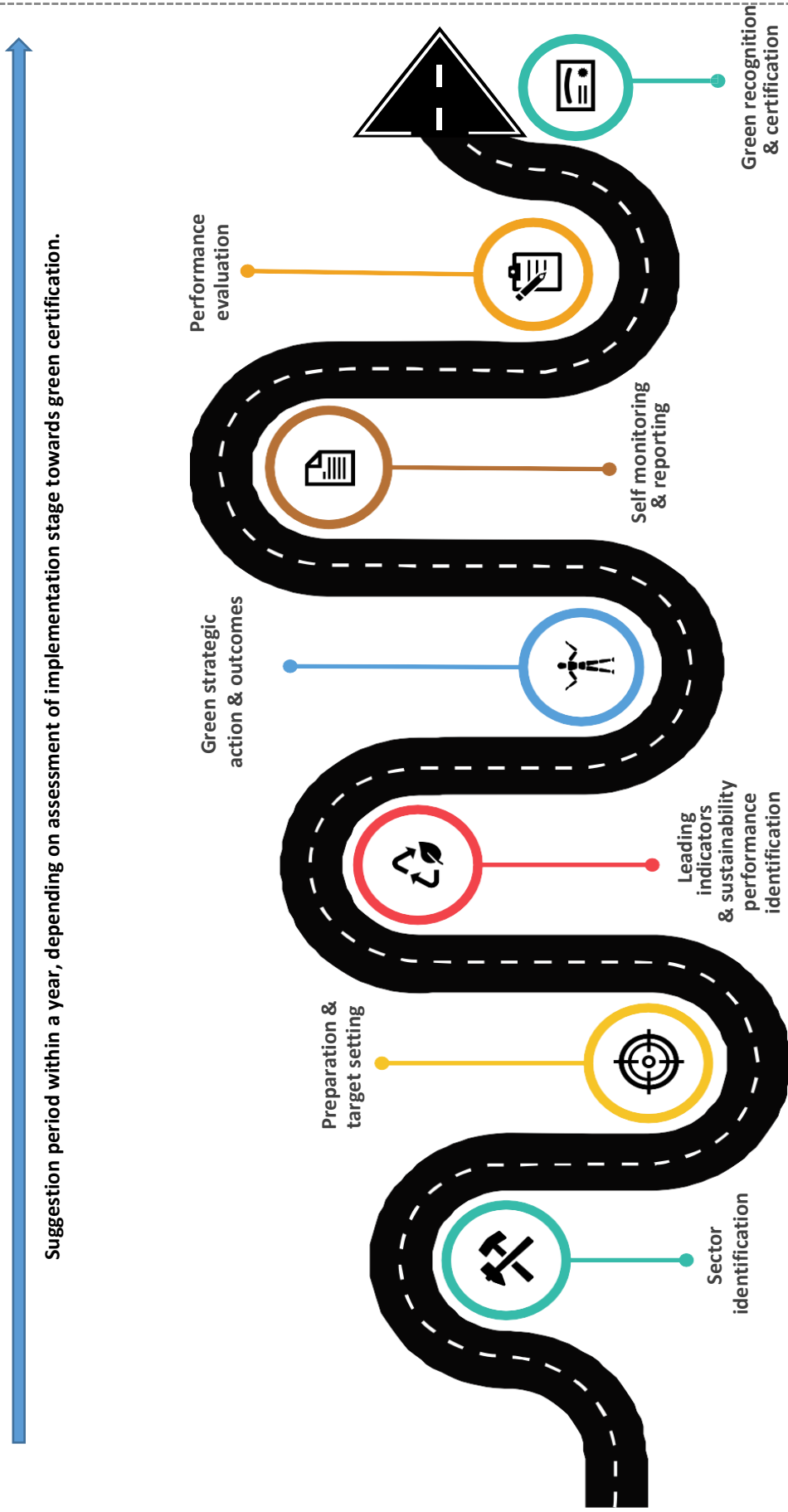
- To support the roadmap in a participatory manner and encourage proactively measures, mine operators shall provide inputs of their green practices to be evaluated. This includes reporting their achievements in meeting the target(s) of green practices within their operations. This shall be based on the identified indicators of green mining.

Performance Evaluation

- Following the submission of the green practices performance report, the industry shall evaluate the level of accomplishment by respective companies and identify any best practices that could be replicated to other mines or mining operations of the same nature. Whilst it is noted that sustainability performance also depends on production scale, the strategic action plan can be used to measure overall mining company's performance across the identified focus areas.

Green Recognition

- In essence, this guideline describes the recommendations and proposed action plans that mining companies can adopt to implement green practices in their operations. This is driven by the eventual development of a **Green Certificate** which recognises the green practices in the industry. It is envisioned that mining companies that have implemented green and best practices in the industry may apply for the Green Certificate, which is recognised by the Government of Malaysia, hence being eligible for, as of now, proposed financing benefits and support.



Suggestion period within a year, depending on assessment of implementation stage towards green certification.

Figure 13. Roadmap of green mining implementation towards green certification.



5.7 Challenges of Green Practices in Mining Sector

On a general note, the concept of sustainable mining involves integrating economic activity with environmental integrity, social concerns, and efficient government systems. There are, however, challenges to the adoption and implementation of green practices in the mining industry. While environmental impact is critical to mining, revolutionised driving factors including economic trends, technology development, and environmental and social expectations will shift the industry towards better sustainability performance in the future.



Figure 14. Challenges to the adoption of green mining practices.



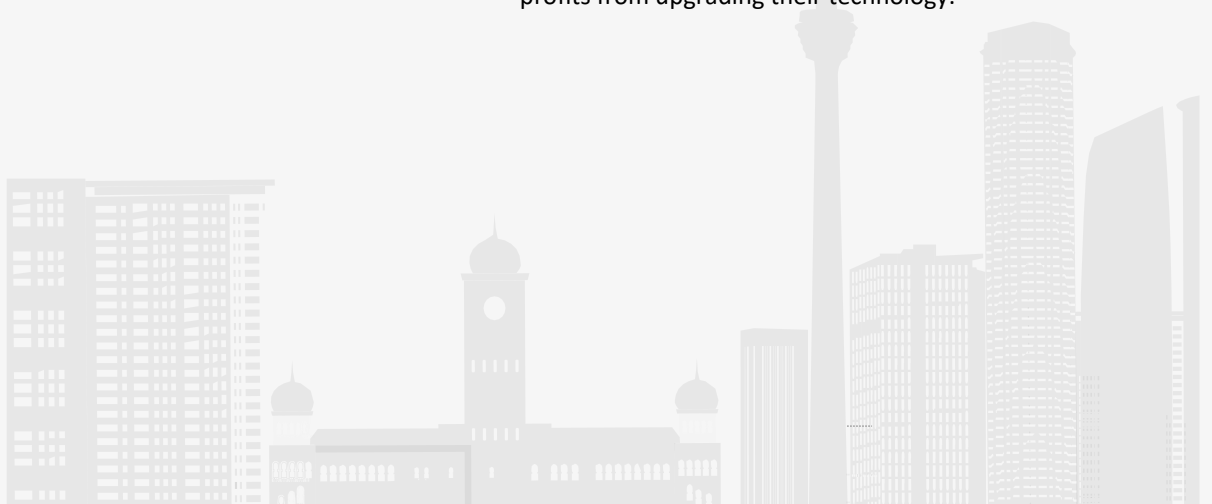
Synergy between companies and government for the future

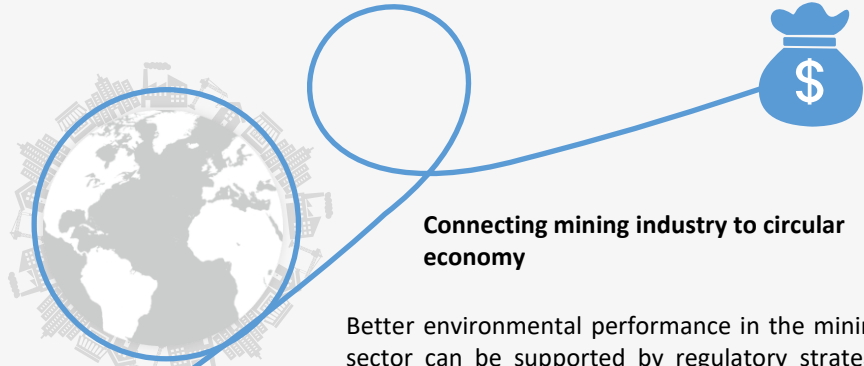
Companies that manage their value chain well can establish a significant source of competitive advantage and value creation. Mining value chains face pressure from recent shifts in commodity markets such as strong price fluctuations, changing market structures from the new entrants, as well as uncertainty by current pandemic. The government may perform its duty in monitoring mining activities based on the existing and future environmental regulations and policies. Similarly, mining companies may adopt green practices with the guidance of green mining framework.



Motivation to embark on green technology

The production scale of a mining company can affect its intention to embark on green initiatives or to upgrade to green technology. For instance, a large-scale production mine invests in green technology and innovation to improve the technical level of the entire operation and to increase its profits. On the other hand, a small mine that invests in high technological development may face investment or operational risks. It is recommended that green mining implementation be structured in such a way that it reflects the production scale of a mining company. The initiative for green mining technology also needs to be investigated carefully based on the mining companies' profits from upgrading their technology.





Connecting mining industry to circular economy

Better environmental performance in the mining sector can be supported by regulatory strategy and policy that links to the green economy. This includes the creation of a government approach and engagement with a wide range of stakeholders. It also looks at the development of capacity building and innovation, as well as creating linkages to the circular economy. This will have broadly beneficial impacts on the environmental sustainability of mining through the reduction of waste, and hence the need for new resources can be reduced in the future.

Professional human resources and talent management

Developing professional human resources is important to make adaptation easy. This includes building reputation among experts and examining the strategies and practices that can improve the professionalism of the industry. Professional human resources play a key role in developing, reinforcing, and changing the culture of an organisation which is important to achieve its success at all management levels.





5.8 Way Forward

Moving forward in the coming years, the Green Practice Guideline will be the key reference for green mining practices in Malaysia. To drive the national green agenda, and in particular to reach the targets of the green practices, it is proposed that the following initiatives are taken into consideration;

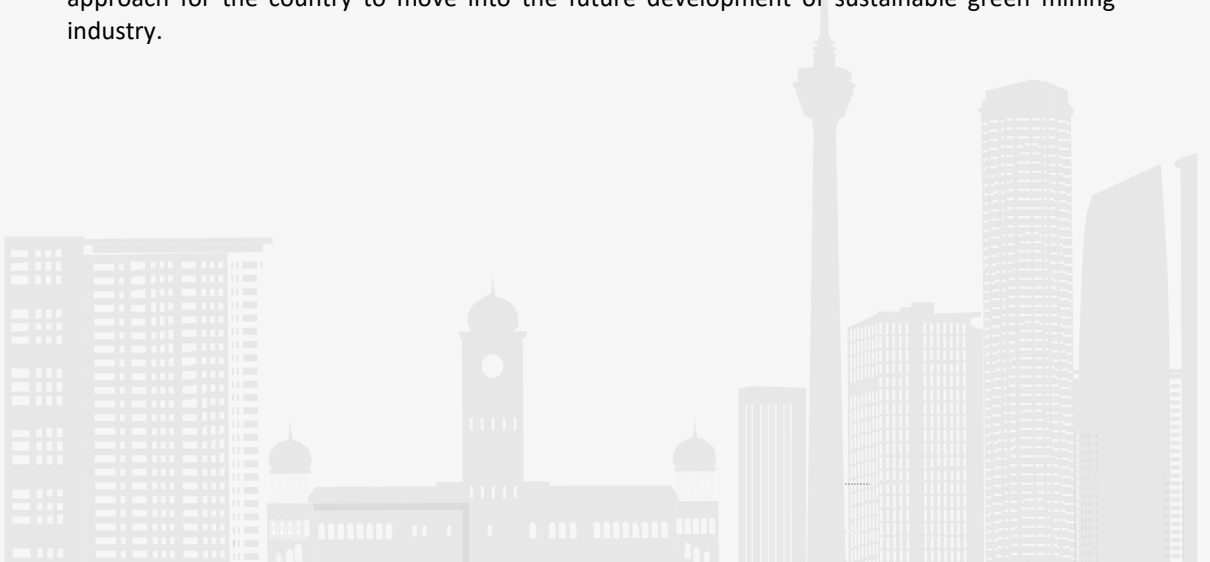
- Creating widespread awareness on green practices amongst key mining industries.
- Promoting the adoption of green practices along the mining value chain.
- Implementing strategic monitoring and evaluation of green practices within mining sector.
- Enhancing coordination between government and industry players.
- Strengthening governance and policy planning and implementation.
- Encouraging public-private collaboration or partnership in R&D&C.
- Strengthening existing government funded R&D&C related to green practices.
- Cultivating green culture among all key stakeholders in mining industry.
- Fostering pro-active engagement with NGOs to increase coverage of green programmes.

To enhance the effectiveness of green practices, the initiatives have to be prioritised based on the desired outcomes that the respective industries aim to achieve. In summary, these holistic strategies will provide a platform for the implementation of green practices in mining industry that will facilitate Malaysia's aim to achieve long term shift from green adoption to successful green development in the future.



5.9 Conclusions

Continuous efforts to strengthen the achievement and ensure the success of the green mining industry which is supported through the sustainable development implementation can be achieved with the commitment of all parties, including the Federal and State Governments as well as all stakeholders of the mining industry. Although the mineral industry in Malaysia is relatively small compared to other countries, commitment to imparting sustainable development efforts should be understood and practised by all parties to portray Malaysia's positive branding in this sector globally. It is hoped that this guideline will serve as a beneficial approach for the country to move into the future development of sustainable green mining industry.





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