2025 IERE-TPC Taipei Net-Zero Workshop
May 26–29, 2025

Unlocking the Potential of CO2 Capture and Utilization for a Sustainable Energy Future: A Case Study of Thermal Power Plants in Malaysia

***Noraziah MUDA[1)], Nur Muhammad Afifi ZAINAL[2)], Hazha ABDUL HAMID[3)]**
[1)]Head, Decarbonization and Renewable Energy Centre, TNB Research
[2)]Researcher, Decarbonization and Renewable Energy Centre, TNB Research
[3)]General Manager, Sustainable Energy and Environment Department, TNB Research

Keywords: *CCUS, Energy Transition, Post Combustion Carbon Capture , Dercarbonisation*

Abstract
The global shift towards decarbonization has intensified the need for innovative strategies to reduce CO_2 emissions, particularly in the energy sector. In Malaysia, thermal power plants, which rely heavily on fossil fuels, are among the largest sources of carbon emissions. This study explores the potential of CO_2 Capture, Utilization, and Storage (CCUS) as a viable pathway toward a sustainable energy future.

A structured approach is adopted, beginning with a Concept Identification (CID) study to assess the feasibility of CCUS integration in Malaysia's thermal power plants. The evaluation focuses on the entire CO_2 management process, from its source at power plants to its transportation via different routes to a designated CO_2 receiving hub in Peninsular Malaysia. Two types of power plants which are gas-fired and coal-firedare analyzed for their suitability in adopting carbon capture technologies. A Carbon Capture Technology Screening identifies the most effective solutions based on technical feasibility and efficiency. The Plot Area Plan ensures spatial feasibility, while a Cost Estimate provides insights into the financial implications of CCUS implementation. Additionally, a Carbon Footprint Assessment (CFA) quantifies potential emission reductions and assesses their impact on national sustainability goals.

Beyond CO_2 capture, this study explores its utilization potential in various industries, including enhanced oil recovery (EOR), synthetic fuel production, and biological CCU approaches for value-added applications. The research also examines critical challenges, such as economic feasibility, regulatory frameworks, and infrastructure development, ensuring a holistic evaluation of CCUS deployment.

By addressing economic, environmental, and policy challenges, this study presents a comprehensive roadmap for CCUS integration in Malaysia's thermal power plants, supporting the nation's transition toward a low-carbon future and its commitment to sustainable development and carbon neutrality.