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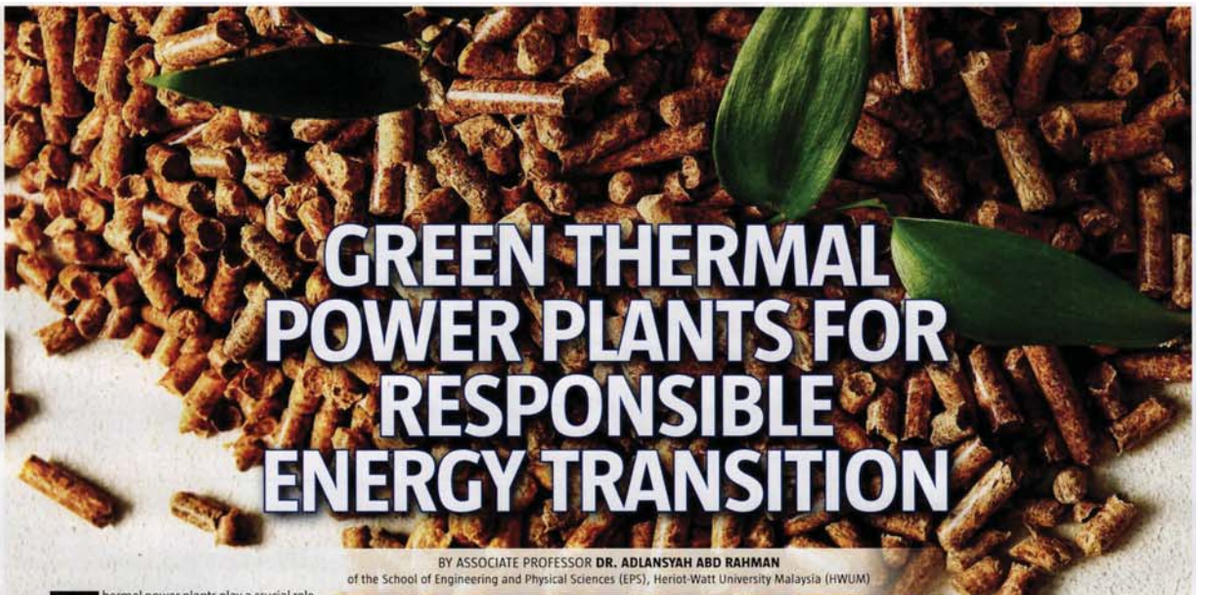

GREEN THERMAL POWER PLANTS FOR RESPONSIBLE ENERGY TRANSITION

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Thermal power plants play a crucial role in supplying the essential baseload power needed to ensure the security of our energy supply and the uninterrupted flow of economic activities. However, renewable energy sources like Solar Photovoltaic (Solar PV) and hydropower are deemed unable to fully compensate for the gap left by thermal power plants. This shortfall poses a challenge to maintaining equitable and accessible electricity services for the public.

Nonetheless, opportunities abound in the near future within the growing bioenergy sector as a renewable fuel source for the nation to achieve net zero by 2050.

As part of the global collective effort to address climate change and its impacts, Malaysia is among the many countries aspiring to achieve net-zero greenhouse gas (GHG) emissions by 2050. Recognising that the energy sector is the largest contributor to GHG emissions, significant focus is directed toward it.

In 2023, the Malaysian Government launched the National Energy Transition Roadmap (NETR) and established the Ministry of Energy Transition and Water Transformation (PETRA), formerly known as the Ministry of Energy Transition and Public Utilities, demonstrating a commitment to a more sustainable and resilient future.

The NETR outlines 10 flagship projects that encompass six energy transition levers: energy efficiency (EE), renewable energy (RE), hydrogen, bioenergy, green mobility, and carbon capture, utilisation, and storage (CCUS).

According to the National Energy Policy 2022-2040, the energy sector accounted for approximately 29 percent of Malaysia's GDP and employed 25% of the total workforce. Given these significant contributions, any major structural shift in the energy systems will not only impact the nation's income and economic growth but also affect the livelihoods of its people who rely on secure and affordable energy. Therefore, the energy transition must occur in a just and responsible manner, aiming for an equitable net-zero status that is fair and inclusive for all.

Currently, the nation's total primary energy supply (TPES) comprises approximately 42% natural gas, with oil and coal each contributing 27%, and renewable sources (including hydropower, solar, and bioenergy) making up 4%. By the year 2050, the net-zero emission target sets TPES from natural gas at 56%, followed by renewables at 23%, with the remaining 21% from oil products and new energy sources, and a complete phase-out of coal. This represents a significant transition, particularly given the current reliance on coal power for over 46% of electricity generation, and further compounded by the projected 7% growth in electricity demand by 2050.

We've witnessed significant growth in RE capacity over the past decade, largely due to various government initiatives and incentives. These measures have accelerated installations, particularly benefiting solar photovoltaic (PV) through programmes such as feed-in-tariff (FiT), self-consumption (SELCO), net energy metering (NEM), large-scale solar schemes (LSSPV), and the recent Solar for Rakyat Incentive Scheme (SolaRIS). As a result, operational solar PV capacity reached 1,700 MW by the end of 2023, accounting for almost 4% of the national total installed power. Hydropower follows at 6%, with a total capacity of 2,170 MW. In comparison, coal and natural gas power plants boast installed capacities of 12,000 MW and 13,800 MW respectively. Fully replacing the soon-to-be-phased-out coal power plants with RE by 2050 is unlikely, prompting the National Energy Transition Roadmap (NETR) to recognise natural gas as a partial solution for this task.

Malaysia is estimated to possess the potential for 269 GW of solar PV and 29 GW of hydropower capacities. However, harnessing most of this energy is deemed impractical and costly. A major concern lies in the capacity factor, representing the actual power generation against the installed capacity for a power plant. Under optimal conditions, only 3 to 4 hours of full solar capacity are available per day for electricity conversion, compared to a thermal power plant operating over 90% of the time annually. Consequently, solely based on capacity, replacing a decommissioned thermal power plant would require 6 to 7 times the plant up size. This in turn would require vast swathes of land, effectively locking it from future use throughout the project's lifespan. Hydropower exhibits a better capacity factor at approximately 60%, though still significantly lower than an equivalent coal power plant.

Another major concern is the availability and intermittency of renewable energy (RE). Solar PV is not only limited by daylight hours, but also particularly susceptible to weather conditions or any shading on the panels, affecting its reliability. Similarly, hydropower plants face limitations when reservoir storage levels become too low, rendering them unable to provide sufficient energy. Conversely, during periods of excess power generation, typically during times of low demand, adjustments must be made to reduce the output of some thermal power plants to safeguard the integrity of the national grid.

> "Greening of existing thermal power plants would significantly reduce new plant up costs by leveraging on the readily installed infrastructure such as grid interconnection, access roads, and fuel storage and handling."
> — Dr. Adlansyah

This highlights the significant role that thermal power plants continue to play in the ongoing energy transition. Thermal power plants are essential in a net zero future to provide secure energy due to its reliability and availability of fuel sources. Furthermore, greening of existing thermal power plants would significantly reduce new plant up costs by leveraging on the readily installed infrastructure such as grid interconnection, access roads, and fuel storage and handling.

Bioenergy and hydrogen, serving as potential green replacement fuels for thermal power plants, offer promising alternatives, capitalising on their higher capacity factors. While uncertainties persist regarding their readiness for large-scale deployment, bioenergy appears to be the more competitive option, given the substantial existing biomass resources in the country, estimated at 63.5 million tonnes of oil equivalent (mtoe). Biomass, especially those derived from commodity and agricultural residues, is a continuously renewable resource that is available to be used as fuel. Hence, efforts are underway to pave the path for the next phase of RE growth through large-scale bioenergy projects. Highlighted in the NETR, flagship projects like Biomass Clustering by various government agencies and Biomass Co-firing at Malakoff's Tanjung Bin Power Plant, one of the driving champions alongside the Ministry of Plantation and Commodities (KPK) are expected to serve as catalysts for creating demand for biomass and achieving the target of 1.4 GW bioenergy capacity by 2050.

Despite its abundance, biomass is unevenly distributed across the nation and requires several preprocessing steps, while also falling under the jurisdiction of various ministries. To address these challenges, the National Biomass Action Plan 2023-2030 (NBAP) was launched in December last year. Its primary objective is to ensure the availability of locally sourced biomass feedstock sustainably while promoting socioeconomic development. The NBAP has delineated 17 key strategies across five policy thrusts: sustainability, productivity, value creation, market development, and inclusiveness. Active involvement from government agencies, industry players, and academia is anticipated to unlock the vast potential of this largely untapped resource.