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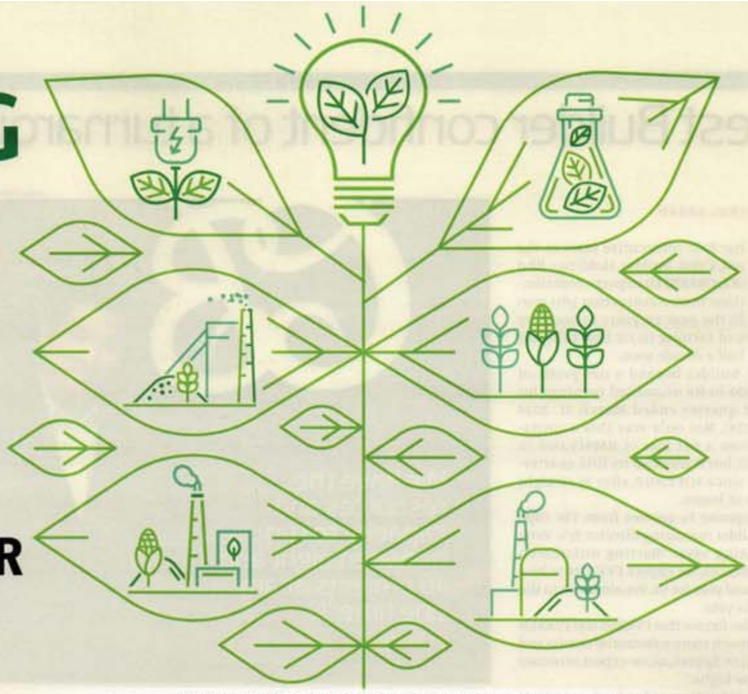
CO-FIRING BIOMASS WITH COAL

The Edge, Malaysia

CO-FIRING BIOMASS WITH COAL:

THE PATH FOR SUSTAINABLE THERMAL POWER GENERATION



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Modern bioenergy currently stands as the largest source of global renewable energy, according to the International Energy Agency (IEA). It is primarily positioned as a replacement for the retiring fleet of conventional thermal power plants. It has been established that deploying modern bioenergy ensures the security of supply and energy equity as the world strives towards a net-zero future.

With its often-reported abundance of biomass resources, Malaysia aims to achieve the 1.4 GW bioenergy capacity target by 2050, as outlined in the National Energy Transition Roadmap (NETR).

As a nation that relies on 78 per cent of electricity generated from traditional resources, the bioenergy sector has a significant opportunity for growth and development. However, in 2023, bioenergy generated under the feed-in-tariff scheme provided less than 1 per cent of the nation's total electricity generation.

Apart from the current supply, which comes mainly from small generators in the form of biogas power plants, only a handful of biomass power plants feed into the electricity grid network.

There are various contributing factors to the limited utilisation of biomass as a sustainable replacement fuel, but they mainly stem from the 'chicken and egg' problem of supply or demand. Biomass pellets producers lack the confidence to commit to the production of biomass fuel pellets without a large demand in place, and independent power producers (IPPs) do not embark on building biomass power plants without securing long-term fuel contracts.

Most local biomass pellets suppliers are presently exporting to the international market, where the trend has shown steady growth in demand and is expected to continue as more thermal power plants are phased out worldwide. Nonetheless, this is still insufficient to spur more biomass pellets producers if a sizeable local demand is not established in the near term.

Greater local demand can be accomplished by developing large-scale biomass power plants or co-firing biomass fuel pellets into our existing thermal power plants. The latter would be a more cost-effective approach if carefully implemented.

Co-firing biomass in thermal power plants is widely accepted as an option to directly reduce greenhouse gas (GHG) emissions from burning coal and, at the same time, increase the use of renewable energy sources. This is practised in almost every developed country, which is currently phasing out coal in its energy mix.

Existing thermal power plants could be retrofitted for co-firing relatively quickly, especially for biomass fuel substitutions in the lower range, typically below 15 per cent thermally. IPPs would also leverage the existing power plant site access and associated supporting infrastructures to connect to the electricity grid, which would need to be developed for a new dedicated biomass power plant.

Other than being a more cost-effective method of harnessing bioenergy when compared to building a dedicated biomass power plant, co-firing also takes advantage of the higher thermal efficiencies due to the higher operating temperatures of the coal boiler. Dedicated biomass boiler conversion efficiencies are typically between 20 to 30 per cent, while modern subcritical coal boilers achieve mid-30 per cent efficiency, and newer supercritical coal boilers can easily surpass 40 per cent. Considering coal boilers are typically large power units, even a small percentage increase in efficiency equates to significant fuel savings and, in turn, a worthwhile reduction of GHG emissions.

Another advantage of the large existing coal boilers is that co-firing will create a big enough demand to entice more biomass pellets producers and form a practical supply chain, making biomass a valuable commodity for the nation.

As an example, under the NETR flagship project, biomass co-firing at Malakoff's Tanjung Bin Power Plant in Pontian, Johor, has recently entered its trial phase. In this early stage, the co-firing rate is up to 5 per cent of thermal substitution, equivalent to 105 MW of bioenergy, making it 10-times larger than the current dedicated biomass power plants in operation. This requires approximately 900 tonnes of biomass pellets daily, with the intention of reaching up to 15 per cent substitution by 2027.

Meeting this large demand would most likely require the relatively widely available biomass sourced from the agriculture sector, primarily identified as wastes or residue streams from the palm oil industry, paddy cultivation and other crops such as coconut, cocoa, rubber and fruits.

Focusing on agricultural residues has numerous benefits. First, it avoids the exploitation of limited land resources for planting dedicated energy crops, mitigating further deforestation and continuing food security. Secondly, significant GHG reduction in the agricultural sector of naturally emitted methane by wet biomass, especially from the palm, coconut and cocoa industries, whilst concurrently reducing energy sector GHG by substituting fossil fuel. Thirdly, a new biomass processing and fuel pellet production sector would incur additional income and employment opportunities for rural economic growth, an important element for a just and equitable energy transition.

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> — Dr. Adlansyah

Compared to coal, the above biomass is diverse in physical and chemical properties, requiring further processing to be a viable substitute fuel in co-firing applications.

Each type should be thoroughly investigated to identify the appropriate pre-treatment method for improved transportation, handling and storage safety. Additionally, periodical characterisation tests are essential at the receiver to ensure suitability and manage any potential impact on the boiler when the biomass pellets are introduced.

Furthermore, proper appraisal of the correct business model and supply chain logistics is key in determining which biomass should be prioritised, also considering any variation in seasonal supply.

The extent of these challenges varies for different biomass and respective thermal power plants and is expected to increase fuel costs. The current mechanism of fuel cost pass-through must be extended to biomass, with sufficient study on the anticipated adjustments on supply and properties, for a successful co-firing endeavour. An increase in costs could also be softened by an appropriate carbon credit scheme designed to cater to GHG reductions both in the agriculture and energy sectors.

In conclusion, Malaysia has significant potential of co-firing biomass in its existing thermal power plants to significantly reduce GHG emissions and increase the use of renewable energy. Co-firing is a cost-effective bioenergy application and could also contribute to reducing waste from the agricultural sector. The implementation of co-firing would ensure energy security and stimulate further economic activities. Co-fired power plants also have the potential to eventually convert to full biomass firing as the nation phases out coal power and progress towards net-zero.