The Reliance and Utilization of Coal and Its Effects in Malaysia

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ABSTRACT

This article explores Malaysia's reliance on and use of coal, balancing its economic necessity for power generation against its adverse environmental and public health impacts. Using a doctrinal research methodology, the authors examine how coal functions as a cheap, abundant resource vital for addressing energy poverty, despite being a major driver of global greenhouse gas emissions and climate change. The study outlines Malaysia's legal framework governing mining activities primarily through the Mineral Development Act 1994 and the Environmental Quality Act 1974 and notes that while the nation possesses domestic reserves, it relies heavily on imports to generate approximately 40% of its electricity. Finally, the paper reviews mitigation strategies to reduce environmental degradation. These include international compliance under the Paris Agreement, clean coal technologies like carbon capture and storage (CCS), and transitioning toward renewable energy alternatives such as biomass and waste-to-energy systems.

Keywords: Coal, Energy, Pollution, Sustainability, Legal framework

INTRODUCTION

Coal, which is mostly composed of carbon and hydrocarbons, has a high energy density that is released upon combustion. In many nations, coal is widely used to generate energy. Approximately 40% of the world's primary energy consumption comes from coal, making it the second-most significant energy source globally. Coal has been widely used by developing countries as a primary energy source because it is globally abundant, unlike oil and natural gas. The world's coal reserves are distributed across more than 75 countries in sizable volumes, but more than 75% of them are concentrated in the US, Russia, China, Australia, India, and Germany. The majority of coal is produced and consumed within its region of origin.

Although coal use is widespread, it has significant negative environmental impacts. Ambient air pollution resulting from coal combustion poses a severe risk to the environment. The atmosphere is filled with a complex variety of particles and gaseous byproducts from coal combustion, each possessing unique size, morphology, chemical, physical, and biological properties. Pollutants from power plants expose nearby communities to various health risks. Burning coal, however, is not the only stage that poses a health risk. During extraction, transportation, and handling processes, substantial volumes of coal dust are generated, affecting workers and nearby neighbourhoods through xenobiotic impacts. Several fatal diseases are linked to chronic exposure to airborne contaminants. In an effort to avert dangerous climate change and enhance public health, significant efforts must be made to minimize the use of coal as an energy source. Therefore, it is necessary to implement environmentally friendly coal mining techniques.

Particularly in Malaysia, the Mineral Development Act 1994 sets out the powers of the Federal Government regarding the inspection and regulation of mineral exploration and mining. Major coal reserves in Malaysia are located primarily in Sabah and Sarawak, with smaller reserves in Perak, Perlis, and Selangor. The Labuan

coalfield produced coal from 1848 until 1912. In 2012, the annual production of coal in Malaysia was 2.9 million tonnes. However, the government of Malaysia has initiated research for agricultural and aquacultural development on former mining lands. Some restored mining areas have also been converted into public parks or tourist attractions, such as the Titiwangsa Lake Gardens and Sunway Lagoon. Therefore, given the severity of coal mining activities affecting public health both societally and individually, this study examines Malaysia's reliance on coal mining alongside its positive and negative impacts on residents.

Nearly 93% of electricity in Peninsular Malaysia is generated using coal and natural gas. Malaysia has remained active in coal mining, with 2021 statistics indicating that primary coal production exceeded 3,000 short tons, growing at an average annual rate of 10.94%. Therefore, this research aims to study the reliance on and utilization of coal as a primary energy source in Malaysia. Given that coal is known to be hazardous, the question arises as to why Malaysia continues to rely on it. A doctrinal research methodology is adopted to guide this study.

RESEARCH METHODOLOGY

This study adopts a doctrinal research methodology, which focuses on analyzing various legal documents and academic articles related to the topic. The rationale behind this method is to evaluate the extent of coal reliance and assess how current laws govern these activities. The primary limitation of this methodology is the scarcity of available literature. Currently, there is no alternative energy source that can replace coal efficiently while simultaneously mitigating its negative environmental impacts on living organisms.

LITERATURE REVIEW

Energy Justice

Energy poverty

Coal is known to be one of the cheapest fuel resources for power generators in Malaysia, supplying electricity throughout the country. Electricity is now a fundamental necessity in human daily life; modern society cannot function without it, especially considering the internet and virtual communication. This raises the issue of whether coal is excessively dangerous to humans. Although numerous studies show that coal is hazardous, many countries remain dependent on it for power generation because it is cheap and widely available. Consequently, coal cannot be viewed as entirely detrimental, as impoverished populations rely solely on it for affordable and accessible electricity. In addition, coal is relatively simple to transport and store. Therefore, for the poor, utilizing coal is necessary to sustain daily life, often overshadowing concerns about the pollution generated by its combustion.

According to Jeremy Bentham (1789), determining whether an action is right or wrong depends on the extent to which it increases or decreases human well-being or utility. In this context, utilizing coal maximizes societal happiness because it remains affordable and accessible to the poor. Although critics argue that coal causes severe harm as the dirtiest fossil fuel responsible for over 0.3°C of the 1°C increase in global average temperatures. Bentham's framework suggests it is just for the poor to utilize coal if it is their only viable option to generate electricity and sustain their well-being.

Moreover, according to John Rawls' (1971) distributive paradigm, dependency on coal is closely linked to energy poverty. Energy poverty significantly diminishes the quality of life for impoverished communities. Applying Rawls' theory, the poor lack the financial capacity to afford alternative clean energy sources. Without coal, their quality of life would deteriorate significantly, as energy scarcity impedes agricultural and manufacturing development. Therefore, the government must provide solutions to overcome this problem, either by introducing clean, environmentally safe alternative energy sources or, if coal remains irreplaceable, by distributing energy resources fairly to achieve energy justice.

Climate Change

Climate change generally refers to long-term shifts in global temperatures and weather patterns. These shifts can be natural, occurring through variations in the solar cycle. Evaluating Peter Singer's perspective on energy justice

(as cited in Vernon, 2011), utilitarianism has historically struggled to address the challenges of climate change effectively compared to traditional ethical frameworks. Two main factors make climate change a challenge for utilitarian ethics. First, reducing global carbon output is intrinsically tied to a rising human population. In the context of Malaysia's coal mining industry, despite escalating concerns over climate change and public health, mining activities persist due to the essential role coal plays in meeting human electrical demands. As population grows, mitigating climate change becomes increasingly complex because individuals prioritize short-term personal benefits over long-term environmental protection, leading to slow policy responses based primarily on future climate predictions.

Consequently, long-term climate concerns are often marginalized by immediate human preferences. This relates to the second consideration: the preferences of both current and future generations. As previously discussed, public confidence remains low regarding future generations' commitment to environmental preservation; future societies may prioritize the immediate consumption of digital and virtual experiences over the physical state of the Earth. To understand this philosophical conflict, one must acknowledge that coal is the cheapest fuel resource for power generation in Malaysia. Because electricity underpins critical infrastructure like the internet, individuals often prioritize virtual convenience over global climate stability for short-term gains (as cited in Vernon, 2011).

DISCUSSION

Utilization of Coal and Legal Framework in Malaysia

In Malaysia, the Mineral Development Act 1994 grants discretionary powers to the Federal Government to inspect and regulate mineral exploration and mining, including coal. This Act governs prospecting licenses, mining leases, and related certificates within state legislative boundaries. Furthermore, ten out of thirteen Malaysian states have adopted the Model State Mineral Enactment without significant amendments to unify their respective state mining legislation. The three states that have not adopted the Model State Mineral Enactment are Perlis, Sabah, and Sarawak.

Section 63 of the Mineral Development Act 1994 empowers the Minister to formulate regulations to enforce the Act. Under this authority, seven regulations have been established by the Ministry of Natural Resources and Environment: the Mineral Development (Operational Mining Scheme, Plans and Record Books) Regulations 2007, the Mineral Development (Blasting) Regulations 2013, the Mineral Development (Safety in Exploration and Surface Mining) Regulations 2014, the Mineral Development (Licensing) Regulations 2016, the Mineral Development (Effluent) Regulations 2016, the Mineral Development (Statistical Return) Regulations 2019, and the Mineral Development (Compounding of Offences) Regulations 2019. Additionally, the Act provides seven types of mineral tenement licenses: fossicking, dulang, individual mining, prospecting, exploration, proprietary mining, and mining leases.

The Environmental Quality Act 1974 requires mining operators to comply with environmental safety and health standards. Mining operations fall within the limitations of the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015. Mining activities are permitted only after receiving an official approval letter from the Department of Environment following the submission of a comprehensive Environmental Impact Assessment (EIA) report.

The Effects of Coal Utilization in Malaysia

The mining and combustion of thermal coal have detrimental effects on human health and well-being, necessitating a transition away from fossil fuels. Coal utilization impedes basic human rights, including the right to a safe, clean, and sustainable environment, the right to life, the right to health, and the rights of children and indigenous communities. Coal-generated energy is the largest single source of global greenhouse gas emissions (carbon dioxide and methane), a primary driver of ambient air pollution that causes millions of deaths annually, and a major source of toxic water contamination. According to the United Nations Environment Programme's 2018 Global Mercury Assessment, stationary coal combustion accounts for 21% of the 2,220 tonnes of global

anthropogenic mercury emissions annually. Furthermore, coal combustion produces toxic fly ash, which contaminates local water tables and exposes fence-line communities to hazardous pollutants.

Coal combustion accounts for 46% of global CO2 emissions and 72% of total greenhouse gas emissions within the energy sector. Amid the current climate emergency, nations must fulfill their commitments to limit global temperature increases to 1.5°C above pre-industrial levels; current temperatures have already risen by 1°C. Given the availability of affordable renewable energy alternatives, continued reliance on coal is increasingly untenable. Even with technological advancements, coal-fired power generation remains inefficient. Reports indicate that Malaysia requires flexible energy architectures to prevent waste rather than legacy 'dinosaur' plants. Currently, Malaysia imports up to 98% of the coal required to generate roughly 40% of its electricity. In 2018, the country ranked as the eighth largest global importer of coal briquettes and the twelfth largest importer of bituminous coal.

Although renewable energy alternatives are competitive with oil and gas, Malaysia's existing coal plants continue to operate normally due to the low cost of fuel. However, the externalities associated with coal combustion such as environmental degradation and public health costs, are not fully internalized into domestic electricity pricing. If the government fails to reassess its current energy architecture, the nation faces a carbon lock-in that will extend emissions trajectories for decades, potentially violating its obligations under the Paris Agreement. This carbon lock-in exposes the local population to severe climate risks. While energy security remains vital for Malaysia, it must not be pursued at the expense of escalating climate dangers, particularly when safer renewable alternatives are accessible.

Energy policy dictates whether state interventions or market forces should regulate key economic sectors. In Malaysia, energy policy increasingly emphasizes environmental conservation, with the government introducing initiatives to support green energy producers and consumers. For instance, the government encouraged Independent Power Producers (IPPs) to source coal from third-party suppliers rather than relying exclusively on Tenaga Nasional Bhd (TNB) under existing Power Purchase Agreements (PPAs). This measure aimed to secure cheaper fuel and generate cost savings during the first half of 2021. Moving forward, the Energy Commission aims to propose supplementary agreements enabling IPPs to procure coal and natural gas independently.

Reliance On Coal

History of Coal Mining in Malaysia

Malaysia utilizes a diverse energy mix comprising natural gas, oil, coal, and hydropower, with coal infrastructure heavily managed by Tenaga Nasional Berhad (TNB). Historical data indicates that 98% of the country's coal reserves are located in Sabah and Sarawak on the island of Borneo, while the remaining 2% are situated in Peninsular Malaysia. Domestically, coal was extracted from the Batu Arang coalfield in Peninsular Malaysia between 1915 and 1960. The nation's first commercial mine opened in 1851 in Labuan, Sabah, producing between 0.5 and 1.5 million tonnes of coal for local consumption. In Sarawak, two primary mines collectively produced approximately 1 million tonnes of coal before operations at the Silantek mine ceased in 1991. Total indigenous coal reserves are currently estimated at 1,938.4 million tonnes.

While domestic production historical volumes are notable, they remain insufficient to meet total power generation demands, necessitating substantial coal imports. Consequently, Malaysia is unlikely to become a major coal exporter. Although records from July 2009 indicate that the Andhra Pradesh Power Generation Corporation Ltd (ApGenco) in India contracted to purchase 0.5 Mt of Malaysian coal between August and October 2009 at an estimated price of 112 $/t, these exports represent isolated commercial agreements. ApGenco primarily secures low-energy coal from Indonesia under fixed short-term contracts to feed its power plants directly.

Coal Production and the Extent of Malaysia's Reliance

In 2020, approximately 66% of the electricity generated by TNB in Peninsular Malaysia was derived from imported coal. Institutional research highlights that coal's abundant global supply and low, stable pricing drive

this reliance. TNB plans to import an estimated 374 million metric tonnes of coal, valued at RM150 billion, through 2030. Although domestic reserves exist in Kapit and Mukah (Sarawak) and Maliau (Sabah), high extraction costs and inadequate infrastructure in interior regions make importing coal from Indonesia, Australia, China, and South Africa more economically viable.

According to Worldometer data from 2016, Malaysia holds 198 million short tons (MMst) of proven coal reserves, ranking 53rd globally and accounting for a fraction of the world's total reserves. These proven reserves equal roughly six years of domestic consumption at current levels. Annually, Malaysia produces approximately 2.66 million short tons while consuming over 33 million short tons, ranking 24th globally in coal consumption. Per capita, this translates to substantial annual energy consumption driven by a growing population.

Globally, coal accounts for 38% of electricity generation, but Malaysia's reliance is significantly higher; in 2017, coal comprised 50.6% of the national power generation fuel mix. This marks a major shift from 1997, when coal contributed only 7.4% of national electricity generation, and natural gas dominated the market at 63.4%.

FINDINGS

Ways To Reduce The Environmental Effects Of Coal Mining

The Paris Agreement

The Paris Agreement is a legally binding international treaty on climate change adopted in 2015, addressing climate change mitigation, adaptation, and finance. The coal sector increasingly relies on Carbon Capture and Storage (CCS) technologies to withstand global decarbonization pressures and maintain fossil fuels within the energy mix. Industry leaders suggest that these technologies are vital to fulfilling Paris Agreement targets while keeping coal assets relevant as governments accelerate emission reduction efforts to improve urban air quality.

The Paris Agreement requires the global community to reduce greenhouse gas emissions rapidly to limit global warming to 1.5°C above pre-industrial levels, preventing severe climate impacts. The framework mandates the deployment of mitigation options, including CCS, to sequester emissions underground or utilize them in industrial processes. Recent studies indicate that compliance with the Paris Agreement accelerates divestment from fossil fuels, signaling to markets that policymakers are committed to deep carbon reductions through credible, long-term policy mechanisms.

Mitigation Alternatives

Regulatory frameworks like the Clean Air Act and Clean Water Act mandate that industries minimize air and water pollution. The coal industry utilizes several methods to reduce sulfur and particulate contaminants, including implementing more efficient mining and washing techniques alongside adopting low-sulfur coal blends.

Power plants install Flue Gas Desulfurization (FGD) systems, commonly known as scrubbers, to remove sulfur dioxide from flue gases before they exit smokestacks. Collaborative research between the public sector and the coal industry focuses on developing clean coal technologies to enhance combustion efficiency, thereby reducing the volume of coal required per unit of electricity generated. Furthermore, specific coal grades can be treated to lower mercury emissions using co-benefit effects from existing SO2, NOx, and particulate control devices. Ongoing research aims to optimize dedicated mercury control systems for coal-fired power utilities.

To address carbon dioxide emissions, carbon capture technologies isolate CO2 from flue gas streams into a concentrated form. Once captured, the CO2 can be injected into deep geological formations for long-term storage and permanent sequestration. The environmental impacts of coal production can also be mitigated through recycling and repurposing. Former mining lands can be reclaimed for public infrastructure, such as landfills or regional airports. Additionally, byproducts from scrubber operations are recycled to manufacture commercial cement and synthetic gypsum for wallboards.

Renewable Energy Transition

The U.S. Department of Energy defines renewable energy as energy derived from regenerative resources that cannot be depleted through practical use. Biomass, municipal solid waste (MSW), solar, wind, geothermal, and hydropower represent the primary pillars of renewable energy infrastructure. Legacy coal plants are increasingly evaluated for conversion to natural gas or biomass fuels. While conversion costs remain high, utilities can leverage existing grid transmission lines, water access, and physical plant structures, making fuel switching highly competitive compared to installing advanced emission control systems on aging coal infrastructure.

Converting coal utilities to biomass is gaining traction as a rapid mitigation strategy. Biomass fuels contain negligible sulfur and mercury levels, reducing maintenance costs and avoiding expensive pollution control upgrades. Additionally, biomass can often be sourced locally, generating regional employment opportunities. Because the CO2 released during biomass combustion is offset by the carbon absorbed during crop regrowth, the process is considered carbon-neutral. Globally, impoverished populations still rely heavily on traditional biomass to meet basic energy demands due to a lack of modern infrastructure.

In the context of waste-to-energy, hazardous industrial industrial coal byproducts like fly ash, gypsum, and slag can be beneficially reused. For example, coal ash serves as a critical raw material in producing high-strength concrete and wallboards. Similarly, Municipal Solid Waste (MSW) diversion strategies convert non-hazardous refuse into electricity, mitigating landfill pollution, preventing groundwater contamination, and protecting downstream water resources.

CONCLUSION

Overall, Malaysia remains highly reliant on coal to satisfy its national electrical demands. This reliance is sustained through a combination of domestic extraction in East Malaysia and heavy institutional importation, making coal a cornerstone of the national mineral and energy economy. Historical data reveals over a century of continuous coal use, and contemporary demand remains robust. Balancing this reliance against the adverse effects of climate change and energy poverty is critical. In response, the Malaysian government has implemented comprehensive legal frameworks including Acts, Regulations, and statutory Orders to regulate extraction and manage environmental externalities. Although current coal utilization has not plunged the nation into an immediate climate emergency, the government continues to prioritize environmental conservation. Through compliance with the Paris Agreement and the adoption of alternative clean energy technologies, Malaysia is actively working to mitigate environmental degradation before emissions trajectories escalate further.

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