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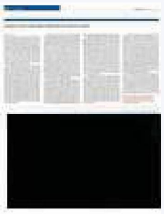

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From Resource Abundance to a Structured Energy Transition

The Edge, Malaysia

Unlocking Bioenergy Clustering Potential in Peninsular Malaysia:

From Resource Abundance to a Structured Energy Transition

Bioenergy's Strategic Moment

Bioenergy has long been recognised as a cornerstone of Malaysia's renewable energy landscape. While it is not a dominant contributor to the national energy mix today, bioenergy plays a critical supporting role across electricity generation, industrial heat applications and selected transport use. Malaysia's comparative advantage lies in its biomass resources. Blessed with an extensive palm oil ecosystem, the country possesses one of the world's richest sources of biomass, placing bioenergy in a unique position to support energy security, decarbonisation and the circular economy—while leveraging existing industrial infrastructure rather than creating new land pressures.

This strategic advantage is reflected in our national energy policy. Under the National Energy Transition Roadmap (NETR), bioenergy is identified as one of six energy transition levers. Among the flagship initiatives, bioenergy clustering, particularly involving palm oil mills (POMs), stands out as a pragmatic and scalable approach to unlock untapped resources such as excess Empty Fruit Bunches (EFB) and biogas from Palm Oil Mill Effluent (POME).

From National Vision to Ground Reality

To translate national ambitions into implementable solutions, SEDA Malaysia undertook the Study on Bioenergy Clustering Potential in Peninsular Malaysia.

> ***The objective was clear:***
> ***move beyond theoretical potential and identify investment-ready pathways that align policy aspirations with on-the-ground realities.***
>
> said Dato' Hamzah Bin Hussin, CEO of SEDA Malaysia.

Malaysia's palm oil sector generates an estimated 155 million tonnes of biomass annually, accounting for over 85 percent of the nation's total biomass resources. While EFB is often cited as abundant, its use for energy generation faces competition from established and emerging markets such as pulp and paper manufacturing, fibre products, composting and other bio-based materials. As such, EFB availability for power generation must be assessed in the context of existing market demand and value chains.

Similarly, POME-derived biogas is a proven and reliable renewable energy source, a significant portion of this potential remains untapped due to technical, economic and implementation constraints at the mill level. Much of this resource is still underutilised or is channelled into low-value applications, underscoring the need for a more structured and systemic approach, one that bioenergy clustering is designed to address.

By
Dato' Hamzah Bin Hussin
Chief Executive Officer (CEO) of Sustainable Energy Development Authority (SEDA) Malaysia

Why Clustering Change the Game

Bioenergy clustering offers a shift from isolated, mill-level solutions to coordinated, regional energy development. By aggregating biomass resources from neighbouring mills, it improves economies of scale, reduces logistical and operational risks, and enhances project bankability—an essential factor in attracting private investment.

Clustering also provides a practical platform to assess the commercial viability of electricity generation from EFB and POME, taking into account competing feedstock markets, technology configurations and cost structures. The study therefore serves as an evidence base to evaluate existing policy instruments, including the Feed-in Tariff (FiT) framework, and to assess whether a review of FiT 2.0 is warranted.

More importantly, clustering enables bioenergy to contribute meaningfully to NETR and Malaysia Renewable Energy Roadmap (MyRER) targets by transforming agricultural by-products into reliable source of clean power, while strengthening rural energy resilience.

A Rigorous, Data-Driven Study

The study was guided by three core objectives: increasing bioenergy capacity through targeted policy and support mechanisms, assessing the technical and economic viability of exporting excess bioenergy from existing palm oil mills to the grid, and promoting environmental sustainability, including emissions reduction and improved waste management.

To ensure robust and credible outcomes, the study combined national-level screening with field engagement and detailed assessment. From an initial pool of 240 licensed palm oil mills, 100 were shortlisted for in-depth analysis across Peninsular Malaysia.

Insights from the Ground

Field visits to 106 palm oil mills provided valuable insights from mill owners, engineers and operators, revealing both opportunities and gaps in current bioenergy utilization.

For biomass, an estimated 24 percent of EFB remains available as excess feedstock, with potential for energy applications, subject to market competition as well as logistical and operational considerations.

For biogas, while 48 percent of POME-derived biogas is already utilised for grid-connected power under the Feed-in Tariff (FiT) mechanism, an estimated 36 percent is still flared or released via open ponds—representing both lost energy value and avoidable environmental impact.

Encouragingly, awareness of emerging bioenergy business models is increasing. Many mills expressed interest in power export opportunities, particularly under simplified, lower-capital-expenditure configurations.

Business Models That Fit Diverse Realities

The study evaluated four bioenergy plant configurations reflecting differences in mill size, feedstock availability and grid proximity. These include large-scale centralised biomass plants, integrated mill-biomass facilities, small-scale power-exporting mills, and POME-based biogas plants with carbon credit monetisation potential.

Beyond electricity generation, these models support structured EFB and POME management, helping palm oil millers address feedstock handling, effluent treatment, logistics and market uncertainty. Each model offers distinct advantages, reinforcing the need for flexibility rather than a one-size-fits-all approach.

Eight Clusters, One Strategic Direction

Based on technical and economic viability, eight bioenergy clusters were identified across Peninsular Malaysia, involving 72 mills as potential feedstock suppliers. The clusters—Kota Tinggi, Kulai, Bahau, Jerantut, Cheneh Baru, Kemaman, Teluk Intan, and Nibong Tebal—demonstrate strong alignment between biomass availability, grid access and project readiness, illustrating how both biomass and biogas resources can be translated into bankable electricity generation opportunities.

A Catalyst for the Energy Transition

"Bioenergy clustering is more than a technical solution; it is a strategic enabler of Malaysia's energy transition. By converting agricultural waste into clean electricity, it supports renewable energy expansion without additional land use, reduces emissions in the palm oil sector, creates rural economic opportunities and strengthens ESG performance.

"With the right policy signals, including targeted incentives and appropriate review of support mechanisms, and sustained industry collaboration, bioenergy clustering can move Malaysia decisively from resource abundance to a structured, bankable and impactful energy transition—one that delivers both economic and environmental dividends," Dato Hamzah concluded.

Dato' Hamzah Bin Hussin is the CEO of SEDA Malaysia.