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Fuel diversification critical to future proof Malaysia's electricity supply

The Malaysian Reserve, Malaysia



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Shifting to secure, balanced energy mix takes time and demands political will, long-term planning and consistent action

by AKMAR ANNUAR

AS MALAYSIA eyes a low-carbon future, energy experts are warning that the country's heavy dependence on a few fuel types – particularly gas and coal – could leave the national grid increasingly vulnerable to disruptions.

The ultimate solution? A bold, diversified energy mix that blends traditional fuels with renewables, distributed power generation and even nuclear power.

While that might sound like a lot of jargon, the takeaway is simple: If we want our lights to stay on, our bills to stay low and our environment to stay livable, we need more than just one or two types of fuel powering our lives.

Heriot-Watt University Malaysia's School of Engineering and Physical Sciences Assoc Prof Dr Adriansyah Abd Rahman explained that fuel diversification is no longer a trendy, catchphrase, but an essential strategy to ensure Malaysia's energy security and long-term sustainability.

"Our electricity generation is still almost 50% coal-based, which guarantees affordable base-load power, but we cannot keep relying on it forever," he told *The Malaysian Reserve* (TMR).

He explained that while coal power stations are effective in ensuring constant supply of electricity, they are also the biggest contributor of greenhouse gas emissions.

"However, we must not do this transition too abruptly. We need proper replacements of thermal power such as biomass, which is still underutilised," he added.

The Dangers of Putting All Your Eggs in One Socket
Malaysia's current power grid is like an old strip where most of the plugs go into the same outlet: Gas.

According to Prof Ahmad Farid Abidin@Bahru, the Dean for the Faculty of Electrical Engineering, Universiti Teknologi MARA (UiTM) Shah Alam, gas currently makes up about 40% of the fuels used for electricity generation, and projections show it may rise to 70% by 2040 or 2050 if nothing changes.

"That is a huge risk. If there is a disruption in gas supply – say, a pipeline rupture or global price shock – our whole power grid will be exposed to limited power supplies. We have already seen small-scale shutdowns when this happened recently," he said to TMR.

Despite existing policies encouraging fuel diversification dating back to the early 2000s, implementation remains slow. Ahmad Farid believes part of the problem lies in a lack of financial incentives and effective long-term planning.

At the moment, it is still cheaper and easier to stick with coal or gas. Therefore, the government needs to step in with tax exemptions, special tariffs or subsidies to encourage industry players and independent power producers to invest in alternative fuels.

On the other hand, coal has kept the country's homes, factories and offices humming for decades. It is cheap, can be reliably stored for months, and does not rely on vulnerable supply routes like pipelines.



Our electricity generation is still almost 50% coal-based, says Adriansyah



According to Ahmad Farid, biomass is flexible and an untapped goldmine

Ahmad Farid described it as a paradox. He said while coal is stable and reliable, its utilisation for power generation goes against the nation's ambition of achieving net-zero carbon emissions by 2050.

Both experts agreed that Malaysia's plan to shift away from coal must be handled carefully. Rushing the process could lead to blackouts or skyrocketing costs, but delaying it too long puts the environment and future generations at risk.

A middle ground could lie in "clean coal" technologies which would reduce the emissions from the coal power plants. Some of the modern plants have incorporated these technologies such as low NOx burners, electrostatic precipitators, bag filters and flue gas desulfurisation.

Others like carbon capture system involve high capital investment cost and utilise high parasitic power. Meanwhile, an option that would likely be applicable to local coal plants is cofiring with low carbon fuels – where coal is burned alongside biomass like palm waste or wood chips, reducing the overall emissions output.

"Cofiring is suitable since the local palm oil industry produces abundant amount of waste that can be harnessed as valuable fuel for power generation," said Adriansyah.

"We can start small – with 5% biomass substitution, gradually increasing the cofiring percentage, and eventually replace coal entirely."

A recent example of fuel diversification in action can be seen at the Tanjung Bin Power Plant in Pontian, Johor – one of Malaysia's largest coal-fired facilities, with a capacity of 2,100 megawatts (MW). Since late 2022, the plant has begun integrating biomass into its operations through a cofiring approach. Starting with a modest 0.5% blend, the project has since scaled up to 2% and aims to reach 15% by 2027.

Rather than focusing solely on emissions reductions, the initiative demonstrates how cofiring can strengthen energy security by reducing reliance on both coal and gas. By introducing a third fuel stream – sourced from local agricultural waste like palm residues or wood biomass – the plant can diversify its feedstock without compromising generation stability. This helps ensure continuous power supply, especially in times of fossil fuel supply disruptions or price volatility.

Adriansyah noted that developing a robust and scalable supply chain for local biomass is

essential to expand such efforts nationally. With the right policies, logistical support and incentives, he said, biomass cofiring could become a viable and secure component of Malaysia's energy mix – enhancing grid resilience while supporting local industry.

Energy is Personal: From Rooftop Solar to Backyard Grids

The conversation about Malaysia's future energy is not just for engineers or policymakers. It affects everyone who flips a light switch or charges their phone.

Ahmad Farid champions the idea of a decentralised grid, where energy does not just come from massive plants in distant industrial zones, but also from small-scale, local sources.

"Imagine a future where your neighbourhood has its own solar panels, your university campus has its own mini hydro system and your home has battery storage to keep things running during outages," he said.

This model, known as distributed generation, is already in use in countries like Germany and Spain.

Even in rural Spain – despite its highly developed national grid and technical expertise – blackouts have occurred, highlighting the risks of over-reliance on centralised systems. This, he said, underscores the importance of distributed generation (DG), which decentralises electricity supply and reduces the impact of disruptions in any one location. Malaysia, he said, can learn from that.

"We have seen what happens when the system is too centralised. A hiccup in one place affects everyone. With distributed energy resources, the energy system no longer relies solely on the transmission grid, thereby reducing the risk of major outages."

The DG component, which consists of shared renewable energy resources such as solar arrays, battery storage systems or neighbourhood-scale microgrids, proves to be clean in terms of environmental perspective, collectively improves energy resilience, ensures more stable power during outages and offers financial savings for residents.

One example is the smart homes in Kajang, Selangor, equipped with solar photovoltaic (PV) panels that sell excess electricity back to Tenaga Nasional Bhd (TNB) under the Net Energy Metering (NEM) scheme, allowing homeowners to earn credits on their electricity bills.

In addition to environmental benefits, these systems provide

a smarter and more sustainable approach to energy management – particularly during planned maintenance or supply disruptions, when local generation can continue to power homes without interruption.

Beyond being green, both Ahmad Farid and Adriansyah said, it's also about being smart and financially savvy. In areas equipped with DG, scheduled maintenance by TNB would have less impact on residents because part of their electricity is locally generated and managed.

Biomass and Micro-hydro, the Hidden Powerhouse

While solar and hydro get the spotlight, experts said biomass could quietly play a starring role in Malaysia's transition. Biomass includes organic waste from agriculture, such as palm oil residues, coconut husks or even food waste.

Ahmad Farid explained that biomass is flexible. It can be used in large plants or in DG, but currently, it only makes up 0.2% of Malaysia's capacity.

"That is an untapped goldmine," he said.

He believes that one of the main barriers to greater investment in alternative energy sources like biomass is the high upfront capital required.

Many potential investors are discouraged by the long return-on-investment period, which can stretch to 10 or 15 years, in addition to the current low demand for the energy sources.

He argued that this is why government's aspiration and support through fiscal policies – such as tax incentives or subsidies – is crucial to make these investments more attractive and viable.

Micro-hydro, which harnesses the power of small rivers or streams without building massive dams, is another overlooked option.

"You do not need a big waterfall – just the natural flow of water can power rural communities," Ahmad Farid said.

Are We Ready to Talk about Nuclear Energy?

Perhaps the most controversial topic of all is nuclear energy. While many Malaysians are hesitant about the idea of nuclear reactors, experts believe small modular reactors (SMRs) may offer a safe, stable and clean option.

"People fear what they do not understand, but we have had a nuclear research reactor operating in Bangi, Selangor, for over 50 years. It is safe. We have the expertise. What we lack is awareness," Ahmad Farid said.

He added that SMRs, which are compact and designed with enhanced safety features, could be deployed in remote areas or industrial parks.

While SMRs are not intended to replace large coal plants overnight, they can play a critical role in bridging capacity gaps left by phased-out coal facilities. At the same time, they help reduce reliance on gas-fired plants and address the intermittency challenges associated with solar energy.

Meanwhile, Adriansyah said the public needs to understand that net zero does not mean zero carbon – just a balance between what we emit and what we absorb, and nuclear energy can be part of that balance.

Planning, Politics and Public Will

Both experts pointed out that achieving a resilient, low-carbon energy future will require more than just good ideas: It will take political will, inter-ministerial coordination and clear national direction to execute them to achieve the goals.

Ahmad Farid noted that Malaysia's energy planning is currently fragmented, with different ministries managing different aspects of the sector – hydropower under one, biomass under another and nuclear energy under yet another.

This lack of coordination, he said, makes it difficult to implement a unified strategy. He stressed the need for a single, consolidated roadmap guided by a central authority to ensure consistent direction and efficient execution.

He called on ministries and agencies – including the Ministry of Energy Transition and Water Transformation (PETRA), the Ministry of Natural Resources and Environmental Sustainability (NRES), the Economic Planning Unit (EPU) and the Energy Commission (EC) – to align their strategies under a unified national framework.

Disjointed efforts, such as one ministry championing solar while another pushes gas, send mixed signals to investors and hamper coordinated progress.

Both academicians concluded with a sobering yet hopeful message: The window for change is narrowing, but the opportunity is still within reach.

Adriansyah said fuel diversification is not just about energy – it is a matter of sovereignty, affordability, sustainability and economic growth. Meanwhile, Ahmad Farid believes that for Malaysia to remain regionally competitive, the country must adopt a more strategic approach to how electricity is generated and consumed.

Such a transition, however, will not happen within five years. The shift towards a more secure, balanced energy mix will take time – likely over a decade – and requires strong political will, long-term planning and consistent execution.

Malaysia cannot afford to fail or squander the investments it is already making in energy transition. A sound, unified national endeavour is essential to guide this journey forward.

Ultimately, a well-diversified energy mix means more than national resilience – it means fewer blackouts, more stable electricity prices and cleaner environment. For everyday Malaysians, it translates into a better quality of life: Uninterrupted power for homes, schools and hospitals; smarter energy bills; and a sustainable future for generations to come.