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Please fill in your manuscript title.	The March towards Carbon Neutrality: First Offshore, Greenfield Carbon Capture and Storage Development

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Abstract

Lang Lebah Carbon Capture & Storage (CCS) has been deployed as part of the Lang Lebah Development where CO_2 removal is required to meet MLNG sales specifications. This flagship project aims to reduce CO_2 emissions from removed CO_2 stream, thus enabling PETRONAS, PTTEP and KUFPEC to contribute to Net Zero Carbon emission

An extensive CCS feasibility study has been performed by a multidisciplinary team including subsurface, drilling and well, facilities, development planning, and SSHE disciplines to ensure secure storage and operation through storage site selection, well design and integrity, facilities design, and safety assurance.

Storage site screening was carried out to rank and identify the best CO_2 storage location. Subsequently, the integrated geomechanical, geochemical, and dynamic models of screened reservoirs were built to capture the fluid behavior, injectivity, rock interactions, and long-term effects during CO_2 injection and stored periods. Engineering studies were performed for proper CO_2 injection well and surface facilities designs to ensure long-term well integrity and to address flow assurance concerns.

Carbon Capture & Storage, along with this feasibility study, is a crucial part in enabling the Lang Lebah Development to achieve its target commercial production in 2027. Based on the CO_2 storage field screening and assessment, the primary CO_2 storage sites are located offshore in Sarawak, Malaysia, and consist of depleted reservoirs.

In addition, a robust Measurement, Monitoring and Verification Plan has been developed to ensure the conformance and containment for geological carbon storage, support risk management, and provide safety assurance for well integrity.

In this development, CO_2 is captured at the Onshore Gas Plant 2 where the CO_2 content in the gas from Lang Lebah is reduced from 12-18% to meet the required 6.5% CO_2 sales specifications. The removed CO_2 is then captured and concentrated by means of an amine-based gas enrichment unit. The captured CO_2 stream will then be compressed and transported from onshore to be injected at the aforementioned CO_2 storage sites. Material selection and flow assurance studies were performed to ensure the entire CO_2 system is fit for service.

Well engineering assessment were also conducted to address the in-well flow assurance, well components selection and well integrity of injection wells and existing wells after P&A to ensure no CO_2 leakage from reservoirs.

An estimated 1.5 MTPA of CO_2 is expected to be captured from Lang lebah Development. The feasibility studies conducted as part of the Lang Lebah Carbon Capture and Storage Development have uncovered valuable learnings and practices that could benefit the advancement of green development value-chain. The methodologies and lessons learned from subsurface, well, and facilities studies can be applied fieldwide and used as a future framework for PTTEP and other operators.