

Accelerating carbon capture adoption in Malaysia

The urgency of climate change is becoming increasingly apparent, with Malaysia experiencing more frequent and intense weather-related disasters, food insecurity and water scarcity. The effects of climate change are accelerating faster than predicted. Certainly, there is a need for an emergency response to deal with the scale of the climate crisis. Without stronger action, current global commitments would only reduce our total greenhouse gas (GHG) emissions by half compared with 2022 levels.

As Malaysia grapples with its energy transition and climate mitigation strategy, carbon capture, utilisation and storage (CCUS) emerges as a crucial tool for managing net emissions, particularly in hard-to-abate industries.

Emissions in Malaysia are disproportionately high

In 2022, Malaysia's CO₂ emissions reached about 291 million tonnes, making it the No 22 largest emitter globally despite being only the No 45 most populous country. This disproportionate level of emissions is largely due to the country's heavy reliance on fossil fuels — our carbon emissions are dominated by energy production and industrial sectors including minerals, electronics and chemicals.

The Malaysian government has pledged to reduce carbon emissions intensity relative to gross domestic product (GDP) by 45% by 2030, compared with 2005 levels. This commitment is part of the broader National Energy Transition Roadmap, which includes establishing the Ministry of Energy Transition and Water Transformation. However, our current decarbonisation rate of 2.5% is far behind Malaysia's Nationally Determined Contribution target of 7.2%, according to a 2023 PwC survey.

One of the key challenges is balancing economic activities with sustainable practices. A well-implemented carbon pricing framework may incentivise industries to decarbonise, enhance Malaysia's competitiveness as a trading nation and stimulate the growth of low-carbon technology and green sectors. But, if not implemented effectively, it could constrain domestic output relative to neighbouring countries.

CCUS: A key pillar in Malaysia's energy transition

So where does CCUS lie in addressing Malaysia's decarbonisation challenges? To begin, it is worth understanding the

processes involved in this technology.

The terminology of CCUS broadly describes the two different end-of-life pathways for captured carbon — that is, either utilisation (CCUS) or storage (CCS). The process of CCUS technology begins with the capture of carbon emissions from industrial processes or power generation, preventing them from entering the atmosphere. This captured carbon can then be stored underground or utilised in various industrial applications.

Economic benefits that can be derived from CCUS development include:

- **Industrial decarbonisation:** CCUS is vital for decarbonising hard-to-abate industries such as cement production, where around two-thirds of the emissions result from the chemical processes rather than fuel combustion.

- **New energy sources:** CCUS enables the production of low-carbon fuel alternatives such as hydrogen and ammonia that would further drive decarbonisation of the transport sector. For instance, hydrogen-powered agricultural and construction vehicles and ammonia-powered shipping vessels could contribute to Malaysia's economic diversification.

- **Job preservation and creation:** CCUS will allow Malaysia to maintain energy-intensive industries in a net zero-compliant manner while transitioning to a lower carbon economy, preventing job losses and asset stranding.

Several pilot projects in Malaysia today are exploring CCUS applications, including green and blue hydrogen and ammonia production. Landmark CCS projects such as the Kasawari-M1, Lang Lebah-Golok, BIGST Cluster, and M3 project for industrial CO₂ emissions storage are underway, marking significant progress in this area.

Overcoming challenges to build a sustainable CCUS solution

Widespread adoption of new practices typically comes with its own set of challenges, including financial constraints, technical issues and regulatory hurdles. CCUS is no exception.

- **Monetisation of CO₂:** Making CCUS economically viable is crucial for attracting investments and enabling large-scale deployment. The expectation is that CO₂ can be used for enhanced oil recovery, industrial applications and carbon trading. In terms of carbon trading, the introduction of Malaysia's Voluntary Carbon Market (VCM) in 2022 is a promising step. In 2023, VCMs globally realised a record US\$104 billion in carbon



pricing revenue, indicating its potential for substantial economic benefits.

The economic viability of CCUS, including non-financial measures such as avoided GHG emissions, hinges on the cost-effectiveness of capturing carbon.

- **Regional positioning:** Malaysia is positioning itself as a regional CO₂ storage hub, leveraging its abundant storage resources. This strategic move is expected to attract industries aiming for net zero emissions, enhancing capital efficiency and fostering synergies.

- **Cost-effectiveness of technology:** Handling CO₂ in the context of CCUS involves significant advancements and scaling up of existing technologies used across industries. While traditional CO₂ management in oil and gas has laid the groundwork, the sheer volumes involved in CCUS necessitate modifications and enhancements that would require additional capital investment and initial higher operating costs during the early stages of the project.

However, these costs are anticipated to decrease over time as the market grows and technologies advance. A prime example of this trend is the notable reduction in CO₂ capture costs in power generation. From the first to the second large-scale CCUS facility, these costs have decreased by 35% over the last decade, indicating a positive trajectory towards more cost-effective carbon capture solutions.

- **Policy and regulatory support:** Effective policies and regulations are crucial for accelerating the adoption of CCUS technologies. These frameworks are often complex, involving environmental, social, economic and technical considerations.

However, the urgency of climate change has led to greater global collaboration, enabling the exchange of best practices across various industries. Insights from successful strategies in other areas such as pollution control can help guide and expedite the iden-

tification of viable business models for CCUS.

Policymakers can study practical implementations from other countries to develop carbon pricing frameworks and design mechanisms that encourage private sector participation and ensure the safe and effective operation of carbon storage sites, either underground in its supercritical, liquid state or through mineralisation.

- **Public engagement and education:** Raising public awareness about the benefits of CCUS is essential for social acceptance. Currently, many people may view CO₂ as a waste product and a danger. Educating the public on how CCUS mitigates climate change, enhances energy security and creates economic opportunities can shift this perception. Highlighting successful projects and their environmental benefits can build trust and support for CCUS initiatives.

CCUS represents a critical technology for Malaysia's energy transition and climate mitigation strategy. Despite challenges, the potential environmental and economic benefits justify the investment. Industry leaders have opportunities to invest in CCUS technologies and pilot projects to demonstrate viability, backed by financial institutions, policy and regulatory support.

Public-private partnerships can be a route to increase participation in the sector. For the private sector, this represents an opportunity to capitalise on demand for CCUS as a solution and invest in pilot projects to demonstrate viability. The public sector will be able to observe inflows of foreign direct investment and stimulate job growth in value chains that support CCUS.

CCUS is not an excuse for continued high emissions, but rather one of the tools available to support a pragmatic net zero response, alongside efficiency improvements, growth of new green businesses and carbon offsets. Innovation and having a unified approach will be crucial in tackling climate change while ensuring a sustainable future for all. ■

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