Addressing UN Sustainable Development Goals in the ASEAN Coal Value Chain



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The report was jointly developed by FutureCoal (former World Coal Association—WCA) and the ASEAN Centre for Energy.

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Foreword

The Association of Southeast Asian Nations (ASEAN) is a rapidly growing region, with a total population of 671.7 million and a combined GDP of USD 3.6 trillion in 2022, respectively. Fuelling this growth is the increasing demand for energy. The ASEAN Centre for Energy projected that energy demand will increase threefold from 2005 levels, reaching 1,281 Mtoe by 2050- with electricity consumption growing at an average annual rate of 4.4%.

Coal mining and power development have been pivotal in ensuring ASEAN citizens have access to affordable, reliable, and modern energy services. Coal capacity in the power sector at the ASEAN level was 84.1 GW in 2020 and by 2040 was expected to increase by about 250%. Even in energy systems that are transitioning to a higher share of RE, coal fleets are still expected to play a role as a source of flexible and secure generation.

Moreover, for developing countries, particularly those that export coal, this resource is vital for economic growth. Coal exports still provide revenue that supports infrastructure development, social services, and improved living conditions. Additionally, the coal industry generates significant job opportunities and contributes to economic stability, reinforcing energy security where alternatives are limited.

As mandated by Annual Milestones from the region's energy blueprint document- the ASEAN Plan of Action for Energy Cooperation (APAEC) Phase II: 2021 - 2025, ASEAN still aims to enhance public awareness and image of CCT. In this regard, this report explores how the coal value chain would continue to have a role in the context of global energy demands, environmental considerations, and socio-economic development goals outlined in the United Nations Sustainable Development Goals (SDGs). We extend our gratitude to FutureCoal for their invaluable collaboration in shaping this report. This report highlights coal's pivotal role in various aspects. Firstly, coal acts as a transitional energy source, aiding the shift to cleaner technologies while considering environmental and social goals in the UN SDGs. Moreover, coal plays a crucial role in economic growth, infrastructure development, and government revenue generation, supporting essential services and improving living conditions.

As we navigate the complexities of sustainable development, it is crucial to acknowledge coal's strategic importance and broader economic contributions.

We hope the insights presented will serve as a valuable resource for policymakers, industry stakeholders, and communities as we work towards a just and inclusive future.



Beni Suryadi

Acting Executive Director
ASEAN Centre for Energy

Foreword

The ASEAN region has seen remarkable economic progress and industrialisation in recent years and is poised to become the world's fourth-largest single market by 2030.

A key driver of this growth has been coal, which has played an essential role in powering economic expansion, generating revenue, and funding vital services like healthcare, education, and transportation—all critical for improving living standards and reducing poverty.

Through the valued collaboration between FutureCoal and the ASEAN Centre for Energy (ACE), we continue to highlight coal's critical contribution presenting this our second report, "Addressing UN Sustainable Development Goals in the ASEAN Coal Value Chain."

Coal continues to support many ASEAN countries where modern practices and advance coal technologies are and can contribute to various SDG's, such as affordable and clean energy (SDG 7), decent work and economic growth (SDG 8), strengthens infrastructure and innovation (SDG 9), and efficient and responsible consumption and production of resources (SDG 12). The report also presents further direct and indirect opportunities to contribute to other of the SDGs.

These contributions are not about coal remaining the same. FutureCoal's Sustainable Coal Stewardship (SCS) philosophy underscores coal's potential to not only support these SDGs through innovation and technology. SCS is about enabling ASEAN countries to meet their sustainability targets. It is about a nation's right to choose its sustainability pathway, unique to its economic circumstances.

At its core it is about enabling nations to establish a modern and sustainable coal ecosystem which fosters efficiency, safer working practices, lower environmental impacts, including emissions abatement and less waste, through investment and cooperation.

This report outlines, coal's contribution to socio-economic development, reaffirming a critical role in the ASEAN. It is a reminder that economic development and addressing global climate expectations are not mutually exclusive. 'Responsible' investment needs to adopt a balanced and neutral all fuels and all technologies approach particularly among emerging and developing countries, where coal supports sustainable development within and beyond the ASEAN. The practice of respect and collaboration can only advance our shared goals and drive progress toward a modernised and technology led global coal value chain.

We extend our deepest gratitude to the ASEAN Centre for Energy for their invaluable cooperation and contributions.



Michelle Manook

Chief Executive
FutureCoal: The Global Alliance for Sustainable Coal

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Abbreviations

ACE	ASEAN Centre for Energy
AEC	ASEAN Economic Community
AEI	Adaro Energy Inc.
AMS	ASEAN Member States
APAEC	ASEAN Plan of Action for Energy Cooperation
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
ATVSV	An toàn vệ sinh viên (Vietnamese for Student Safety and Hygiene)
BLFRP	Barito Lestari Forest Restoration Project
BLPP	Barito Lestari Peatland Project
BPJS	Badan Penyelenggara Jaminan Sosial Ketenagakerjaan (Indonesian for Social Insurance Administration Organization)
BSML	PT Bintang Samudera Mandiri Lines
BUMDes	Badan Usaha Milik Desa (Indonesian for Village-owned Enterprise)
BUMI	PT Bumi Resources Tbk
BWC	Better World Cubao
CAC	Collective Action Against Corruption
CARE	Centre for Alternative Dispute Resolutions, Regulation & Policy Analysis and Community Empowerment
CCR	Coal Combustion Residuals
CCS	Carbon Capture and Storage
CCT	Clean Coal Technology
CCUS	Carbon Capture, Utilization, and Storage
CEIS	Community Empowerment and Innovations for Sustainability Project
CFA	Coal Fly Ash
CFB	Circulating Fluidised Bed
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
CSR	Corporate Social Responsibility
CTL	Coal-to-Liquids
DLH	Dinas Lingkungan Hidup (Indonesian for The Environmental Agency)
DWSSII	Divine Word School of Semirara Island Inc.
EAS	East Asia Summit
EGAT	Electricity Generating Authority of Thailand
ERIA	The Economic Research Institute for ASEAN and East Asia
ESG	Environmental, Social, and Governance
ESP	Electrostatic Precipitators
EVs	Electric Vehicles
FAME	Fatty Acid Methyl Esters

GCCSI	The Global Carbon Capture and Storage Institute
GHG	Greenhouse Gas
GNI	PT Gunbuster Nickel Industry
GW	Giga Watt
HELE	High-Efficiency and Low Emissions
HPAL	High-Pressure Acid Leaching
HYNC	PT Huayue Nickel and Cobalt
IGCC	Integrated Gasification in Combined Cycle
IMIP	Indonesia Morowali Industrial Park
IOD	Thai Institute of Directors Association
IPB	Institut Pertanian Bogor (Indonesian for Bogor Institute of Agriculture)
IPCC	The Intergovernmental Panel on Climate Change
IRPC	Integrated Refinery & Petrochemical Complex
JOGMEC	Japan Organization for Metals and Energy Security
KEBAYA	Kelompok Bahagia Berkarya
KPC	PT Kaltim Prima Coal
LPG	Liquefied Petroleum gas
LPPM	Lembaga Penelitian dan Pengabdian Masyarakat (Indonesian for Institute for Research and Community Services)
MDG	Millennium Development Goals
MMC	MMC Corporation Berhad
MRI	Mitsubishi Research Institute, Inc
MSMEs	Micro, Small and Medium Enterprises
MW	Mega Watt
NCMF	North Cikarang MSMEs Forum
NGO	Non-Governmental Organization
OHS	Occupational Health and Safety
OHSAS	Occupational Health and Safety Assessment Series
OSH	Occupational Safety and Health
OSS	Online Single Submission
PDD	Project Design Document
PEP	Energy and Mining Polytechnic
PETI	Pertambangan Tanpa Izin (Indonesian for Unlicensed Mining)
PLN	PT Perusahaan Listrik Negara (Persero) (Indonesian for State Electricity Company)
PPDI	Indonesian Association of Persons with Disabilities
PPI	Persatuan Pelajar Indonesia (Indonesian for World Association of Indonesian Students)
PTBA	PT Bukit Asam Tbk

PTP	Port of Tanjung Pelepas
PUPR	Kementerian Pekerjaan Umum dan Perumahan Rakyat (Indonesian for The Ministry of Public Works and Housing)
SCS	Sustainable Coal Stewardship
SDGs	Sustainable Development Goals
SEACA	Southeast Asia CCS Accelerator
SIG	Semen Indonesia Group
SMGP	San Miguel Global Power
SOx	Sulphur Oxides
SPPP	Solar Power Plant Program
STEM	Science, Technology, Engineering, and Mathematics
TKV	Than và Khoáng sản Việt Nam (Vietnamese for Vietnam Coal and Mineral Industries Group)
TNB	Tenaga Nasional Berhad
TNBJ	TNB Janamanjung Sdn. Bhd.
TPES	Total Primary Energy Supply
UN	United Nations
UNDP	United Nations Development Programme
UPN	Universitas Pembangunan Nasional
US	United States
USC	Ultra Supercritical
USD	United States Dollar
VDNI	Virtue Dragon Nickel Industry Co. Ltd
VND	Vietnamese Dong

Disclaimer

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Executive Summary

The Sustainable Development Goals (SDGs) represent a holistic global agenda within the 2030 Agenda for Sustainable Development, acknowledging the interconnectedness of economic, social, and environmental dimensions. Serving as a guiding framework, the SDGs provide direction for nations, organisations, and industries to formulate impactful, sustainable strategies addressing global challenges.

This Report is an output to the Annual Milestones of the APAEC Phase II: 2021 - 2025, under Outcome Based Strategy No 2 to "Conduct Strategic Outreach to Advance Regional Actions to enhance Public Awareness and Image of CCT" from the Coal and Clean Coal Technology Programme Area.

This report highlights the relationship between the coal value chain and the SDGs, showcasing direct and indirect contributions to achieving each goal. Direct contributions arise from the industry's core business activities, while indirect contributions stem from companies' initiatives benefiting the environment and local communities.

Each stage of the coal value chain—from exploration and mining to coal processing, consumption, and beyond consumption—adds significant value that drives economic growth.

Goals: SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), and SDG 10 (Reduced Inequalities)

The coal industry serves as a catalyst for economic growth by providing affordable and reliable energy, supporting various business activities, and creating job opportunities across different sectors. Through fair wages, safe working conditions, and equitable sharing of benefits, coal-related companies contribute to SDGs related to poverty alleviation, hunger eradication, decent work, and reduced inequalities. Additionally, targeted programs aimed at empowering communities, such as supporting local enterprises like Micro-, Small, and Medium-sized Enterprises (MSMEs/UMKM), Village-owned Enterprise (BUMDes) and marginalised groups (low-economy and disabled communities), foster inclusive growth and enhance social resilience, aligning with SDGs focused on sustainable economic growth and partnerships for development.

Sustainable economic growth must be supported by a socially equitable and high-quality of life.

Goals: SDG 3 (Good Health and Wellbeing), SDG 4 (Quality Education), SDG 5 (Gender Equality), SDG 9 (Industry, Innovation, and Infrastructure), SDG 16 (Peace, Justice, and Strong Institutions), and SDG 17 (Partnership for The Goals)

Coal-related companies prioritise the health, safety, and well-being of coal workers through occupational safety initiatives and comprehensive healthcare access. Additionally, they enhance health standards in surrounding communities by establishing healthcare facilities, conducting health check-ups and treatment programs, and promoting healthy lifestyles.

Education is also a key focus, with investments in the local community's educational infrastructure, scholarships, and training initiatives. Moreover, companies emphasise gender equality through tailored workshops and skill enhancement programs for women. Internally, corporate governance focuses on sustainable practices, including anti-corruption measures and promoting transparency. Collaboration with governments, NGOs, and stakeholders strengthens institutional operations, advancing SDGs and highlighting the coal value chain's commitment to sustainable development and positive community impact.

Coal-related companies actively implement measures to protect the environment and mitigate negative impacts.

Goals: SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), SDG 14 (Life Below Water), and SDG 15 (Life on Land)

These measures include responsible mining practices and effective waste management to safeguard water resources and protect marine environments. The coal companies are also engaged in land reclamation and restoration efforts to preserve terrestrial ecosystems, addressing air quality concerns by adopting clean coal technologies. Additionally, these companies are committed to sustainable waste management practices, aligning with circular economy principles and FutureCoal's Sustainable Coal Stewardship. Externally, they contribute to climate change mitigation through CSR initiatives focused on carbon capture, such as reforestation and tree-planting projects. They obtain business permits for carbon sequestration and storage, underscoring their dedication to environmental sustainability.

Towards sustainable development, the world is moving towards carbon neutrality.

Goals: SDG 7 (Affordable Clean Energy) and SDG 13 (Climate Action)

Clean coal technologies (CCT) are pivotal in achieving affordable and clean energy while combating climate change. These technologies, including biomass co-firing, circulating fluidised bed (CFB) boilers, and coal-to-methanol plants, are adopted by companies to enhance plant efficiency, reduce fuel consumption, and mitigate greenhouse gas emissions.

FutureCoal's Sustainable Coal Stewardship (SCS) principles guide the coal value chain towards sustainability by improving mining processes, adopting efficient combustion techniques like high-efficiency and low emissions (HELE) and ultra-supercritical (USC) plants, and exploring innovative coal-to-product methods. By transforming coal into higher-value products beyond traditional power generation, such as coal-to-liquids and coal-to-hydrogen, coal-related companies contribute to global energy sustainability and climate action.

In conclusion, the coal value chain is pivotal in advancing the SDGs. This exploration enables companies to align their strategies with the SDGs towards sustainable development by highlighting its current impacts and advocating for innovative approaches. The report sets the stage for collaborative efforts towards target achievement. It showcases past and ongoing contributions of the coal value chain in the ASEAN region. It identifies opportunities for future partnerships, emphasising the importance of collective action in moving towards a more sustainable future. Further, coal companies might take several new initiatives to contribute to the SDGs. Therefore, it is recommended to provide periodic updates on the initiatives and case studies.

Key areas of mapping the coal sector with SDGs



Introduction

The coal value chain impacts the United Nations (UN) Sustainable Development Goals (SDGs) areas positively and negatively, affecting communities, ecosystems, and economies. Coal contributes to sustainable development by creating jobs, providing essential energy access for economic and social progress, generating government revenue, fostering technological advancements, supporting local entrepreneurship and capacity building, investing in community welfare, and prioritising environmental protection and human rights. However, environmental sustainability challenges persist, requiring more significant efforts to mitigate adverse impacts on biodiversity, climate change, and communities. Addressing these challenges is crucial for coal to align effectively with the broader sustainable development objectives outlined in the SDGs.

Why produce this report?

This Report serves as an output to the Annual Milestones of the ASEAN's regional energy blueprint document- the APAEC Phase II: 2021 - 2025, under Outcome Based Strategy No 2 to "Conduct Strategic Outreach to Advance Regional Actions to enhance Public Awareness and Image of CCT" from the Coal and Clean Coal Technology Programme Area.

The report explores the connections between the coal value chain and the SDGs, aiming to understand better how the coal value chain can best contribute to achieving the SDGs. It outlines the industry's current impacts and encourages companies to discover new ways to aid countries in advancing towards the SDGs. It guides coal companies and stakeholders in effectively addressing environmental and social challenges while optimising economic advantages.

The report serves as a valuable tool for coal companies, fostering a shared understanding among industry stakeholders on ways to contribute to the SDGs. Unlike the Millennium Development Goals (MDGs) that primarily focus on governments, the broader scope of the SDGs calls for collaborative efforts from sectors of society. This report will showcase past and ongoing contributions of members of the coal value chain in the ASEAN to the UN SDGs while highlighting opportunities for future partnerships to pool resources towards achieving the SDGs.

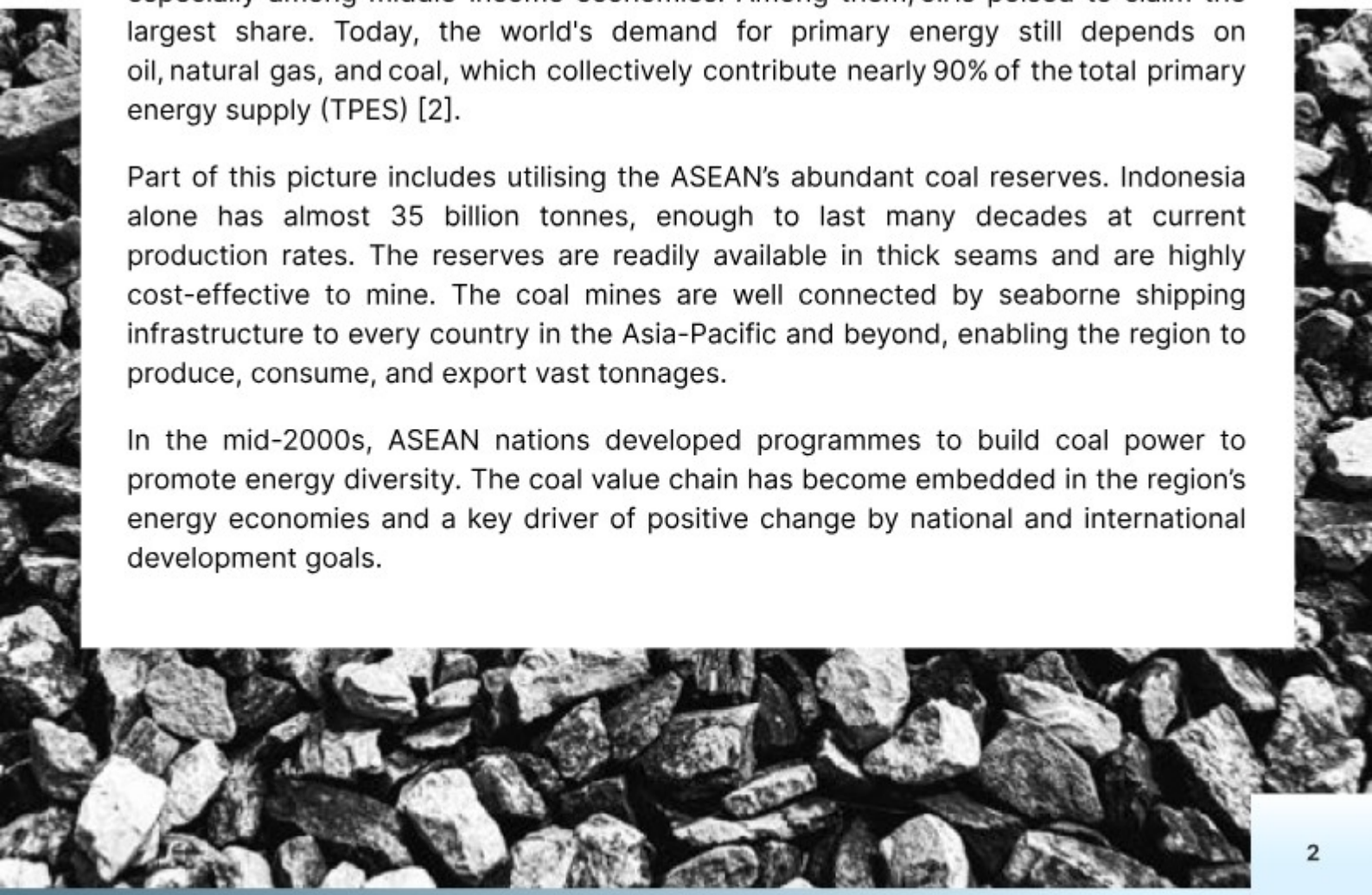
Coal mining and power development have developed rapidly among the Association of Southeast Asian Nations (ASEAN) members and are essential to the citizens of this growing region. Since 2000, the demand for energy in Southeast Asia has surged significantly, with electricity consumption growing at an average annual rate of 6%. Efforts are ongoing to ensure universal access to affordable, reliable, and modern energy services across the region [1]. Approximately 95% of households now have electricity, and around 70% have access to clean cooking solutions such as liquefied petroleum gas and improved cook stoves. These shares remain lower in some smaller economies like Cambodia and Myanmar, where more needs to be done.

However, increased commerce, industry, household prosperity and industrial growth across the ASEAN, plus the spirit of collaboration and unity, has led to a collective rise in energy demand. The 7th ASEAN Energy Outlook describes how the energy landscape in the region is modelled on sustainability, efficiency, and energy security. Scenarios for energy demand suggest total final energy consumption could reach 473 million tonnes of oil equivalent (Mtoe) by 2025 and more than double to 1,282 Mtoe by 2050.

There is a strong emphasis on the growth in renewable energy; however, to reach these various goals, the world must also recognise there will be a period of ongoing industrialisation in the Global South. Instead of completely reconstructing its energy infrastructure from the ground up, fossil fuels are projected to maintain dominance, especially among middle-income economies. Among them, oil is poised to claim the largest share. Today, the world's demand for primary energy still depends on oil, natural gas, and coal, which collectively contribute nearly 90% of the total primary energy supply (TPES) [2].

Part of this picture includes utilising the ASEAN's abundant coal reserves. Indonesia alone has almost 35 billion tonnes, enough to last many decades at current production rates. The reserves are readily available in thick seams and are highly cost-effective to mine. The coal mines are well connected by seaborne shipping infrastructure to every country in the Asia-Pacific and beyond, enabling the region to produce, consume, and export vast tonnages.

In the mid-2000s, ASEAN nations developed programmes to build coal power to promote energy diversity. The coal value chain has become embedded in the region's energy economies and a key driver of positive change by national and international development goals.



In 2005, coal contributed 27% of total electricity generation in the ASEAN. By 2020, this share had risen to 41%. In 2022, the region's coal consumption reached 413 million tonnes (Mt), marking a 13% increase compared to the previous year. Coal consumption is predominantly driven by power generation, accounting for 71% of total consumption in 2022. Indonesia led the way, consuming nearly half of ASEAN's coal (49%), followed by Viet Nam (20%), Malaysia (9%), and the Philippines (9%) [3]. Despite the criticism directed at the coal sector, it's essential to recognise that coal plays a pivotal role in various dimensions, several of which this report explores, such as:

Balancing Transition to Clean Energy

Photo source: Freepik

Coal bridges the transition to cleaner energy sources, ensuring a stable energy supply while renewable technologies mature. Responsible coal use involves adopting cleaner technologies to mitigate environmental impacts. Despite global trends indicating a decline in coal use, the ASEAN region remains significant, balancing energy needs with environmental and social considerations encapsulated by the SDGs. FutureCoal collaborated with the ASEAN Centre for Energy (ACE) to explore coal-value chain activities across the association's countries, elucidating how the coal value chain aligns with SDGs, benefiting local communities and industry stakeholders through specific case studies.





Photo source: Freepik

Job Creation and Livelihoods

The coal industry's value chain offers job opportunities to millions globally, bolstering businesses and communities. These jobs range from miners to office staff, playing a crucial role in maintaining economic stability and societal welfare at both local and national levels. Employment is not confined to the coal mines. Mine operators also procure goods and services from other businesses with their employees. Moreover, the earnings of mine workers are spent, further driving employment. The operation of a mine or the development of a plant often stimulates broader economic activity, leading to job creation and wealth distribution - a phenomenon known as the multiplier effect. As a result, the total number of jobs and income generated will be many multiples of the 4.5–5.0 million people directly employed in coal mining alone.



Photo source: Freepik

Energy Security and Accessibility

Coal remains a crucial energy resource, especially in regions with limited alternatives. It directly powers electricity generation, industrial processes, and residential heating. Developing countries often depend on coal to meet their growing energy demands. Without coal, millions would lack access to electricity, hindering progress and quality of life.

Economic Growth and Infrastructure

Coal is directly and indirectly essential to heavy industry, manufacturing, and transportation by supplying affordable and dependable electricity. Infrastructure development often depends on coal mining. It plays a significant role in promoting trade and commerce, benefiting entire regions. However, the contributions of coal to power generation, as well as steel and cement production, warrant further investigation. While there may be a focus on the negative impacts of coal in the ASEAN region, the strategic value and broader economic opportunities created by the coal value chain also demand more comprehensive research.



Photo source: Freepik

Revenue Generation and Taxes

Coal mining generates substantial government revenue through taxes, royalties, and fees. These funds can be reinvested in education, healthcare, and public services. Local governments receive financial support from coal-related activities, which aids in maintaining essential services and improving overall living conditions.

Sustainable Coal Stewardship

The chapter describes strategies for the coal industry to support SDGs, focusing on innovation and best practices. FutureCoal has pinpointed key technologies that advance this progressive concept known as Sustainable Coal Stewardship (SCS). It outlines a long-term vision for enhancing the coal value chain, transforming it into a cleaner and more efficient entity and guiding coal-using countries towards a sustainable future. It explores ways to reduce resource consumption and waste generation, innovate technology, and maximise the creation of valuable by-products, thus extracting more value from each tonne of coal than has ever been realised. This value is assessed and quantified in terms of both economic gains and environmental advantages.

SCS describes a broader definition of the abatement opportunities that the coal value chain can use to modernise and transform coal to meet and advance the needs of our global society. Within SCS, members of the coal value chain can identify opportunities to not only abate emissions and discharges but also further exploit coal's economic opportunities, enabling sustainable business practices with positive socio-economic and environmental returns.



Figure 1. FutureCoal Sustainable Coal Stewardship Map



SCS does not prescribe what abatement opportunities should be adopted by any nation or company. Instead, it supports the right to choose and establish a coal ecosystem that includes options for efficiency, process improvements, health and safety, emissions reduction, carbon emission abatement, waste management and recycling, land rehabilitation, technological advancement, and innovation. Specifically, SCS comprises three components:

1. Pre-combustion

The coal value chain offers opportunities for emissions abatement that extend beyond the combustion stage. The process of emissions abatement begins during the mining phase before the coal is even burned. The term "pre-combustion" refers to the abatement opportunities available to the upstream sector of the coal value chain. This includes:

- Efficient and Innovative Mining Processes: Implementing efficient and innovative mining processes, practices, and equipment can help reduce emissions during coal extraction and initial processing.
- Improved Mining Practices: Adopting best practices and technologies in coal mining operations can lead to more environmentally friendly extraction methods, reducing the overall carbon footprint of the upstream activities.
- Advanced Mining Equipment: Utilising advanced, energy-efficient mining equipment and machinery can also contribute to lower emissions during the mining stage of the coal value chain.

By reducing pre-combustion emissions, the coal industry can address a significant portion of the environmental impact of using coal as an energy source. This holistic approach to emissions reduction is crucial for the coal sector to improve its sustainability and environmental performance.

2. Combustion

Combustion describes the range of efficiency technologies that support power and heat utilities and steel and cement production in avoiding, abating, capturing and reusing up to 99% of emissions and utilising waste. ASEAN coal value chain members already employ these and other pre-combustion opportunities. These include the use of:

- HELE plants, such as USC or advanced USC, are equipped with a full suite of emission controls (see below).
- Combined Heat and Power (CHP).
- High-efficiency electricity production from coal gasification (integrated gasification in combined cycle (IGCC) rivals natural gas combined cycle gas turbines (CCGT).
- Co-firing coal with sustainable biomass or ammonia.

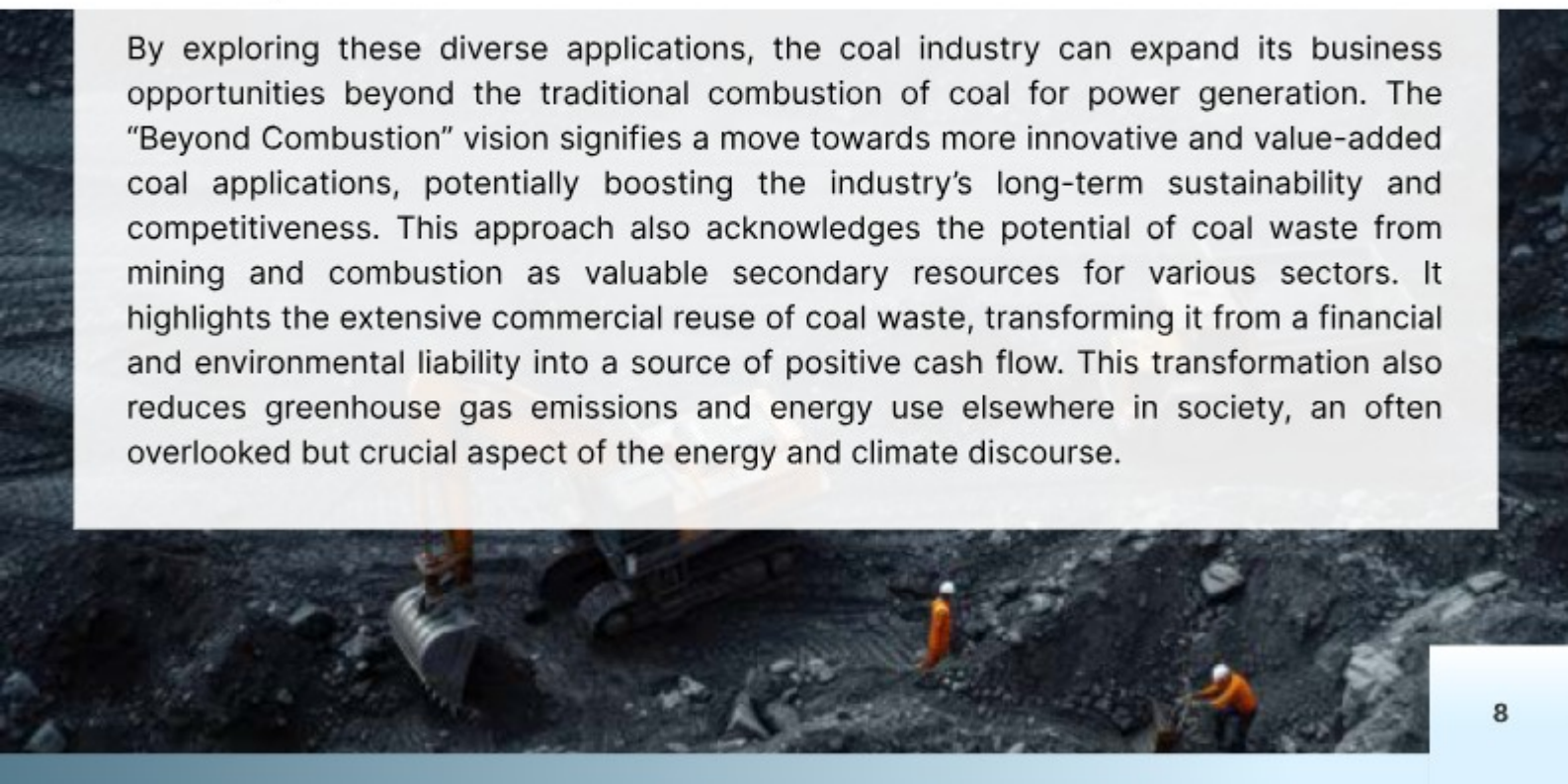
These technologies can be combined with technologies to lower SO_x emissions (e.g. flue gas desulphurisation [FDG], sorbent injection), lower particulate matter control (e.g. electrostatic precipitators [ESP] and bag filters), lower NO_x systems (e.g. selective catalytic convertors [SCR], low-NO_x burners), and decarbonisation technology (e.g. carbon capture storage and utilisation and storage [CCUS]). Some of these technologies are not confined to power generation; they also have broader industrial applications, including steel and cement production and processing, where cleaner technologies reuse and recycle by-products from emission capture technologies.

3. Beyond Combustion

The concept of "Beyond Combustion" encapsulates a vision where future business opportunities in the coal industry expand beyond the traditional use of coal for power generation. This vision explores transforming coal into a range of new, higher-value products. Some of the key opportunities identified under the "Beyond Combustion" approach include:

- Coal-to-liquids (CTL): Converting coal into liquid fuels, such as diesel or gasoline, through various chemical processes.
- Coal-to-hydrogen: This process extracts hydrogen from coal. The hydrogen can be combined with nitrogen to form ammonia, a clean and more dense hydrogen carrier, or used in its pure form in various industrial applications.
- Synthetic liquid hydrocarbons: Producing synthetic liquid hydrocarbon fuels and chemicals from coal.
- Coal-to-methanol/ethanol: Converting coal into methanol or ethanol, which has a wide range of industrial and transportation uses.
- Agri-chemicals: Deriving agricultural chemicals, such as fertilisers, from coal-based feedstocks.
- Soil improvers.

By exploring these diverse applications, the coal industry can expand its business opportunities beyond the traditional combustion of coal for power generation. The “Beyond Combustion” vision signifies a move towards more innovative and value-added coal applications, potentially boosting the industry’s long-term sustainability and competitiveness. This approach also acknowledges the potential of coal waste from mining and combustion as valuable secondary resources for various sectors. It highlights the extensive commercial reuse of coal waste, transforming it from a financial and environmental liability into a source of positive cash flow. This transformation also reduces greenhouse gas emissions and energy use elsewhere in society, an often overlooked but crucial aspect of the energy and climate discourse.



Coal and Coal Waste as Cementitious Materials

Coal and coal waste, such as coal fly ash (CFA) from power stations and slag from ironmaking blast furnaces, can be used as cementitious materials in construction. These materials can partially replace traditional Portland cement, providing a more sustainable and cost-effective solution for the construction industry. Incorporating fly ash into Portland cement concrete (PCC) offers numerous advantages and enhances the performance of the concrete in its fresh and hardened states. Adding fly ash to concrete improves the plastic concrete's workability and augments the strength and durability of the hardened concrete.

The numerous benefits of reusing CFA are as follows:

Resource conservation:

Fly ash can be used in construction materials like concrete, reducing the need for other natural resources and materials that need to be mined. This demonstrates SDG 12: Responsible production and consumption, in this case, waste materials. This reduces the life cycle impacts specific to cement production and contributes to the principles of a production model called the Circular Economy.

Reduced greenhouse gas emissions:

Using fly ash in concrete reduces energy use and greenhouse gas emissions, as it can replace or displace manufactured cement, which is very energy—and emissions-intensive. Concrete production contributes to 8% of the world's carbon emissions, with "clinker" being the primary source of energy use and process emissions that are a natural result of the production. The worldwide demand for cement, which solidifies into concrete, is projected to rise by 48%, from 4.2 billion to 6.2 billion tonnes by 2050, predominantly due to the growth in developing countries. For context, during the rapid emergence of China's economy in recent decades, the country used more concrete between 2011 and 2013 than the United States did in the entire 20th century.

Waste Management:

Utilising fly ash in industrial applications reduces the amount of coal combustion products that must be disposed of in landfills. Storing fly ash in ponds can be safely done, but standards worldwide vary. Reusing and locking away fly ash in cement avoids potential risks and liabilities of storing the material and reduces storage costs incurred by the power plant operator or steel plant.



Coal and the Circular Economy

Another approach to the sustainable reuse of coal waste, which aligns with SDG 12—Responsible Production and Consumption—involves the extraction of critical minerals from this waste. Coal waste is a rich source of these critical minerals, including rare earth metals, vital for our increasingly digital and electrified world.

These critical minerals can be extracted from coal waste, unlocking a new, valuable resource to meet the growing demand for advanced technologies and renewable energy systems. While the concentrations of these minerals can vary in coal in its natural state, the concentrations can be significantly higher in the ash produced by power stations.

Extracting and refining these critical minerals and rare earth metals from coal waste reduces the need to mine these materials from natural deposits. Mining can pose significant environmental risks and have detrimental effects on local communities. Therefore, extracting these materials from coal waste contributes to many SDGs and supports SDG 7, which focuses on clean energy.

By reusing coal waste in this way, we can mitigate the environmental impact of mining, support the development of advanced technologies and renewable energy systems, and contribute to sustainable production and consumption. This approach exemplifies how we can turn waste into a valuable resource and make strides towards achieving our sustainable development goals.

Expanding the Utilisation of Coal

By recognising these existing pathways and exploring new opportunities, the "Beyond Combustion" approach expands the potential utilisation of coal beyond its traditional use for power generation. Diversifying coal applications can enhance the industry's sustainability, competitiveness, and contribution to a more circular economy. Overall, the "Beyond Combustion" vision represents a holistic and innovative approach to coal utilisation, unlocking the full potential of this abundant natural resource and aligning it with the evolving needs of a sustainable and technologically advanced future.

The United Nations Sustainable Development Goals (SDGs)

The SDGs are a comprehensive global agenda unanimously adopted by all nations in 2015, encapsulated within the 2030 Agenda for Sustainable Development. The 17 SDGs delineate a shared commitment to address and resolve pressing challenges worldwide, ranging from poverty alleviation to environmental preservation.

At the core of the SDGs lies a recognition of the interdependencies between various facets of development—economic, social, and environmental. This paradigm shift underscores the need for an integrated and holistic approach, acknowledging that advancements in one domain impact outcomes in others. This departure from conventional, compartmentalised strategies marks a pivotal evolution in global development discourse.

The SDGs encompass diverse aspirations, spanning poverty eradication and hunger mitigation and promoting clean energy, good health, quality education, gender equality, and clean water and sanitation. The SDGs emerge as a guiding framework, providing direction to nations, organisations, and industries. They embody a vision of a future where responsible and sustainable production and consumption are paramount, reflecting the goals' ambitious and multifaceted nature.

These goals are designed to be achieved by the year 2030. They build on decades of work by countries and the UN, including the UN Department of Economic and Social Affairs. The SDGs are an urgent call for action by all developed and developing countries in a global partnership.



Figure 2. The 17 Sustainable Development Goals

The report will examine selected case studies demonstrating SDGs in the ASEAN coal value chain and their alignment. The 17 SDGs are as follows:

- **SDG 1 (No Poverty):**

  Coal provides affordable and reliable energy, supports productive activities, and generates income for low-income people in rural areas.

- **SDG 2 (Zero Hunger):**

  The coal value chain supports agricultural productivity by providing energy for irrigation, food processing, and transportation, essential for food security and rural development.

- **SDG 3 (Good Health and Well-Being):**

  Ensuring the health and well-being of coal workers involves occupational safety measures and access to healthcare.

- **SDG 4 (Quality Education):**

  Coal-related industries contribute to education by supporting vocational training programs and skill development in the local community.

- **SDG 5 (Gender Equality):**

  Encouraging gender diversity in the coal sector ensures equal opportunities for women in employment and leadership roles.

- **SDG 6 (Clean Water and Sanitation):**

  Responsible coal mining practices help protect water sources and ensure clean water availability for communities. Power plant cooling can conserve water consumption by adopting air cooling, which releases water supplies for use by local agriculture and communities.

- **SDG 7 (Affordable and Clean Energy):**

  Clean coal technologies improve plant efficiency, reduce fuel consumption and greenhouse gas emissions, and contribute to affordable and clean energy.

- **SDG 8 (Decent Work and Economic Growth):**

  States that fair wages, safe working conditions, and job opportunities in the coal sector contribute to economic growth and decent work.

- **SDG 9 (Industry, Innovation, and Infrastructure):**

  Clean coal technologies, including carbon capture and storage (CCS), represent significant industrial innovation, contributing to resilient infrastructure.

SDG 10 (Reduced Inequalities):

Inclusive policies and practices ensure equitable sharing of benefits from coal-related activities among community members.

SDG 11 (Sustainable Cities and Communities):

Coal industries contribute to urban sustainability through community development projects and infrastructure improvements.

SDG 12 (Responsible Consumption and Production):

Responsible coal consumption involves minimising waste, adopting cleaner technologies, and promoting sustainable practices in the coal value chain.

SDG 13 (Climate Action):

Clean Coal Technologies (CCT) are crucial for reducing greenhouse gas emissions and mitigating climate change impacts.

SDG 14: Life below Water:

Efforts to manage and treat industrial waste help protect marine environments and contribute to the conservation of ocean resources.

SDG 15 (Life on Land):

Coal mining and power generation significantly impact land use and biodiversity. Clean coal technologies can minimise these effects by Reducing waste production and rehabilitating mined land. However, it's essential to recognise that clean coal technologies should be part of a broader energy strategy that includes diverse energy sources.

SDG 16 (Peace, justice, and strong institutions):

The coal sector can foster transparency and accountability in its operations to support the development of strong institutions and legal frameworks that promote peace, justice, and inclusive societies.

SDG 17 (Partnerships for the Goals):

By collaborating with governments, NGOs, and the entire coal-value chain, the coal value chain can forge partnerships that advance the SDGs, sharing knowledge, resources, and best practices.

How Corporations Approach Sustainability: An Overview

Corporations and businesses increasingly recognise their pivotal role in shaping a sustainable future. The strategic approach to sustainability has become paramount, integrating it into the core of business operations. This section explores the significance of sustainability in businesses, focusing on aligning with SDGs.

This section outlines key steps and considerations for corporations aiming to establish a comprehensive and impactful sustainable strategy. Sustainable strategies that integrate Environmental, Social, and Governance (ESG) principles to effectively contribute to achieving SDGs.

The coal value chain is pivotal in achieving the SDGs, which aim to create a more sustainable and equitable world. By aligning their business practices and strategies with the SDGs, corporations can significantly address global challenges such as poverty, inequality, climate change, and environmental degradation.

Corporations possess valuable expertise, resources, and innovative capabilities that can be leveraged to develop and implement solutions supporting the SDGs' achievement. This includes investing in sustainable technologies, implementing ethical supply chain practices, and engaging in community development initiatives.

The coal value chain stakeholders play a crucial role by collaborating with governments, civil society organisations, and other stakeholders to create synergies and amplify the impact of SDG-related efforts. Through strategic partnerships, corporations can pool resources, share knowledge, and collectively work towards achieving the ambitious targets set by the SDGs. By embracing and integrating the SDGs into their core business operations, corporations can drive systemic change and inspire other businesses to follow suit. This collective action can catalyse a broader transformation towards a more sustainable and equitable global economy.

Furthermore, corporations have the potential to be powerful agents of change in the pursuit of the SDGs. Corporations can play a pivotal role in creating a more sustainable and equitable world by aligning their business practices, leveraging their resources, and collaborating with diverse stakeholders.

SDG 1:
NO POVERTY



Photo source: Ben Duchac

Under SDG 1, poverty is defined as living in extreme deprivation and lacking access to basic human needs, such as food, water, sanitation, health, education, and social protection. SDG 1 aims to end poverty in all its forms everywhere by 2030 by implementing policies and measures that address the root causes and consequences of poverty [4].

According to a new report by the Asian Development Bank, only 2.2% of people in the ASEAN region were in extreme poverty in 2022.

This extreme poverty is defined as having less than USD 2.15 at their disposal per day. Despite expectations of continued progress in reducing poverty, an estimated 30.3% of the region's population—approximately 1.26 billion people—are expected to live on USD 3.65-6.85 a day by 2030. The challenge remains to uplift more people out of poverty and create sustainable economic opportunities for all [5].

SDG 1 overlaps with most other SDGs as follows:

- **Access to Affordable Energy:** Ensuring access to affordable, reliable, sustainable, and modern energy is a crucial aspect of SDG 7. This can indirectly contribute to SDG 1 by promoting economic development and reducing the burden of energy costs on poor households.
- **Job Creation:** The energy sector can create jobs in constructing and operating power generation facilities. This can provide income for individuals and help lift them out of poverty.
- **Community Development:** Energy projects can lead to broader social and economic development in the areas where they are located.
- **Energy Efficiency:** Improving energy efficiency can reduce the overall energy cost, making it more affordable for everyone.
- **Climate Action:** By reducing greenhouse gas emissions, renewable energy contributes to the fight against climate change, disproportionately affecting the world's poorest people.
- **Social Protection Systems:** Strong social protection systems are essential for mitigating the effects and preventing many people from falling into poverty. To achieve these benefits, it's necessary to implement policies that promote the transition to renewable energy, improve energy efficiency, and ensure that the benefits of these changes are shared equitably.

Photo source: Freepik

Case Study: PT Cikarang Listrindo Tbk (Indonesia)

PT Cikarang Listrindo Tbk, a key electricity provider for industrial and residential areas in Cikarang, Bekasi, and Karawang, demonstrates a profound commitment to sustainable energy and community development through its Kertarahayu Deswita program.

This initiative transforms Kertarahayu Village into a model of sustainable development, focusing on boosting the local economy, fostering self-reliance, and reducing poverty. The program creates job opportunities and promotes economic stability by supporting the Cikahuripan Tourism Awareness Group and local Micro, Small and Medium Enterprises (MSMEs).



Figure 3. Capacity Building on MSME Programme by PT Cikarang Listrindo Tbk

But the commitment continues beyond there. Dozens of MSMEs in North Cikarang received training to enhance their business capacity [6]. Collaborating with the North Cikarang MSMEs Forum (NCMF), the company organised an MSME Day event to level up the local business landscape. Additionally, infrastructure support was provided to MSMEs in the food and beverage sector, enabling product diversification and improving the area's economic condition.

PT Cikarang Listrindo Tbk's dedication to Kertarahayu Village's well-being showcases corporate initiatives' transformative power in driving positive change and fostering sustainable communities while contributing to SDG 1, which aims to reduce poverty.

Case Study: PT Bumi Resources Tbk (Indonesia)

PT Bumi Resources Tbk (BUMI) is a leading natural resources group in Indonesia, with its core business in coal mining and operations spread across various parts of Indonesia [7].

BUMI has initiated a housing development program for low-income communities since 2018. Up to the present, the company has constructed 30 houses with earthquake-resistant specifications by the 2019 regulations of the PUPR Ministry. The program aims to provide permanent decent housing, including living rooms, two bedrooms, and a bathroom.

In the latest project, BUMI built ten houses in Kampung Cimandala, Bogor Regency. It also conducts livelihood training for beneficiaries and residents to enhance their entrepreneurial skills, aiming for economic empowerment. Furthermore, BUMI involved its employees in CSR activities, contributing to achieving SDGs, including eradicating poverty, ensuring good health and well-being, facilitating access to clean water and sanitation, and supporting the development of inclusive, safe, durable, and sustainable cities and settlements.

Case Study: PT Bukit Asam Tbk (Indonesia)

PT Bukit Asam Tbk (PTBA) is a state-owned enterprise in Indonesia that operates in the coal mining sector. PTBA has become one of Indonesia's prominent coal miners, primarily in Sumatra.

PTBA has implemented several programs under the SDG 1 umbrella, focusing on no poverty [8]. These include a community development and empowerment program for unlicensed mining workers (PETI) and a community skills improvement training program. With a budget exceeding Rp1.3 billion in 2022, these initiatives aim to reduce poverty and enhance skills among community members, reflecting the company's commitment to contributing to national development goals aligned with SDG.

Case Study: PT PLN (Persero) (Indonesia)

PT PLN (Persero) is a cornerstone of Indonesia's energy sector. It manages a diverse portfolio that significantly focuses on coal-powered generation, playing a crucial role in meeting the nation's escalating energy demands.



Figure 4. Empowerment Through Volunteering Programs, from Culinary to Horticulture

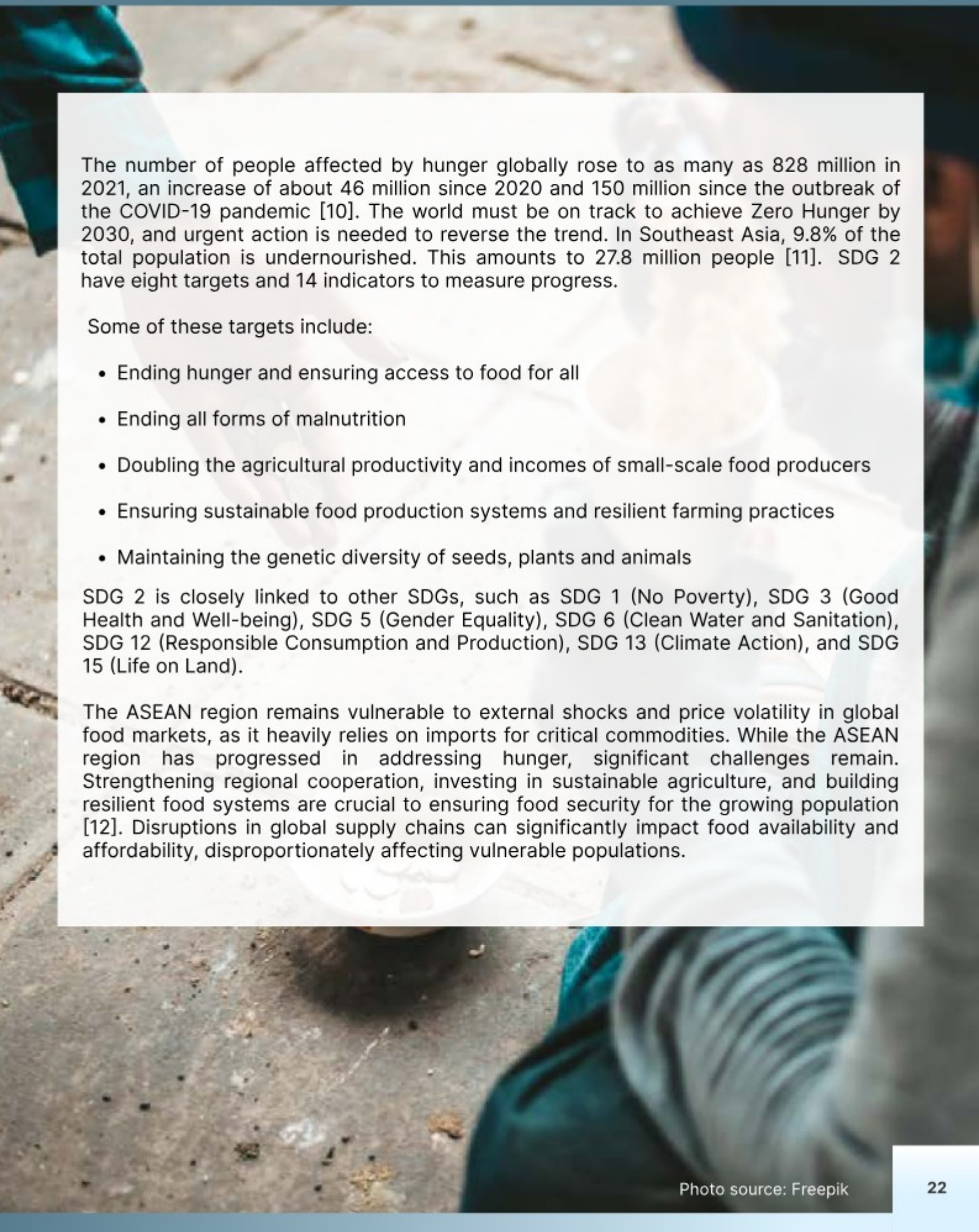
PT PLN's Srikandi Movement exemplifies a proactive approach towards eradicating poverty in Indonesia [9]. By empowering vulnerable communities nationwide, including women, disabled individuals, and the elderly, through diverse training programs ranging from culinary arts to horticulture, the initiative has made significant strides in fostering economic independence and enhancing the participant's ability to contribute meaningfully to their communities. By the end of 2023, the initiative had engaged over 610 beneficiaries across multiple provinces in 35 varied training modules, equipping them with the skills and resources necessary for self-reliance and prosperity.

The movement embodies PLN's commitment to ESG principles, focusing on uplifting the quality of life for Indonesia's most vulnerable citizens. Some 3,243 PLN employees volunteer for community service, emphasising welfare as a corporate priority. In East Java, West Java, Bali, Lampung, Aceh, and Papua's Raja Ampat, the Srikandi Movement collaborates with MSMEs to provide training, essential tools, and access to resources like electricity equipping individuals with the means to be lifted from poverty and foster a cycle of growth and empowerment.

SDG 2:
ZERO HUNGER



Photo source: Freepik



The number of people affected by hunger globally rose to as many as 828 million in 2021, an increase of about 46 million since 2020 and 150 million since the outbreak of the COVID-19 pandemic [10]. The world must be on track to achieve Zero Hunger by 2030, and urgent action is needed to reverse the trend. In Southeast Asia, 9.8% of the total population is undernourished. This amounts to 27.8 million people [11]. SDG 2 have eight targets and 14 indicators to measure progress.

Some of these targets include:

- Ending hunger and ensuring access to food for all
- Ending all forms of malnutrition
- Doubling the agricultural productivity and incomes of small-scale food producers
- Ensuring sustainable food production systems and resilient farming practices
- Maintaining the genetic diversity of seeds, plants and animals

SDG 2 is closely linked to other SDGs, such as SDG 1 (No Poverty), SDG 3 (Good Health and Well-being), SDG 5 (Gender Equality), SDG 6 (Clean Water and Sanitation), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 15 (Life on Land).

The ASEAN region remains vulnerable to external shocks and price volatility in global food markets, as it heavily relies on imports for critical commodities. While the ASEAN region has progressed in addressing hunger, significant challenges remain. Strengthening regional cooperation, investing in sustainable agriculture, and building resilient food systems are crucial to ensuring food security for the growing population [12]. Disruptions in global supply chains can significantly impact food availability and affordability, disproportionately affecting vulnerable populations.

Photo source: Freepik

Case Study: PT Bukit Asam Tbk (Indonesia)



Figure 5. PT Bukit Asam Supports Sustainable Agriculture

PT Bukit Asam Tbk (PTBA), a leading Indonesian coal mining company, has consistently demonstrated its commitment to environmental sustainability and social responsibility alongside its operational achievements. In 2023, PTBA produced 41.9 million tonnes of coal. The company also made strides in sustainable agriculture by implementing solar irrigation systems across Indonesian villages, supporting SDGs 2 and 7 [13]. Notably, Karang Raja Village in South Sumatra saw a significant increase in agricultural output, harvesting 14.9 tons of organic rice without chemical fertilisers, thanks to these solar systems. PTBA's Sustainable Economic Social and Environment department reflects the firm's commitment to environmentally friendly farming and community well-being, with plans to extend the solar irrigation system to benefit more areas.

Case Study: PT Cikarang Listrindo Tbk (Indonesia)

PT Cikarang Listrindo stands out in Indonesia's coal industry with its dedication to sustainable practices and innovative projects. The company has initiated a significant project to address water scarcity in Sodana Village, West Sumba Regency, East Nusa Tenggara [14]. The village, predominantly inhabited by farmers, struggled with clean water access, which was vital for their agricultural livelihoods. Collaborating with Solar Chapter Madison, PT Cikarang Listrindo installed a solar-powered water system with 24 solar power plants, which pumps five cubic meters of water per hour. This system has provided the community with convenient access to clean water via three public taps, transforming the villagers' daily routines by reducing the time spent on water collection and enhancing their productivity. PT Cikarang Listrindo's initiative in Sodana Village exemplifies their dedication to the SDGs, especially SDGs 2, 3, 6, and 8. The project reflects the company's commitment to "Powering Goodness" and its goal to promote a sustainable, healthy, and economically prosperous future for the local community.



Figure 6. Empowering Sodana Village

Case Study: PT Bumi Resources Tbk (Indonesia)

PT Bumi Resources Tbk (BUMI), in partnership with CARE LPPM IPB, implemented a community-based waste management assistance program in Kebalen Village, Bekasi Regency, which has reached the stage of independence in its third year [7]. The program includes capacity building through training on converting waste into fuel, greening riverbanks, and organising a clean village competition. This initiative has led to the management of 13.38 tonnes per year of organic waste, thus avoiding landfill disposal. Additionally, BUMI fostered eight local waste banks with 480 household customers, generating a total income of 40 million rupiah/month from selling processed waste products such as composts and fertilisers. The afforestation efforts along riverbanks involved planting 800 tree seedlings resistant to river erosion. This program contributes to SDG 2 by promoting sustainable agricultural practices through waste management and environmental conservation.

Case Study: Electricity Generation Authority of Thailand – EGAT (Thailand)

The Electricity Generating Authority of Thailand (EGAT) is Thailand's largest power producer, with 53 power plants nationwide. EGAT's Community Empowerment and Innovations for Sustainability Project (CEIS) focuses on improving the quality of life and enhancing self-reliance among communities in areas near its operations [15]. The project has three primary target groups: in the Northeastern part, it aims to create food security and safety for villages near transmission lines by promoting organic agriculture and reducing chemical use in farming. The Eastern region focuses on community resource and environmental management around the Bang Pakong power plant, including mangrove restoration and wastewater management. In the Southern part, it supports older people living near transmission lines in Ban Khao Noi, Satun Province, by providing knowledge on turmeric planting for medicinal standards and income generation through value-added products. These initiatives support SDG 2 by promoting sustainable agriculture, food security, and community-centric development.

SDG 3: GOOD HEALTH AND WELL-BEING



Photo source: Freepik

The coal value chain, encompassing the entire chain from mining to utilisation, plays a significant role in socio-economic development and public health. Despite the environmental concerns associated with coal, strategic interventions along the coal value chain can positively impact SDG 3 – ensuring healthy lives and promoting well-being for all ages. This SDG overlaps with many others, including ending poverty and zero hunger. The coal value chain aids community projects that contribute to SDG 3 in several ways:

- **Healthcare Facilities:**

  The coal value chain can fund the construction and operation of healthcare facilities in mining communities. These facilities can provide essential health services such as vaccinations, maternal care, disease treatment, and health education.

- **Health and Safety Programs:**

  The coal value chain can implement health and safety programs for its workers and the surrounding communities. These programs can include occupational health and safety training, provision of personal protective equipment, regular health check-ups, and emergency response training.

- **Environmental Protection:**

  By implementing CCT, the coal industry can reduce air and water pollution, improving health outcomes in mining communities.

- **Socio-Economic Development:**

  The coal value chain can invest in socio-economic development projects that indirectly contribute to SDG 3. For example, it can fund education programs, create jobs, improve infrastructure, and support local businesses in mining communities.

The impact will depend on various factors, such as the commitment of the coal companies, the involvement of the local communities, and the regulatory framework in each country.

Case Study: Bayan Group (Indonesia)

Healthcare facilities are crucial in mining areas, often lacking medical services. Coal companies can utilise their resources to build and maintain healthcare centres, aiding employees and residents. A prime example is Bayan Group's Health Program in Indonesia, which extends beyond mining to focus on health initiatives for local communities, especially women and children, thus contributing to SDG 3 [16].

Bayan Group's Health Program is dedicated to creating a healthier community by working with locals and focusing on women and children. The program includes nutritional support for children and expectant mothers and infrastructure improvements like building toilets and Community Health Centers (Puskesmas). Bayan Group collaborates with healthcare providers and offers ongoing support, including food aid and complementary healthcare. The company is also enhancing its fight against stunting in supported villages, which aligns with national public health efforts, showcasing its commitment to comprehensive community growth.

Case Study: Electricity Generation Authority of Thailand – EGAT (Thailand)

The coal industry prioritises its workers' and neighbouring communities' health and safety. Comprehensive health and safety initiatives can reduce the risks of coal mining and processing [17]. Such programs include occupational health and safety training, personal protective equipment, regular medical check-ups, and emergency response training. EGAT's Wan Kaew Project in Thailand exemplifies these efforts. As a key entity in power generation, EGAT promotes public health by financially supporting Mettapracharak Hospital's eye care services, aligning with SDG 3's focus on Good Health and Well-being. In 2022, EGAT's contribution of 2,000,000 Baht (USD 57k) to Mettapracharak Hospital was crucial for the Wan Kaew Project's success, featuring twenty-five nationwide mobile units to deliver vital eye care services.

EGAT has initiated the Sports Association Promotion Project to foster good health in line with SDG 3 [18]. This initiative involves financial support to various sports associations, highlighting the importance of nurturing sports potential among the youth. EGAT's project is a vibrant example of how supporting community sports activities can contribute to the holistic development of sustainable and vibrant communities.

Case Study: San Miguel Corporation (Philippines)

San Miguel Global Power (SMGP) is a leading energy company committed to sustainable development and community empowerment. It provides 20% of the nation's electricity through coal-fired power. San Miguel has demonstrated a profound commitment to improving community health services across the Philippines [19]. With significant investment, the company established a network of six clinics within its fence line communities, strategically dispersed across the nation: three in Luzon (Valenzuela, Pampanga, Batangas), two in the Visayas (Bacolod and Cebu), and one in Mindanao (Davao del Sur). These clinics, operated in partnership with the San Miguel Foundation and local barangay health offices, offer comprehensive healthcare services tailored for children and the elderly, as well as those with chronic conditions such as diabetes or heart disease.

The clinics serve as vital healthcare hubs, providing preventive care, treatment, family planning, nutrition advice, and health education. Notably, the clinic in San Fernando, Pampanga, specialises in managing lifestyle-related diseases, distinguishing it as a secondary healthcare facility, while the others function as primary care clinics. The effectiveness and impact of these clinics are underscored by the growing trust and reliance of the local communities they serve. In 2022, the clinics collectively catered to nearly 900 patients, amounting to 8,705 visits, reflecting San Miguel's dedication to fostering healthier communities and supporting SDG 3: Good Health and Well-being.

Photo source: Freepik

SDG 4:
QUALITY EDUCATION



Photo source: Freepik

Quality education, as outlined in UN SDG 4, is fundamental to achieving sustainable development and fostering inclusive societies. This goal aims to ensure all individuals have access to equitable and inclusive education by 2030. The targets associated with SDG 4 address various aspects of education, including access, quality, inclusion, and lifelong learning, recognising education as a fundamental human right and a key driver for sustainable development. Some key objectives of SDG 4 include:

- **Ensure inclusive and equitable quality education:**
  The goal emphasises the importance of providing accessible education to all, regardless of gender, socioeconomic status, disability, or other factors.
- **Promote lifelong learning opportunities:**
  SDG 4 recognises that education is a lifelong process and encourages learning opportunities for people of all ages. This includes formal and informal education, vocational training and skill development in coal operations.
- **Improve literacy and numeracy skills:**
  The goal aims to enhance foundational skills such as literacy and numeracy to ensure that individuals have the basic skills needed for personal development and active social participation.
- **Enhance educational facilities and resources:**
  SDG 4 calls for improving educational infrastructure, the availability of qualified teachers, and access to relevant learning resources, including information and communication technologies.
- **Promote education for sustainable development:**
  The goal encourages the integration of sustainable development principles into education curricula to foster a greater understanding of environmental, social, and economic issues.

By achieving the targets outlined in SDG 4, the United Nations aims to empower individuals with the knowledge and skills needed to build a more just, inclusive, and sustainable world. Progress toward this goal contributes to broader efforts to eradicate poverty, promote gender equality, and address other global challenges.

Case Study: Semirara Mining and Power Corporation (Philippines)

Semirara Mining and Power Corporation, a key player in the coal mining and power generation sectors, understands education's pivotal role in shaping local communities' futures. The company firmly believes education is the cornerstone of progress and has undertaken various initiatives to support educational development in Semirara Island, Philippines.

Semirara Mining and Power Corporation invests in students' education through scholarship programs, ensuring they have access to quality learning opportunities [20]. Additionally, the company provides financial assistance for the tuition and fees of workers' dependents enrolled at the Divine Word School of Semirara Island Inc. (DWSSII), fostering educational access and equity within the community.

Aligned with the objectives of SDG 4, Semirara Mining and Power Corporation prioritises enhancing STEM (Science, Technology, Engineering, and Mathematics) education. Collaborating with Semirara Training Center, Inc., the company supports DWSSII to be K-12-ready, with a strong focus on the STEM academic track. By building classrooms and facilities conducive to learning, Semirara Mining and Power Corporation creates an environment where students can thrive academically and pursue their aspirations.

Moreover, Semirara Mining and Power Corporation's commitment extends to skills training, empowering residents with the expertise needed for favourable employment opportunities. Through these comprehensive educational initiatives, the company not only invests in individuals' academic success but also contributes to the socio-economic advancement of the community, laying the foundation for a sustainable future.



Case Study: Adaro Group (Indonesia)

Adaro Ignites Education is an integral part of the Adaro Group in Indonesia, which is committed to educational development and human resource enhancement. Through a multifaceted approach, Adaro Ignites Education focuses on integrating knowledge, skills, and character education to nurture holistic development among students [21].

In 2021, the program included mentoring for early education, scholarship provisions, and support for Islamic boarding schools. Through extensive mentoring programs spanning 63 early education schools across Adaro Group's operational regions, characterised by regencies such as Tabalong, Balangans Barito Kuala, Banjar, Banjarmasin, and Murung Raya, Adaro nurtured a holistic educational environment. By instilling a character-based holistic education framework, these initiatives aimed to imbue children with nine pillars of character, fostering comprehensive development and unlocking their latent potential.

Furthermore, Adaro's Indonesia Bright Future Leaders scholarship program played a pivotal role in fostering academic excellence by granting scholarships to deserving students from the group's operational locales. These scholarships, awarded to outstanding individuals, facilitated access to higher education opportunities. In 2021 alone, Adaro disbursed 229 scholarships to students at the University of Lambung Mangkurat in Banjarmasin, 32 at the Bogor Agricultural University, and 14 at UPN "Veteran" Yogyakarta.

Case Study: Bayan Group (Indonesia)

The Bayan Group, operating primarily in Indonesia's coal mining sector, recognises the significance of education in empowering communities and driving socio-economic development. Situated in remote locales with limited educational access and facilities, Bayan Group strategically collaborates with partners such as the Sampoerna Foundation and Surya University to address these challenges.

Bayan Group has facilitated scholarship programs benefiting approximately 16 students from 2014 to 2017 through these collaborations [16]. Additionally, in partnership with local stakeholders, Bayan Group initiated the Teacher's Quality Development Program Training, focusing on the professional growth of over 60 teachers within the Tabang area, with plans for expansion in the future. These efforts aim to bolster community capacity building within Bayan Group's operational spheres, fostering a conducive environment for educational advancement.

Complementing these initiatives, Bayan Group has implemented diverse scholarship programs, including those offered at the Energy and Mining Polytechnic (PEP) in Bandung. Moreover, the company spearheads empowerment programs targeting individuals with disabilities in the Tabang Site, providing vocational training and mentoring sessions across various skills domains. Through collaborations with the Indonesian Association of Persons with Disabilities (PPDI) of Balikpapan, Bayan Group aims to uplift disadvantaged communities, fostering their socio-economic advancement and empowering them to achieve financial independence.

Case Study: Vietnam Coal and Mineral Industries Group (Vietnam)

Vietnam's coal mining sector, Vietnam Coal and Mineral Industries Group (TKV), is committed to SDG 4: Quality Education. Beyond its core business interests, TKV actively engages in social development initiatives, particularly those focusing on education and community welfare.

In line with its commitment to quality education, TKV undertakes vital initiatives to enhance educational infrastructure and opportunities within its operational areas. Notably, the company allocates significant resources towards funding the construction of educational facilities, including kindergartens and primary-secondary schools. In 2021 alone, TKV invested VND 13 billion in such projects, specifically focusing on primary and middle schools in Dong Xuan commune, reflecting its dedication to sustainable growth and educational improvement.

Through these initiatives, TKV underscores its role as a responsible corporate citizen, prioritising the well-being of the Thai Binh community and contributing to the region's overall development. By investing in education, TKV supports individuals' academic advancement, fosters socio-economic progress, and empowers communities for a brighter future.

Case Study: Integrated Refinery & Petrochemical Complex – IRPC (Thailand)

The IRPC is a leading energy and petrochemical company operating coal-fired power plants. IRPC actively supports SDG 4 by offering scholarships to students in remote areas and promoting equal educational opportunities.

IRPC's scholarship program targets students from primary to university level, aiming to empower communities through education. In 2020, IRPC awarded 299 scholarships to underprivileged students, achieving a high community satisfaction score. This initiative ensures that students from underserved regions can access quality education, enabling them to unlock their full potential.

Beyond scholarships, IRPC's social development projects contribute to sustainable community growth, reflecting the company's commitment to fostering positive change and developing future leaders. These projects go beyond providing financial support, as IRPC actively engages with local communities to understand their needs and implement tailored solutions to their circumstances.

SDG 5: GENDER EQUALITY

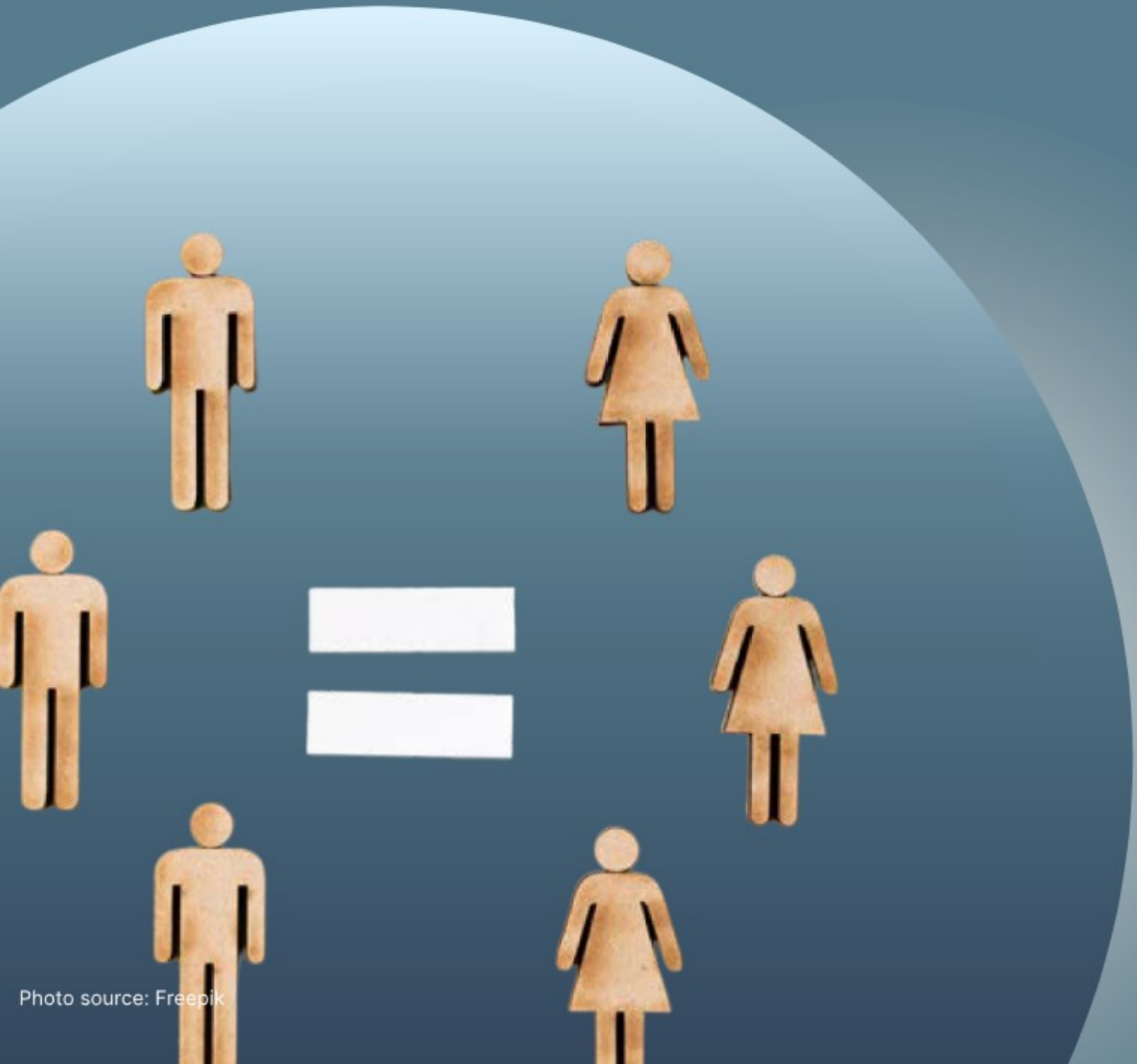


Photo source: Freepik

SDG 5 addresses various forms of discrimination and violence against women and promotes women's participation and leadership in all areas of life. While the coal value chain can take steps to promote gender equality, the transition away from fossil fuels may also have implications for women's employment in the industry. Therefore, efforts should be made to ensure this transition is just and equitable for all.

SDG 5 aims to achieve gender equality and empower all women and girls. Power generation, mainly through modern coal energy sources, can contribute to this goal in several ways:

- **Employment Opportunities:** The coal value chain creates direct and indirect jobs. These jobs provide income for individuals, including women, and help to empower them economically.
- **Access to Energy:** Ensuring access to affordable, reliable, sustainable, and modern energy for all (an essential aspect of SDG 7) can indirectly contribute to SDG 5 by promoting economic development and reducing the burden of energy costs on poor households, which often disproportionately affects women.
- **Education and Training:** Providing education and training opportunities in the coal value chain can empower women and girls, giving them the skills and knowledge they need to succeed.
- **Community Development:** coal projects, especially community-based ones, can lead to broader social and economic development in the areas where they are located, providing opportunities for women to take on leadership roles.
- **Climate Action:** By reducing greenhouse gas emissions, emission abatement coal technology contributes to the fight against climate change, reducing the disproportionate effect on women and girls.
- **Health and Safety:** Access to clean, reliable energy can improve health and safety, particularly for women and girls who are often responsible for cooking and heating in many parts of the world.

To achieve these benefits, it's essential to implement policies that promote gender equality in the coal value chain, improve access to energy, and ensure that the benefits of these changes are shared equitably.

Case Study: PT PLN (Persero) (Indonesia)

PT PLN (Persero) is Indonesia's leading state-owned enterprise that generates, distributes, and transmits electricity across the archipelago. Established to address the country's growing energy needs, PLN plays a pivotal role in powering the nation's homes, industries, and businesses, aiming to ensure reliable and accessible electricity for all Indonesians.

In December 2023, Srikandi PLN extended its support to empower underprivileged women in Pekanbaru, Riau Province, through a sewing skills enhancement program [9]. To foster economic independence among these women, the initiative provided comprehensive training sessions to enhance their sewing capabilities. Upon completing the training, participants were equipped with sewing machines, which are vital assets to kickstart their entrepreneurial ventures. This initiative, aligned with SDG 5, exemplifies Srikandi PLN's commitment to women's empowerment, offering tangible opportunities for socio-economic advancement and self-reliance among underprivileged communities.

Case Study: Adaro Group (Indonesia)

Adaro Group, a leading coal company, champions diversity and gender equality through its Human Capital Development and Management strategy, aligning with SDG 5 [22]. By prioritising meritocracy in recruitment, offering extensive professional development opportunities, and fostering an inclusive workplace culture, Adaro Group empowers individuals, regardless of gender, age, race, or disability, to contribute to its success. Through these efforts, Adaro Group enhances its competitive edge and drives positive social change, making significant strides towards achieving SDG 5.

Through its commitment to diversity and equal opportunities, merit-based recruitment, extensive professional development initiatives, and inclusive workplace policies, Adaro Group strengthens its business operations. It contributes to advancing gender equality and diversity.

Case Study: San Miguel Corporation (Philippines)

San Miguel Global Power (SMGP) is a leading energy company committed to sustainable development and community empowerment. San Miguel Power's Better World Cubao (BWC) exemplifies empowerment and support for women, embodying Sustainable Development Goal 5: Gender Equality. Since its inception in March 2022, BWC has fostered a community where women access vital services and opportunities to thrive in the modern world. With a focus on health, empowerment, and recovery, BWC offers a range of programs, including health consultations and workshops on topics like violence against women, parenting, and gender equality. Over nine months, BWC has enrolled over 420 members, conducted 185 health education classes, and facilitated 2600 empowerment workshops [19].



Figure 7. San Miguel Power's Better World Cubao

BWC has expanded its services to include free ultrasound services, catering to its member's and extended families' health needs. Through these initiatives, BWC has cultivated a strong sense of community, with over 1,600 volunteer hours contributed by its members. By bringing together women from diverse backgrounds, BWC creates an inclusive space, fostering confidence and self-belief and developing a sense of belonging among its members.

Case Study: PT Virtue Dragon Nickel Industry (Indonesia)

A leading nickel smelter in Indonesia, PT Virtue Dragon Nickel Industry (PT VDNI), and PT Obsidian Stainless Steel (OSS). PT VDNI operates the Delong Nickel Phase I Power Station, which powers its nickel smelting operations. The company is committed to employee welfare and safety, especially among female workers, through a partnership with Badan Penyelenggara Jaminan Sosial Ketenagakerjaan (BPJS Employment) [23].

PT VDNI's specific initiative to provide multivitamins for its female employees serves as a proactive stride towards achieving gender equality within the workplace. This measure, part of a holistic health and safety scheme in collaboration with BPJS Employment, underscores PT VDNI's acknowledgement of the unique health needs of its female workforce. By ensuring that female employees maintain good health, the company bolsters their well-being and champions an inclusive work environment where gender-specific needs are recognised and met. Such efforts significantly contribute to the overarching aim of SDG 5.



Photo source: Freepik

SDG 6: CLEAN WATER AND SANITATION



Photo source: Freepik

SDG 6 aims to ensure the availability and sustainable management of water and sanitation for all. It addresses issues relating to drinking water, sanitation and hygiene (WASH), and the quality and sustainability of water resources worldwide. The coal value chain can aid SDG 6 in several ways:

- **Environmental Standards:** The coal value chain has commercial objectives that include cost-effectively achieving environmental standards. This can contribute to SDG 6 by reducing the industry's impact on water resources in coal washing and processing facilities and coal ash ponds.

- **Technology Research and Development:** The coal value chain involves technology research and development, including water efficiency technologies and wastewater treatment. These technologies can help improve the sustainability of water resources and create new clean water resources.

- **Collaboration Along the Value Chain:** The coal value chain collaborates with customers and suppliers along the value chain. This can include working with other sectors to improve water management practices.

- **Community Investment:** Coal companies can invest in the communities where they operate, including programs that aim to improve water and sanitation services.

Thermal power generation can contribute to this goal in several ways, but it also poses some challenges:

- **Water Use Efficiency:** Thermal power plants consume significant amounts of water, especially those using cooling towers. Improving these plants' water use efficiency can help conserve water resources.

- **Wastewater Treatment:** Thermal power plants produce wastewater that can contain pollutants. Proper treatment of wastewater before it is discharged can maintain water quality.

- **Thermal Pollution:** The heat discharged from thermal power plants can raise the temperature of nearby water bodies, affecting aquatic ecosystems. Implementing measures to reduce thermal pollution can help to protect these ecosystems.

- **Desalination:** Some thermal power plants, particularly coastal ones, can be integrated with desalination facilities. This can provide a source of clean water, contributing to SDG 6.

Therefore, while thermal power generation can be made more sustainable, a broader energy transition may also be beneficial for achieving SDG 6.

Case Study: PT Cikarang Listrindo Tbk (Indonesia)

In Indonesia, PT Cikarang Listrindo, a prominent electricity provider, has demonstrated a profound commitment to advancing community welfare through its initiatives in Kampung Beting. This area, home to 300 households and located near the estuary of the Citarum tributary, needs help accessing clean water and sanitation facilities. Recognising the critical link between health and access to clean water, PT Cikarang Listrindo has embarked on a mission to improve the living conditions of the Kampung Beting community by addressing these fundamental needs.

On May 10, 2023, the company celebrated the inauguration of its second clean water facility in the area, incorporating advanced bioseptic tank technology to ensure high-quality water. Serving 50 households, these facilities mark a significant step towards fulfilling the community's clean water requirements. Additionally, PT Cikarang Listrindo's engagement extends beyond infrastructure development to include educational initiatives promoting healthy living practices among the residents, thereby illustrating a holistic approach to community support.



Figure 8. Citarum tributary in Kampung Beting



Figure 9. Cikarang Listrindo's educational initiative

It is aligned with the SDGs, particularly SDG 6, which concerns Cikarang Listrindo's efforts in Kampung Beting—from mangrove planting to establishing clean water and sanitation facilities.

Case Study: Electricity Generating Authority of Thailand – EGAT (Thailand)

EGAT has introduced the Khok Nong Na Model, which embodies the principles of the Sufficiency Economy philosophy [17]. Implemented in river basins near EGAT's dams and power plants, this model aims to foster sustainable agricultural practices among the local communities. By establishing Sufficiency Economy Study and Development Centres, EGAT provides valuable resources and training on this agricultural model, enabling communities to learn and adopt practices contributing to food and water security.

The Khok Nong Na Model represents EGAT's commitment to integrating sustainable development principles into its operations and community engagement efforts. This initiative highlights the potential of sustainable agriculture to enhance food security while conserving water resources, demonstrating EGAT's dedication to promoting environmental sustainability and supporting the well-being of communities in Thailand. Through such projects, EGAT plays a crucial role in advancing the implementation of the SDGs, showcasing the power of corporate responsibility in achieving broader sustainability goals.

Case Study: Integrated Refinery & Petrochemical Complex – IRPC (Thailand)

In addressing the critical need for water security in Thailand's agricultural sectors, the petrochemical company IRPC, which also operates coal-fired power plants, demonstrates a commitment to SDG 6. By constructing wells in strategic areas such as Lam Sai Yong, Nang Rong, and Buriram and extending the model's reach to Uttaradit and Sisaket, IRPC has not only secured a sustainable water supply for both domestic and agricultural use but also laid the groundwork for enhancing living standards in these communities.

The success of the Lam Sai Yong Model is a testament to IRPC's dedication to community empowerment and sustainable development. By fostering water security, the initiative directly contributes to the resilience and self-sufficiency of agricultural communities, enabling them to thrive despite the challenges posed by water scarcity. Moreover, IRPC's engagement with multiple stakeholders to replicate and implement this model across various regions highlights the company's proactive role in promoting the well-being and prosperity of Thailand's rural populations.

SDG 7: AFFORDABLE AND CLEAN ENERGY



Photo source: Freepik

SDG 7 ensures access to affordable, reliable, sustainable, and modern energy for all. In the context of the Association of Southeast Asian Nations (ASEAN), tracking the region's progress towards achieving targets under SDG 7 is crucial.

Key targets of SDG 7 include ensuring universal access to electricity and clean cooking, increasing the share of renewable energy in the energy mix, and accelerating energy efficiency. These targets are particularly relevant for ASEAN countries, many of which are rapidly developing and undergoing significant energy transitions.

ASEAN countries have made progress in various aspects of SDG 7. However, much more aggressive measures are needed than the path set by current policies if ASEAN is to support the achievement of the SDG 7 target. This includes:

- **Efficiency Solutions:** Many ASEAN member states are demonstrating their commitment to deploying efficiency solutions, including HELE and coal upgrading technologies. HELE coal generation: this includes supercritical (SC), USC, advanced USC (A-USC), CHP, and IGCC systems, emitting 20-50% less carbon (per unit of energy produced) than older subcritical power technologies.

- **Pollution Control Technology:** Used in coal-fired energy production to reduce airborne emissions by up to 99.9%.

- **Co-firing with Coal:** Co-firing carbon-neutral fuels such as agricultural and forestry waste biomass with coal feedstocks to neutralise GHG emissions from coal plants.

- **Carbon Capture and Storage (CCS):** Involves permanently storing captured CO_2 deep into a rock formation or for use in power and industrial applications. CCS was commercialised in the 1970s, and the world's first coal power plant unit with CCS was commissioned in 2014 and has been operating successfully since. The CO_2 is stored in oil reservoirs for enhanced oil recovery.

- **Reports and Studies:** ASEAN, in partnership with FutureCoal (formerly the World Coal Association) and the ASEAN Centre for Energy (ACE), launched a report titled 'Clean Coal Technology in ASEAN Balancing Equity, Security & Sustainability'. The report comprehensively analyses the energy security and sustainable development opportunities CCT promotes in implementing the ASEAN Plan of Action for Energy Cooperation (APAEC) Phase II: 2021 – 2025.

Case Study: PT PLN (Persero) (Indonesia)

Indonesia is actively pursuing biomass co-firing in coal-fired power plants to reduce carbon emissions and transition to cleaner energy sources. One notable example of this initiative is the implementation of cofiring at the Tembilahan coal-fired power plant in Indragiri Hilir Regency, Riau Province. This plant successfully conducted a trial using 100% biomass from palm kernel shells, marking a significant step towards cleaner energy production in Indonesia. This trial, part of PT PLN's green booster programs, aims to increase the mix of national renewable energy and is expected to serve as a model for other power plants across the country [24].

The co-firing initiative involves substituting a portion of coal with biomass to reduce greenhouse gas emissions. PLN aims to develop clean energy resources to achieve a 23% new renewable energy mix by 2025. The plan includes substituting 10% of coal with biomass in coal-fired power plants. This program has been implemented in various locations. PLN aims to have 52 power plants implementing the co-firing program by 2025, generating 10.6 GW of electricity using 9 million tonnes of biomass per year [24].

Case Study: CV Powerindo Cipta Energy (Indonesia)

Gasification in Indonesia: Indonesia's coal gasification projects are advancing, with significant investments aimed at transforming the country's abundant coal resources into methanol and dimethyl ether. One notable project involves a collaboration between Indonesia's CV Powerindo Cipta Energy and China National Chemical Engineering Corporation to study the feasibility of building a coal-to-methanol plant valued at USD 560 million.

Additionally, Air Products announced plans to invest USD 13-15 billion into several gasification projects supported by the Indonesian government. These projects aim to utilise domestic coal resources to reduce reliance on imported liquefied petroleum gas (LPG) and stimulate domestic demand for coal. Despite concerns about environmental impacts and greenhouse gas emissions, these agreements underline Indonesia's continued exploration of ways to capitalise on its coal reserves [24].

Another significant endeavour is a USD 2.3 billion coal gasification plant built on the island of Sumatra, part of a broader USD 15 billion investment by Air Products and Chemicals. This investment marks one of the US company's most significant overseas coal investments, reflecting Indonesia's push to create a new national coal gasification industry [25].

Case Study: PT Bukit Asam Tbk (Indonesia)

PT Bukit Asam Tbk (PTBA), a key player in the coal industry based in Indonesia, showcases SDG 7 through its innovative initiatives[26]. By implementing solar power-based irrigation programs, the company addresses agricultural requirements in diverse villages, effectively linking its operations to SDG 7's mandate of ensuring access to affordable and clean energy. Through the Solar Power Plant Program (SPPP), PTBA offers free and sustainable energy for irrigation, supporting local farmers and fostering environmental sustainability. This commitment underscores the company's alignment with SDG 7's objectives, contributing to the global effort to promote clean and accessible energy solutions while positively impacting agricultural communities and the environment [27].

Case Study: PT Cikarang Listrindo Tbk (Indonesia)

PT. Cikarang Listrindo Tbk operates a coal technology called a circulating fluidised bed (CFB) boiler in Babelan, Indonesia. CFB enables a much more flexible approach to power generation, replacing coal with other solid fuels. The investment reflects PT Cikarang Listrindo's initiative for greener energy production and environmentally friendlier operation of a coal plant by reducing reliance on fossil fuels and cutting CO_2 emissions by cofiring sustainable biomass [28].

Through initiatives aimed at popularising biofuels and advancing electric vehicle technologies, PT Cikarang Listrindo aligns itself with SDG 7, which advocates for accessible and clean energy solutions [29]. The company collaborates with government bodies such as the Ministry of Energy and Mineral Resources of Indonesia and PT PLN (Persero) to combat energy poverty. By offering free electricity connections to underserved communities, PT Cikarang Listrindo ensures universal access to affordable, reliable, sustainable, and modern energy for all, thus fostering positive societal and environmental outcomes.



Photo source: Freepik

Case Study: MMC Corporation Berhad (Malaysia)

MMC Corporation Bhd is a leading Malaysian coal company operating Port Terminal P (PTP) among other ports within its group. PTP primarily relies on electricity and fuel, focusing on container handling activities.

Recognising the environmental impact associated with carbon emissions from such operations, the company has set an ambitious target to reduce PTP's energy consumption by 45% by 2030, in alignment with the Paris Agreement goals [30]. In the fiscal year 2022, PTP's Sustainability Committee prioritised achieving this target through energy optimisation measures, transitioning to electric vehicles and green marine vessels, and integrating renewable infrastructure where feasible.

Similarly, Northport, another subsidiary of MMC Corporation Bhd, has implemented energy-saving policies and installed solar panels on its warehouse rooftops, demonstrating the company's commitment to green energy practices and sustainability.

Case Study: Tenaga Nasional Berhad (Malaysia)

Tenaga Nasional Berhad (TNB), Malaysia's leading electricity utility, exemplifies the pursuit of SDG 7 through its commitment to sustainable and efficient energy generation. Operating a diverse array of thermal power plants, TNB is at the nexus of addressing the energy demands of millions while mitigating the environmental challenges inherent in fossil fuel use.

The company's strategic initiatives to enhance thermal efficiency—such as improving coal fineness, ensuring condenser cleanliness, and employing advanced monitoring technologies—underscore its dedication to reducing carbon emissions and optimising fuel consumption [31]. These efforts are bolstered by TNB's commitment to minimising auxiliary power consumption and adopting closed-loop water systems, reinforcing its holistic approach to sustainability. TNB's journey reflects a pivotal shift towards integrating environmental stewardship within the energy sector, setting a precedent for utility companies worldwide.

SPOTLIGHT: Carbon Capture and Storage

Research on Carbon Capture and Storage (CCS) in the ASEAN region is gaining momentum. However, the power sector is limited to plans for gas-fired power plants and the natural gas processing industry. However, some key policy initiatives are described below:

- **Southeast Asia CCS Accelerator (SEACA):** The Global CCS Institute (GCCSI) and the ASEAN Centre for Energy (ACE), in cooperation with the Ministry of Energy of Thailand, organised the 1st SEACA Workshop in May 2023, with the Ministry of Energy and Mineral Resources of Indonesia organised the 2nd SEACA Workshop in November 2023, and with Ministry of Economy of Malaysia organised the 3rd SEACA Workshop in August 2024. SEACA aims to accelerate commercial CCS deployment in the region and is built on three pillars crucial to the development of CCS projects: CCS Regulation, Enabling Policy, and Geological Storage Resource Development.
- **Asia CCUS Network:** The Economic Research Institute for ASEAN and East Asia (ERIA) oversees the Asia CCUS Network, which works on the roadmap and implementation of CCS in the ASEAN region. The network organises knowledge-sharing conferences, conducts research studies, and provides capacity-building training focusing on CCUS/CCS issues.
- **ASEAN CCS Strategic Considerations:** A document by the Global CCS Institute rationalises the need for CCS in the ASEAN region, describes ASEAN's long-term energy path, quantifies the CCS contribution to emission reductions in ASEAN, and provides insights into the status of CCS activities in the ASEAN Member States.
- **Asia CCUS Potential Map:** The Asia CCUS Potential Map provides information about significant CO_2 emissions sources, possible storage areas, and planned and existing gas pipelines to perform a preliminary evaluation of CCUS feasibility in the ASEAN and East Asia Summit (EAS) region.
- **CO_2 Cross-Border Transportation in ASEAN:** A joint research paper titled "Opportunities and Challenges for CO_2 Cross-Border Transportation in ASEAN for Advancing CCS Towards a Net Zero Future" was developed by the ASEAN Centre for Energy (ACE) with the support of the Japan Organization for Metals and Energy Security (JOGMEC), in collaboration with national experts from ASEAN Member States (AMS) and Mitsubishi Research Institute, Inc (MRI). This paper aims to review and analyse the regulatory framework for CCS and cross-boundary CO_2 transport within ASEAN and identify its challenges and opportunities in ASEAN.

In conclusion, ASEAN is actively pursuing CCS research and development, with various initiatives and collaborations aimed at accelerating the deployment of CCS technology in the region. The report recommends a more concerted effort among the nations to explore capture, transport, and storage possibilities and turn these into reality.

8 DECENT WORK AND ECONOMIC GROWTH

SDG 8: DECENT WORK AND ECONOMIC GROWTH



Photo source: Freepik

The coal value chain can aid SDG 8 in several ways. It contributes to economic growth by providing jobs and stimulating economic activity. This includes indirect jobs in mining and related industries such as transportation, equipment manufacturing, and power generation. The coal value chain intersects with SDG 8 through various avenues, including job creation in the mining, manufacturing, and energy sectors, infrastructure development, and investment in local communities.

- **Job Creation:** Coal mining and related industries can create employment opportunities, especially in regions where coal extraction is a significant economic activity. This can help reduce unemployment rates and provide communities with livelihoods.

- **Infrastructure Development:** Coal-fired power plants and associated infrastructure projects require significant investment, which can stimulate economic growth and contribute to infrastructure development such as roads, railways, and power transmission lines. This infrastructure development can further support economic activities beyond the coal industry itself.

- **Energy Access and Affordability:** In regions where coal is abundant and other energy sources are scarce or expensive, coal-fired power plants can provide a relatively affordable and accessible energy source. Access to affordable energy is crucial for economic development and can support various industries, businesses, and households.

- **Industrialisation:** Coal is often used as a feedstock in various industrial processes, including steel production and chemical manufacturing. These industries play a vital role in economic development by producing goods and materials for construction, manufacturing, and other sectors.

By fostering decent work and economic growth, the coal value chain can drive prosperity, reduce poverty, and support the achievement of the sustainable development objectives outlined in SDG 8.

Case Study: PT Cikarang Listrindo Tbk (Indonesia)

PT Cikarang Listrindo Tbk, based in Indonesia, actively fosters economic growth and sustainable development through various empowerment programs. These initiatives promote inclusive and sustainable economic growth, aligning with Sustainable Development Goal 8 (SDG 8) objectives. One such program involves supporting Independent and Creative Village-Owned Enterprises (BUMDes) in catfish farming, empowering communities in Karangraharja Village to achieve economic independence [29].

Additionally, PT Cikarang Listrindo's Micro, Small, and Medium Enterprises (MSME) program in Buni Baru Village focuses on fostering innovation and business development, contributing to sustained economic growth and prosperity in the region. Furthermore, the company collaborates with stakeholders to implement Sustainable Village Tourism in Kertarahayu Village, emphasising social, financial, and environmental aspects. Through training and empowerment initiatives, PT Cikarang Listrindo's efforts in Kertarahayu Village contribute to sustainable economic growth, thereby advancing the goals of SDG 8.

Case Study: Bayan Group (Indonesia)

Bayan Group, operating in Indonesia, is committed to fostering economic growth and prosperity within local communities through targeted economic programs. These initiatives are designed to empower residents by creating sustainable income-generating opportunities across various sectors, including fisheries, animal husbandry, agriculture, and alternative economic ventures [16]. By collaborating with external stakeholders, Bayan Group implements initiatives like the Animal Husbandry Program, establishing cattle farms and laying hens in strategic locations such as Belusuh and Kota Bangun Village.

Additionally, the company supports fisheries-focused economic initiatives in several villages alongside agricultural programs promoting vegetable cultivation and rice farming in Sepaso Timur and Lebak Cilong. Through these multifaceted efforts, Bayan Group aims to uplift local communities and foster long-term economic resilience, aligning with the objectives of SDG 8 to promote sustained, inclusive, and sustainable economic growth.



Figure 10. Bayan Group's Animal Husbandry Program

Case Study: MMC Corporation Berhad (Malaysia)

MMC Corporation Bhd, a prominent player in the coal industry based in Malaysia, demonstrates a solid commitment to sustainable development and social responsibility. In the financial year 2022, the Group's Ports and Logistics division conducted 988 training programs, focusing on soft skills, compliance, and technical literacy, contributing to workforce capacity building and skill enhancement. Notably, the division prioritised gender equality by implementing innovative practices and policies to empower women in operational and leadership roles. Initiatives such as the Young Engineer Apprenticeship Programme and Female Terminal Equipment Operator Fast Track Up-Skilling Programme have been introduced to support women's advancement within the organisation. Moreover, the PTP Female Employee Referral Programme incentivises increased female representation in the workforce. These initiatives align with SDG 8, which promotes sustained, inclusive, and sustainable economic growth by fostering a diverse and inclusive workplace environment and investing in human capital development.

Case Study: Vinacomin – Vang Danh Coal (Vietnam)

Vinacomin, a prominent Vietnamese mining company, specialises in coal and mineral mining operations. In Quang Ninh Province, Vang Danh Coal Joint Stock Company, a subsidiary of Vinacomin, exemplifies a robust commitment to SDG 8 [32]. In response to the campaign promoting locally produced goods and services, the company initiated a notable seafood consumption program for farmers impacted by the COVID-19 epidemic. By distributing over 3 tons of distilled clams to voluntarily registered employees, Vang Danh Coal actively bolsters the local economy, contributing to sustainable livelihoods and economic growth in the region. The ongoing effort to engage employees in voluntary registration to purchase and consume seafood products further underscores the company's dedication to Goal 8, facilitating decent work opportunities and economic well-being for the community. This initiative represents a comprehensive approach that aligns with SDG 8, addressing issues related to hunger, health, and economic prosperity in Quang Ninh Province.



Photo source: Freepik

Case Study: PT Bumi Resources Tbk (Indonesia)

PT Bumi Resources Tbk (BUMI), a leading coal production company through its subsidiaries PT Kaltim Prima Coal (KPC) and Arutmin, illustrates a commitment to SDG 8 by integrating health and safety into the core of its operations [33]. Understanding that its workforce is a valued asset, BUMI prioritises the health and safety of its employees not just as a regulatory requirement but as an intrinsic part of its organisational culture. The company's steadfast dedication to Occupational Health and Safety (OHS) transcends mere compliance, embodying a conscientious lifestyle choice for all employees at KPC and Arutmin. By striving for a zero-accident workplace,



Figure 11. BUMI employees at KPC and Arutmin.

BUMI adheres to national and international health and safety standards, including OHSAS 18000 and regulations set forth by the Ministry of Labor of the Republic of Indonesia. This comprehensive and proactive approach underscores BUMI's commitment to creating a safe and secure working environment, essential to enhancing coal productivity and achieving operational excellence. Through this case study, BUMI exemplifies how prioritising employee well-being contributes to sustained, inclusive, and sustainable economic growth, aligning with the objectives of SDG 8.

Case Study: PT Huayue Nickel Cobalt (Indonesia)

PT Huayue Nickel Cobalt (PT HYNC), one of Indonesia's first high-pressure acid leaching (HPAL) projects, relies on coal power. HPAL extracts nickel and cobalt from laterite ore bodies, a common type of nickel deposit [34]. Indonesia's industrial parks, which have become major hubs for nickel and aluminium processing, currently account for 15% of the country's coal power output. If plans to expand the captive power of these industrial parks are fulfilled, their share of Indonesia's total coal power output is expected to rise to 24% [35]. Indonesia Morowali Industrial Park (IMIP), where the PT HYNC's HPAL plant is located, has 1.9 GW of power generation, which could expand to 2.9 GW in the coming years, of which most is coal-fired power[36].

PT HYNC has significantly contributed to SDG 8 by creating over 5000 direct jobs through its establishment and operations, thereby driving local economic development. The company's rigorous adherence to local laws, fair employment practices, and provision of competitive wages and comprehensive training programs reflect its commitment to fostering a healthy working environment. Additionally, its initiatives, like the "Iron Army Plan" and the assurance of 100% physical examination coverage for employees, demonstrate a dedication to employee well-being and career advancement, promoting sustained, inclusive economic growth.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

SDG 9: INDUSTRY INNOVATION AND INFRASTRUCTURE



Photo source: Freepik

SDG 9 shares significant similarities with SDG 8, which focuses on Decent Work and Economic Growth. Both goals are closely intertwined and mutually reinforcing. SDG 9 is dedicated to the development of resilient infrastructure, the promotion of inclusive and sustainable industrialisation, and the encouragement of innovation.

The rapid pace and vast extent of urban growth in the ASEAN region are remarkable. Currently, urban residents make up over half of ASEAN's population. By 2025, it's projected that ASEAN cities will expand by another 70 million inhabitants, surpassing the combined population of the region's capital cities. This urban expansion in Southeast Asia spans the entire spectrum, from the most isolated villages to the largest megacities [37].

The FutureCoal Sustainable Coal Stewardship identifies many activities that contribute to infrastructure development. Modern electricity supplies power the pulse of urban living and commerce. The waste fly ash and other by-products from coal power plants and slag from blast furnace iron and steel plants supply ample materials for construction. These components of modern development, therefore, contribute to SDG 9 in a broader sense as follows:

- **Industrialisation:** Access to reliable and affordable electricity is crucial for industries' operations. Investment in new capital stock. It enables machinery and technology to increase productivity, reduce costs, and promote sustainable industrialisation, manufacturing and trade.
- **Infrastructure Development:** Access to electricity, transportation, communications networks, and public services (water, sanitation, etc.) are critical components of a resilient and prosperous society. However, more than essential energy services, such as minimal access, intermittent supplies, and continued reliance on traditional wood fuels, are required.

Thermal power, such as coal, is essential for establishing support mechanisms to expand renewable energy. Despite the emphasis on advancing renewable energy sources, ASEAN nations will take a prudent approach, highlighting the importance of a cautious transition strategy as these nations develop prosperity and economic resilience for their citizens.

Case Study: Bayan Group (Indonesia)

Bayan Group has taken significant strides towards improving infrastructure and enhancing the living standards of local communities. The region, known for its acute infrastructure necessities, has seen the Group initiating many projects focused on constructing healthcare facilities and community meeting halls and installing vital utilities, including electricity and clean water systems [16].



Figure 12. Bayan Group's Infrastructure Development Efforts

Such initiatives underscore Bayan Group's steadfast commitment to sustainable development and uplifting the communities' socio-economic conditions within its operational ambit. Furthermore, Bayan Group is venturing into sustainable energy solutions and environmental sustainability. Installing solar cell lighting units across public roads and establishing water treatment plants exemplify the Group's holistic approach to community development — marrying environmental stewardship with social welfare. Bayan Group caters to immediate infrastructural requirements and paves the way for enduring sustainability and socio-economic upliftment in Kalimantan.

Case Study: TKV Maritime Pilot Co (Vietnam)

TKV Maritime Pilot Co., Ltd., a Vietnam-based entity, has significantly contributed to infrastructure development in Tan Ha village, Tan Binh commune, Dam Ha district [38]. In alignment with SDG 9, the initiative focuses on constructing a residential road, directly improving the local infrastructure and making transportation more accessible for the community members. The project indirectly supports other critical SDGs, such as SDG 1 (No Poverty) and SDG 11 (Sustainable Cities and Communities), by catering to local infrastructure needs and fostering a more sustainable and resilient community. TKV Maritime Pilot Co., Ltd.'s project is a testament to the company's dedication to building resilient infrastructure, promoting sustainable industrialisation, and encouraging innovation.

Case Study: PT Gunbuster Nickel Industry (Indonesia)

PT Gunbuster Nickel Industry (PT GNI), a subsidiary of Jiangsu Delong Nickel Industry from China, uses coal power for its operations in Indonesia. The company built a captive coal plant on its site to power its nickel smelter [39]. This coal-fired plant is not connected to the national grid and exclusively serves the industrial estate where the smelter is located [40].

Nickel plays a crucial role in the energy transition due to its unique properties and wide range of applications in clean energy technologies, such as battery production. Nickel enhances battery performance by increasing energy density, which supports higher voltages and storage capacities without compromising stability [41]. This has led to nickel's use in lithium-ion batteries, including nickel-manganese-cobalt and nickel-cobalt-aluminium formulations. Nickel-rich batteries can, therefore, reduce the cost of storing excess renewable energy production.

This initiative strengthens Indonesia's position in the global value chain and aligns with SDG 9: Industry, Innovation, and Infrastructure, which promotes inclusive and sustainable industrialisation, a resilient infrastructure, and fostering innovation. The investment in the ferronickel smelter demonstrates industrial advancement, contributing to Indonesia's economic growth and technological capabilities.



SDG 10: REDUCED INEQUALITIES

Photo source: Freepik

SDG 10 aims to reduce inequality within and among countries. The United Nations identifies enduring global disparities related to income, gender, age, disability, sexual orientation, race, class, ethnicity, religion, and opportunity. Such inequalities threaten sustainable social and economic advancement, impede efforts to reduce poverty, and erode individuals' sense of achievement and self-esteem. Addressing these inequalities is imperative to foster a more equitable and prosperous society.

Women and children with a lack of access to healthcare are at risk of early mortality from preventable diseases; the elderly, migrants, and refugees face a lack of opportunities and discrimination. Reducing inequality requires transformative change.

Greater efforts are needed to eradicate extreme poverty and hunger and invest more in health, education, social protection, and decent jobs, especially for young people, migrants, refugees and other vulnerable communities.

These issues are underpinned by prosperity and economic empowerment, and the efforts to phase out specific energy sources, such as coal, risk undermining community social improvements from the contraction of jobs and incomes if a Just Transition is unsuccessful or poorly implemented. The risk of rising energy prices from phasing out affordable coal-based energy could exacerbate price inflation, worsening the negative impacts on the most vulnerable in the ASEAN.

Fairness, transparency, and recognition by international bodies such as the UN IPCC and governments of the Global North should be considered for the energy needs of ASEAN. For this reason, the region should adopt pragmatic policies regarding energy that suit its citizens and promote prosperity and equality.

Case Study: PT PLN (Persero) (Indonesia)

PT PLN (Persero) is Indonesia's national electricity provider and has spearheaded an initiative to uplift marginalised sectors across Indonesia, including women, individuals with disabilities, and older people, called the Srikandi Movement.

Launched in 2023, the program reflects PLN's commitment to Environmental, Social, and Governance (ESG) values, aiming to improve life quality and promote self-reliance among disadvantaged communities [9]. It incorporates vocational training in culinary arts and horticulture, supported by the voluntary efforts of more than 3,243 PLN employees. The initiative marks significant progress in social empowerment and development, spanning regions from East Java to Papua, and has substantially contributed to community advancement.

PLN actively involves female employees, strongly emphasising gender equality and recognising women's pivotal role in driving community progress. Aligning with SDG 10 to diminish inequalities, this focused approach highlights the importance of women as essential agents for change but also illustrates PLN's broader mission: to a more inclusive future for all Indonesians, thereby transcending its foundational role of providing electricity to championing the cause of inclusivity and equity.

Case Study: PT Virtue Dragon Nickel Industry (Indonesia)

PT Virtue Dragon Nickel Industry (VDNI)'s involvement in the scholarship and modern internship program enables Indonesian students to study in China and return with significant job opportunities within a Chinese company in Indonesia, addressing SDG 10 by actively working to reduce inequalities. This initiative ensures that graduates, regardless of socio-economic background, access quality education, international exposure, and subsequent employment in their home country [42]. By providing this unique pathway, PT VDNI and its partners are mitigating the challenges fresh graduates face in the job market, such as the demand for work experience and technical skills, thereby reducing disparities in access to education and employment opportunities.

Case Study: PT Bumi Resources Tbk (Indonesia)

PT Bumi Resources Tbk (BUMI) is actively advancing the Reducing Inequalities (SDG 10) agenda through its Corporate Social Responsibility (CSR) initiatives. These initiatives foster economic self-sufficiency among individuals with disabilities in Indonesia. Recognising the challenges faced by this group during the pandemic, BUMI has provided crucial support, including financial aid for small businesses and capacity-building training for 150 disabled persons [7]. This program aims to promote economic independence and reduce disparities, which aligns with BUMI's broader commitment to positively impact the community and contribute to the SDGs.

This underscores BUMI's commitment to mitigating economic disparities and assisting persons with disabilities via practical programmes. By empowering marginalised communities, BUMI enhances their economic welfare and exemplifies corporate social responsibility's significant role in promoting global objectives towards a more equitable society.



Photo source: Freepik

SDG 11: SUSTAINABLE CITIES AND COMMUNITIES



Photo source: Freepik

Steel is a fundamental material in urban infrastructure. It's used to construct buildings, bridges, railways, and other structures. Therefore, sustainable practices in the steel industry could indirectly contribute to SDG 11 by reducing environmental impact and improving the resilience of urban infrastructure. SDG 11 aims to make cities and human settlements inclusive, safe, resilient, and sustainable.

Infrastructure Development:

Both steel and cement are fundamental materials for infrastructure development. They are used to construct roads, bridges, buildings, and other structures.

Sustainability:

The steel and cement industries are working towards sustainability by investing in research and development for cleaner production processes. For instance, the cement industry is progressing towards its carbon-neutral target, which will positively impact many SDGs.

Secure and Affordable Energy:

Secure and affordable energy can significantly contribute to the achievement of SDG 11. Energy is critical in urban development, powering public transportation, lighting, heating, and other essential services. Access to reliable and affordable energy can enhance the quality of life in cities, improve public services, and facilitate economic development[1].



Photo source: Lerone Pieters

Case Study: PT Virtue Dragon Nickel Industry (Indonesia)

PT Virtue Dragon Nickel Industry (VDNI) champions a unique approach that blends international education with local employment, significantly contributing to SDG11. Through a collaborative effort with Nanjing Polytechnic Institute, PT VDNI facilitates a scholarship and internship program under the "One Belt One Road" initiative, enabling Indonesian students to study in China and subsequently secure employment within PT VDNI upon their return to Indonesia [42]. This initiative addresses fresh graduates' employment challenges by equipping them with essential technical skills and work experience and enriches the local workforce with international expertise and perspectives.

The integration of global education and local employment opportunities by PT VDNI is instrumental in promoting sustainable urban development in Southeast Sulawesi. Armed with advanced technical knowledge and bilingual capabilities, returnees enhance the region's industrial sector, fostering a more efficient, inclusive, and culturally integrated community. This model of leveraging education for local development exemplifies a sustainable approach to urban growth, where the global mobility of talent enriches local industries, thereby contributing to the resilience, sustainability, and inclusivity of cities and communities in Southeast Sulawesi. PT VDNI's initiative bolsters the local economy and ensures that the region remains adaptive and competitive in the global landscape, paving the way for a sustainable future.

Case Study: PT Bumi Resources Tbk (Indonesia)

PT Bumi Resources Tbk (BUMI) is taking significant strides with its community-based waste management program in Kebalen Village, Bekasi Regency [7]. This initiative, developed in collaboration with CARE LPPM IPB, marks a significant move towards sustainability by promoting a circular economy approach within the community. Over three years, BUMI has empowered residents through capacity building, waste-to-fuel conversion training, afforestation of riverbanks, and organising a clean village competition. This program not only effectively manages organic waste but also supports the establishment of local waste banks and contributes to greening urban spaces. BUMI's efforts in Kebalen Village reflect a profound commitment to the principles of SDG 11, demonstrating the potential of community-led initiatives in building more sustainable and resilient cities.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

SDG 12: RESPONSIBLE CONSUMPTION AND PRODUCTION



Photo source: Freepik

SDG 12 ensures sustainable consumption and production patterns. The coal value chain can aid SDG 12 in several ways:

- **Sustainable Consumption and Production:** The coal value chain can contribute to sustainable consumption and production by investing in clean coal technologies that reduce environmental impact and resource use.

- **Resource Efficiency:** The coal value chain can promote resource efficiency by implementing practices that reduce waste and improve the efficient use of fuels, explosives, consumables, etc. This includes practices such as recycling and reusing materials.

- **Environmental Management:** The coal value chain can contribute to environmental management by implementing policies and practices that reduce environmental impact. This includes reducing emissions, managing waste responsibly, and minimising the impact on biodiversity. Removing overburden in mining or storing fuel, by-products, and waste at power plant sites can be practised with care and vigilance to eliminate long-term damage.

Reducing fuel and emissions at coal power plants

Clean coal power can aid SDG 12, which aims to ensure sustainable consumption and production patterns in several ways:

- **Reduced Emissions:** emission control technologies, such as CCS, can significantly reduce the carbon emissions and all other emissions associated with coal from power plants by 80-90%, although 99% is also possible. This contributes to sustainable production by minimising the environmental impact of electricity generation.

- **Efficiency Improvements:** HELE coal power, such as USC improves the efficiency of coal power plants, leading to a 20-40% reduction in emissions compared to old subcritical technology. This means less coal is needed to generate the same amount of electricity, contributing to sustainable consumption.

- **Economic Opportunities:** Developing and deploying clean coal technologies can stimulate economic activity and create jobs. This includes technology development, manufacturing, and plant operation and maintenance jobs.

- **Infrastructure Development:** Developing clean coal power plants often requires significant infrastructure development. This infrastructure can benefit local communities by improving access to services and opening up new economic opportunities through new roads, railways, ports, and businesses that thrive off the new local incomes from energy projects.

Case Study: Adaro Group (Indonesia)

Adaro Energy Inc. (AEI) engages in the integrated coal mining, logistics, and power businesses through its subsidiaries. AEI's waste management practices reflect a commitment to environmental sustainability and regulatory compliance. The company employs a comprehensive approach to handling various types of solid waste, including organic, inorganic, residue, and hazardous materials [43]. Through implementing the Reduce, Reuse, and Recycle (3R) concept, AEI seeks to minimise environmental impact by repurposing organic waste as livestock feed, composting organic matter for fertiliser, and reusing solid waste in operational processes. By leveraging Adaropedia, an online database inventory, AEI ensures efficient tracking and monitoring of waste streams. In contrast, hazardous waste is stored and transferred under applicable laws and regulations, maintaining a clean record devoid of spillages or improper waste disposal practices.

Case Study: Banpu Power (Thailand)

Banpu Power is a leading power-generating company with a balanced portfolio of around 40% coal business. Banpu Power's Zouping Combined Heat and Power (CHP) Plant facility embarked on a pioneering initiative to integrate activated carbons derived from a customer's sugar factory waste, with a heat value of approximately 2300 kcal/kg, with coal for energy production [44]. This strategic blending, maintained within a ratio that preserves the plant's production capacity and adheres to stringent air quality standards, signifies a significant step towards reducing coal dependence and promoting waste reuse.

The initiative allowed for the substitution of 600-1260 tonnes of coal with 2000–4000 tonnes of activated carbons annually, yielding an operational cost reduction of USD 900,000 and contributing to a more sustainable management of industrial waste. Despite a marginal decrease in boiler efficiency by about 0.66%, this project exemplifies Banpu Power's commitment to enhancing sustainability within its operations. By adopting such waste-to-energy practices, Banpu Power addresses waste management challenges in customer industries and demonstrates a viable path towards achieving SDG 12 through innovative and sustainable resource utilisation.

Case Study: Semen Indonesia Group (Indonesia)

Semen Indonesia Group (SIG) is at the forefront of integrating circular economy principles into the construction materials industry, showcasing a profound commitment to SDG 12 through innovative waste management and resource utilisation strategies [45]. SIG significantly reduces environmental impacts and supports sustainable production by converting industrial and municipal waste into alternative fuels and raw materials. Using by-products like bottom ash, fly ash, steel slag, and paper sludge not only diminishes the reliance on virgin resources but also exemplifies the company's dedication to minimising its ecological footprint. With a strategic focus on annually increasing the integration of these alternative resources, SIG's circular economy initiative is instrumental in advancing operational efficiency, promoting environmental stewardship, and driving the cement sector towards more sustainable practices.

Case Study: Tenaga Nasional Berhad (Malaysia)

Tenaga Nasional Berhad (TNB) has developed the TNB Scheduled Waste Roadmap 2018–2030, a strategic initiative to optimise hazardous waste management in alignment with SDG 12. This roadmap embodies a collaborative approach to enhance resource value while minimising environmental harm, setting clear targets for recycling and reducing hazardous waste in line with the Department of Environmental Strategic Engagement Plan 2021–2030 [31]. TNB's commitment to an efficient circular economy is underscored by its rigorous adherence to national regulations and proactive engagement with licensed waste collectors to ensure responsible treatment. By focusing on increasing the recycling rate of key waste types, including fly ash and electronic waste, TNB is leading the way in responsible hazardous waste management, contributing to a sustainable future.

Case Study: San Miguel Corporation (Philippines)

San Miguel Global Power (SMGP) actively contributes to SDG 12 by recycling coal combustion residuals (CCR) and utilising them as a sustainable aggregate material in cement manufacturing [19]. This innovative approach utilises coal ash as a supplementary cementitious material, reducing the need for traditional clinker and significantly lowering greenhouse gas emissions associated with cement production. With high recycling rates of coal ash at the Limay and Malita Power Plants, San Miguel Global Power exemplifies environmental responsibility by efficiently managing CCR. The company's adherence to strict environmental standards and using biomats – a biodegradable natural fibres, such as straw, coir, and jute, to cover the ash and prevent erosion and wind dispersing sentiment. Biomats ensure soil stabilisation and erosion control, demonstrating a commitment to sustainable waste management and environmental protection, paving the way for greener industrial practices.

SDG 13: CLIMATE ACTION



Photo source: Freepik

SDG 13 is a global initiative focused on taking immediate and impactful actions to address climate change and its far-reaching effects. The goal emphasises the importance of international collaboration and commitment to reduce greenhouse gas emissions, enhance resilience, and improve adaptive capabilities to climate-related hazards. The coal industry has a significant role within this framework, especially when it aligns with FutureCoal's Sustainable Coal Stewardship principles. By embracing cleaner production technologies, minimising emissions, and advocating for responsible mining practices, the coal value chain can make a substantial contribution to the realisation of SDG 13:

- **Clean Coal Technologies:** The coal value chain can invest in clean coal technologies that reduce greenhouse gas emissions. This includes technologies for improving efficiency and reducing emissions, such as CCS.
- **Transition to Renewables:** The coal value chain can aid in the transition to renewable energy sources by investing in renewable energy projects or partnering with renewable energy companies.
- **Supply Chain Management:** The coal value chain can manage its supply chains to reduce carbon emissions. This includes working with suppliers to improve their environmental performance.
- **Community Investment:** Coal companies often invest in local communities, supporting education, healthcare, and other social services. This can contribute to improved living standards and economic development.

How can coal power meet SDG13?

"Clean coal" technology refers to various technologies that aim to reduce the environmental impact of coal energy generation. These include CCS, which involves capturing carbon emissions from the industrial stack, typically using a solvent to combine with CO_2, and then separating the CO_2 from the solvent under controlled conditions for transportation by pipeline, truck or ship to facilities capable of piping the gas under pressure into storage rock deep underground.

While these technologies can reduce the environmental impact of coal energy generation, they do not eliminate it. Coal is still a carbon-dense fossil fuel, and burning it releases more CO_2 into the atmosphere than any other fuel. Therefore, while clean coal technologies can contribute to reducing greenhouse gas emissions, they are not a complete solution for achieving the goals of SDG 13, which calls for urgent action to combat climate change and its impacts.

Case Study: Electricity Generating Authority of Thailand – EGAT (Thailand)

EGAT launched the "One-Million-Rai Reforestation for Climate Action," a monumental project dedicated to combating climate change [17]. This ambitious ten-year plan aims to cultivate new forests of over one million rai and sequester 1.2 million tons of CO_2 annually. Through this extensive reforestation effort, EGAT underlines its profound commitment to SDG 13 - Climate Action, setting a benchmark for environmental sustainability and proactive climate stewardship in the energy industry.

Case Study: Adaro Group (Indonesia)

Adaro Energy Inc. (AEI) has committed to mitigating greenhouse gas (GHG) emissions and actively participating in national and global climate change initiatives [43]. Recognising the imperative for transitioning to cleaner energy sources, AEI has embarked on comprehensive plans to bolster business resilience in the face of climate challenges.

Two entities within the Adaro Land segment have secured business permits for carbon sequestration and storage. These initiatives are embodied in PT Alam Sukses Lestari (Barito Lestari Forest Restoration Project-BLFRP), covering approximately 19,520 hectares, and PT Hutan Amanah Lestari (Barito Lestari Peatland Project-BLPP), encompassing roughly 25,804 hectares of the concession area.



Figure 13. Barito Lestari Forest Restoration Project-BLFRP



Photo source: William Bossen

Throughout 2022, these subsidiaries developed a Project Design Document (PDD) to quantify estimated emission reductions or removals from the concession areas. These activities are anticipated to yield an average carbon credit claim of approximately 1.3 million tons of CO_2 equivalent per annum over ten years, with a subsequent increase to 2.4 million tons per annum for the following 30 years and a peak of 2.7 million tons per annum for five years.

AEI is also steadfast in its commitment to low-carbon initiatives and energy transitions. In compliance with the Ministry of Energy and Mineral Resources' regulation No.12/2015, AEI has diligently implemented B30 initiatives across its mining and logistics operations since 2020. Looking ahead, AEI aims to elevate its environmental stewardship efforts by gradually transitioning to B35 and augmenting the utilisation of Fatty Acid Methyl Esters (FAME) in its operations.



Figure 14. AEI Low-carbon initiatives logistics operations.

Case Study: PT Virtue Dragon Nickel Industry (Indonesia)

As Indonesia's largest smelter, PT Virtue Dragon Nickel Industry (VDNI) showcases a profound dedication to environmental sustainability and community engagement through its collaborative tree-planting initiative with the World Association of Indonesian Students (PPI Dunia) in Southeast Sulawesi [46].

In an impactful move to combat climate change, PT VDNI, alongside PPI Dunia, embarked on a mission to plant 1,000 trees within the industrial park in Konawe Regency, Southeast Sulawesi. This initiative is a testament to the company's proactive measures against environmental emissions and improving regional air quality. Through this reforestation effort, PT VDNI demonstrates its commitment to reducing carbon footprints and fostering a healthier planet, embodying the essence of SDG 13 by taking urgent steps towards climate change mitigation and sustainability.



Figure 15. PT VDNI tree-planting initiative

SDG 14:
LIFE BELOW WATER



Photo source: Freepik

Sustainable Development Goal 14 (SDG 14), titled "Life Below Water", aims to "Conserve and sustainably use the oceans, seas and marine resources for sustainable development". The critical targets of SDG 14 that are most relevant to land-based mining and power generation activities can be briefly described as follows [47]:

Reduce Marine Pollution:

By 2025, prevent and significantly reduce marine pollution, particularly from land-based activities, including marine debris, cooling water discharge, land waste, and chemical runoff.

Protect and Restore Ecosystems:

By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, strengthen their resilience, and restore them to achieve healthy and productive oceans.

Conserve Coastal and Marine Areas:

By 2020, conserve at least 10 % of coastal and marine areas, consistent with national and international law and based on the best available scientific information.



Photo source: David Clode

Case Study: PT Cikarang Listrindo Tbk (Indonesia)



Figure 16. Mangrove conservation site and marine tourist destination

PT Cikarang Listrindo is a power company operating 270 MW of coal plant capacity. The plant used Finnish technology capable of burning multiple fuels and mixing coal with biomass in a CFB with emission standards better than the World Bank. It is equipped with ESP and can cofire up to 20% of its fuel with biomass [48].

In the Muara Gembong District of West Java lies Kampung Beting, once renowned for its thriving marine life. However, decades of coastal erosion and land subsidence, driven by mangrove deforestation, threatened the community's livelihood [49]. In response, PT Cikarang Listrindo partnered with local stakeholders in 2019 to revitalise the area into a mangrove conservation site and marine tourist destination. Through collaborative efforts with Kelompok Bahagia Berkarya (KEBAYA), the company has planted 5,000 mangrove trees by 2022, engaging 300 households in sustainable ecosystem management and promoting local tourism. This initiative aims to restore the mangrove ecosystem and uplift the local economy, epitomising SDG 14's commitment to preserving life below water while fostering community prosperity.

Case Study: Tenaga Nasional Berhad (Malaysia)

Tenaga Nasional Berhad (TNB), Malaysia's leading energy provider, is committed to environmental sustainability and promoting biodiversity conservation as part of its corporate responsibility.

One of TNB's initiatives, led by TNB Janamanjung Sdn. Bhd. (TNBJ) involves an annual mangrove planting program to restore coastal ecosystems and support sustainable fisheries in the Mnajung and Kinta areas. Since 2013, TNB has planted over 19,800 mangrove saplings, contributing to protecting coastal environments [50].

Additionally, TNB has championed the preservation of firefly colonies across Malaysia, starting with a successful pilot project in Kampung Kuantan. This initiative has expanded to other locations, promoting regional biodiversity and ecosystem preservation. Through these efforts, TNB demonstrates its commitment to SDG 14: Life Below Water, fostering a healthier marine environment.

Case Study: PT Bintang Samudera Mandiri Lines (Indonesia)

PT. Bintang Samudera Mandiri Lines (BSML) has been established in 2012. The company provides marine shipping and logistics services, particularly coal. In 2022, the Company carried out long-term efforts on biodiversity conservation through ship maintenance, fuel use monitoring, and energy efficiency efforts at the head office with the long-term objective of biodiversity conservation, especially around the operational area [51].



Photo source: Ricky Beren

SDG 15:
LIFE ON LAND



Photo source: Freepik

Sustainable Development Goal 15 (SDG 15) focuses on protecting, restoring, and promoting sustainable use of terrestrial ecosystems, sustainably managing forests, combating desertification, halting and reversing land degradation, and halting biodiversity loss. Mining and coal power companies can practice SDG 15 through various initiatives:

1. **Ecosystem Protection:**
   - Conducting environmental impact assessments to understand and mitigate the effects of their operations on local ecosystems.
   - Implementing measures to protect and restore biodiversity in mining areas, such as creating wildlife corridors and preserving native vegetation.

2. **Sustainable Land Management:**
   - Employing post-mining land rehabilitation strategies to restore ecological functions and enhance land productivity.
   - Reducing land footprint by adopting more efficient mining techniques and reusing mining waste for other purposes.

3. **Combating Desertification:**
   - Engaging in reforestation and afforestation projects to prevent soil erosion and desertification.
   - Supporting sustainable agriculture practices in nearby communities to reduce over-cultivation and overgrazing.

4. **Community Engagement:**
   - Collaborating with local communities and indigenous peoples to ensure their land rights are respected, and their knowledge is incorporated into land management practices.
   - Investing in community-led conservation projects that align with the company's sustainability goals.

5. **Policy and Governance:**
   - Aligning company policies with national and international environmental standards and regulations.
   - Reporting transparently on environmental performance and progress towards SDG 15 targets.

6. **Innovation and Technology:**
   - Investing in research and developing new technologies that minimise land disturbance and rehabilitate ecosystems.
   - Utilising remote sensing and monitoring technologies to track environmental changes and respond promptly.

Photo source: Freepik

Case Study: PT Singlurus Pratama (Indonesia)

One such example is PT Singlurus Pratama, a coal mining company that has proactively taken steps to restore the forest surrounding its mining operations. To address the environmental impact of its activities, the company has implemented a multi-faceted approach to land reclamation and ecosystem restoration. Firstly, PT Singlurus Pratama covered spent coal pits with packed rubble and topsoil to recreate a suitable substrate for establishing vegetation and regenerating the natural landscape [52].

The company then planted two tree species within the rehabilitated areas to re-establish the native vegetation cover and promote the gradual recovery of the local ecosystem. PT Singlurus Pratama created a pond in the heart of the coal mine area. The water body enhanced the aesthetic appeal of the reclaimed landscape and provided a valuable habitat for aquatic flora and fauna, contributing to the region's overall biodiversity.

Case Study: Electricity Generating Authority of Thailand – EGAT (Thailand)

The Electricity Generating Authority of Thailand (EGAT), a cornerstone in Thailand's energy sector, spearheads the Career Development and Income Generation initiative, championing participatory reforestation [17]. With a strategy that involves the financial empowerment of local farmers, EGAT transcends traditional corporate roles by directly engaging with and uplifting communities, thus making a substantial impact on carbon sequestration efforts. This innovative approach seamlessly blends community upliftment with environmental stewardship, showcasing EGAT's commitment to fostering biodiversity and sustainable land management practices in line with SDG 15.

Case Study: PT Cikarang Listrindo Tbk (Indonesia)



Figure 17. Environmental stewardship commitment by planting 300 trees in the Biodiversity Park (Kehati)

PT Cikarang Listrindo reaffirmed its commitment to environmental stewardship by planting 300 trees in the Biodiversity Park (Kehati) Kiara Payung Block 2, located in Sindangsari Village, Sukasari District, Sumedang Regency, West Java [53]. The tree planting initiative, featuring 30 species of productive and endemic plants native to West Java, aimed to safeguard the region's flora and fauna biodiversity, particularly in the upstream Citarum river basin.

In collaboration with the Environmental Services (Dinas Lingkungan Hidup/DLH) of West Java Province, the Company also conducted bird banding activities to enhance the diversity of avian species in the park. Seven bird types from three species, including one protected species, the black hat gourd, were recorded during the event, bringing the total bird species count in Kehati Park to 23. This underscores PT Cikarang Listrindo's commitment to climate action and biodiversity conservation, aligning with Indonesia's Nationally Determined Contributions to SDGs 13 and 15.

Case Study: PT Singlurus Pratama (Indonesia)

PT Singlurus Pratama, a coal mining company in East Kalimantan, Indonesia, endeavoured to reinstate biodiversity and transform degraded landscapes into verdant ecosystems by implementing comprehensive land restoration practices, including soil revitalisation and reforestation [52]. PT Singlurus Pratama involves densely planting two exotic tree species, sengon and acacia, that grow well in degraded soil. These species and cover crops are nitrogen fixers that help replenish the soil's nitrogen content.

This proactive engagement in land rehabilitation is a testament to PT Singlurus Pratama's dedication to minimising the environmental footprint of mining activities. It underlines the crucial role of corporate responsibility in fostering sustainable ecological recovery and land stewardship.

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

SDG 16: PEACE, JUSTICE AND STRONG INSTITUTIONS



Photo source: Freepik

Goal 16 is dedicated to fostering peaceful and inclusive societies, ensuring justice for all, and constructing effective, accountable institutions at every level. It advocates for a world where everyone, regardless of their ethnicity, faith, or sexual orientation, can live without fear of violence and feel safe in their daily lives.

Goal 16 aligns with the broader human rights framework by endorsing societies that respect and uphold individual rights, including privacy, freedom of expression, and access to information. Peace is a crucial prerequisite for social and economic development. Without peace, societies often suffer from conflict, violence, and instability, which can impede progress and lead to the loss of lives and resources. There are several ways the coal value chain can support SDG 16. They include:

- **Social Impact Assessment in the Mining Sector:**

  The mining sector's social impacts can be evaluated using different indicator frameworks. Seventh South-East Asia Multi-Stakeholder Forum: This forum focuses on reinforcing the 2030 Agenda for Sustainable Development and eradicating poverty in Southeast Asia through resilient and innovative solutions, partnerships, investments, and sustainable development commitments.

- **ASEAN 2030:**

  ASEAN aims to establish a Borderless Economic Community, requiring a robust institutional framework and new agencies to govern the markets under the AEC. Managing Mining for Sustainable Development: The UNDP and UN Environment collaborate on managing mining for sustainable development, emphasising the importance of incorporating social, environmental, and economic sustainability into mining practices [54].

South-East Asian countries continue to cooperate and adapt to the increasing sophistication of bribery schemes through increased inter-governmental cooperation. Thailand hosted the 2022 Asia-Pacific Economic Cooperation meeting in June 2022 and has highlighted anti-corruption as one of its main priorities with the current APEC members. Countries in Asia Pacific have taken increasingly proactive steps to improve cooperation with other regional and worldwide enforcement authorities [55].

Photo source: Tingey Injury

Case Study: PT Singlurus Pratama (Indonesia)

In Indonesia, the mining sector is subject to stringent regulations, particularly in the resource-rich province of East Kalimantan, the country's most intensively mined region. By law, mining companies in this area must undertake comprehensive rehabilitation efforts within their mining concessions [52]. These comprehensive rehabilitation initiatives undertaken by PT Singlurus Pratama exemplify the mining industry's commitment to environmental stewardship and compliance with the stringent regulations in East Kalimantan. By actively restoring the land and ecosystems impacted by mining activities, the company demonstrates its dedication to sustainable development and preserving the region's natural resources.

Case Study: Lanna Resources (Thailand)

The Company conducts business responsibly by human rights principles, fair treatment of labourers, safety, and occupational health, including creating a good working environment along with management and development that focuses on providing employees with new knowledge, abilities, and necessary skills, as well as participating in community and social development to create shared values and enhance the quality of life of the community and society for sustainable growth. Become aware of the importance of good corporate governance by adhering to the principles of fairness and integrity, accountability, responsibility, and transparency, promoting equitable treatment, and gaining faith from all shareholders and stakeholders. The Company has declared an intention to be anti-corruption. It has been officially certified as a member of the Thai Private Sector Collective Action Against Corruption (“CAC”), managed by the Thai Institute of Directors Association (“IOD”), since 2015. It has been recertified for the second time until December 31, 2024 [56].

Case Study: Than Quang Hahn – Vietnam

The Company continues to work with trade unions, vocational training institutes and social entities to ensure fair and equitable working and living conditions [57]. Coordinating with experts and unions within the Company to strengthen propaganda work to implement OSH work, implement safety culture in the workplace, and direct departmental Trade Unions to maintain the safety network. Regular student activities ensure and consider requests to pay allowances to 288 ATVSV promptly according to regulations; Organize and encourage timely visits to cases of occupational accidents, illnesses, and joys in the unit. During Workers' Month, the Company's Trade Union rewarded outstanding units and families of workers in difficult circumstances.

17 PARTNERSHIPS FOR THE GOALS

SDG 17: PARTNERSHIPS FOR THE GOALS



Photo source: Freepik

Excellent opportunities exist for coal and power companies to work with the governments of resource-rich, emerging economies to help them develop the capacity to monitor and adequately manage the revenues from the country's resource wealth. These collaborations can provide technical assistance, training and funding support for initiatives that help countries develop efficient and effective tax collection and revenue management frameworks and build the capacity of government staff to implement and enforce such policies and programmes. These efforts contribute to poverty reduction, more vital government institutions, greater transparency and improved rule of law.

Power and coal companies have significant opportunities to collaborate with governments of resource-rich, emerging economies. By assisting these governments in enhancing their capacity to monitor and manage revenues from natural resources, these partnerships can contribute to poverty reduction, more vital institutions, greater transparency, and improved rule of law. Technical assistance, training, and funding support are crucial in developing efficient tax collection and revenue management frameworks [58].



Photo source: Freepik

Case Study: Indonesia Morowali Industrial Park (Indonesia)

Indonesia's foray into transforming nickel into a crucial economic resource perfectly illustrates the core of SDG 17 - Partnerships for the Goals. Indonesia has substantially elevated its nickel industry through a strategic partnership with China under the Belt and Road Initiative, establishing a model for how global collaborations can enhance industrial growth. The Indonesia Morowali Industrial Park (IMIP) in Central Sulawesi, born from this collaboration, is a hallmark of Sino-Indonesian synergy, in line with President Joko Widodo's development plans [59]. Despite encountering local and national challenges, the adaptability of Chinese investors to Indonesia's ever-changing socio-political environment highlights the reciprocal benefits of such partnerships. These collaborations have spurred infrastructure development, technology transfer, and job creation, showcasing the immense potential of international cooperation in reaching economic and development goals.

This partnership boosts Indonesia's capabilities in the nickel sector and promotes compliance with local regulations and practices, presenting a harmonious mix of foreign investment and regional interests. The joint effort has led to a considerable industrial evolution, emphasising the value of flexible strategies that honour and incorporate local contexts. Furthermore, concerted attempts to mitigate environmental and societal issues through corporate social responsibility (CSR) indicate a dedication to sustainable development ethos. As Indonesia aims to bolster its position in the global nickel market, especially concerning electric vehicle batteries, this alliance captures the essence of SDG 17, proving how international collaboration can effectively tackle the complexities of contemporary industrialisation while striving towards a sustainable and just future.

Case Study: PT Huayue Nickel Cobalt (Indonesia)

PT Huayue Nickel Cobalt (HYNC) is the world's largest producer. Based in China, it is an amalgamation of the Qinshan Group and the Luoyang Molybdenum Industry. It established the Indonesian arm to utilise Indonesia's unique laterite nickel resources. The smelter facilities are vital to producing the materials necessary for cathodes used in modern lithium batteries for EVs.

PT HYNC is an Indonesian nickel and Cobalt smelter that uses coal power to produce critical commodities. The Company has launched a joint investment with global nickel and cobalt partners [35]. This collaborative effort not only leverages Indonesia's rich laterite-nickel resources for advanced nickel-cobalt metal smelting but also underscores the importance of international partnerships in achieving sustainable development. The project's emphasis on constructing a responsible supply chain, integrating environmental, social, and governance principles, and its active role in community building through job creation and pandemic prevention efforts highlight the critical role of cross-sectoral and international collaborations in addressing global challenges.

Case Study: PT Virtue Dragon Nickel Industry (Indonesia)

The tree-planting partnership between PT Virtue Dragon Nickel Industry (VDNI) and PPI Dunia illuminates the power of collaboration under SDG 17, showcasing how alliances across sectors can lead to meaningful environmental conservation efforts [46]. This union serves as a beacon of hope, illustrating that significant strides can be made towards achieving sustainability objectives through shared visions and collective actions. The initiative highlights PT VDNI's openness to community ideas and youth engagement in environmental protection. It reinforces the significance of building strong partnerships to advance SDGs on a global scale.

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