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Malaysia Carbon Capture Storage Development (Updates): Asia Pacific Decarbonization Solutions

4th Sept 2025

DISCLAIMERS

CAUTIONARY STATEMENT

This release contains forward-looking statements and statements of future events and similar expressions used to represent our judgements and future expectations. These statements involve risk and uncertainty because they relate to future events and circumstances and should be considered in light of the various important factors. The key factors that could cause our actual performance or achievements to differ materially from those in the forward-looking statements include changes to International Financial Reporting Standards (IFRS) and associated interpretations, applications and practices as they apply to past, present and future periods; ongoing and future acquisitions; changes to domestic and international businesses and market conditions such as exchange rate and interest rate movements; changes in domestic and international regulatory and legislative environments; changes to domestic and international operational, social, economic and political conditions; any labour disruptions and industrial action; and the effects of both current and future litigations.

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PETRONAS has set a Net Zero Carbon Emissions (NZCE) 2050 pathway and identified its main decarbonization levers which includes CCS

2024 & 2025

49.5 $MtCO_2e$

Cap emissions at 49.5 million tonnes of carbon dioxide equivalent ($MtCO_2e$) from PETRONAS' Malaysia operations by 2024.

50% reduction

in methane emissions from PETRONAS Groupwide natural gas value chain operations by 2025

2030

25% reduction

in PETRONAS Groupwide emissions, including:

70% reduction

in methane emissions from PETRONAS Groupwide natural gas value chain

50% reduction

in methane emissions from Malaysia's natural gas value chain

2050

NET ZERO 2050

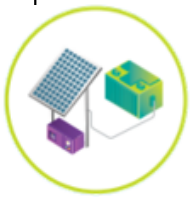
Net Zero carbon emissions

Net Zero Emission by 2050

Achieving Net Zero Carbon Emissions by 2050 is a core part of PETRONAS' strategic vision. **CCS plays a crucial role in this journey**, as it enables the capture and storage of CO_2 emissions from industrial sources, directly contributing to our overall decarbonisation goals. By investing in CCS, PETRONAS is actively working to reduce its carbon footprint and help its clients achieve similar outcomes.

NET ZERO 2050

Zero Routine Flaring and Venting



Energy Efficiency

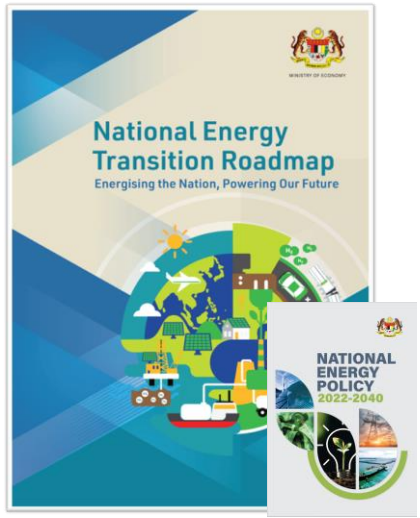
Electrification

Carbon Capture and Storage (CCS)

In early 2022, PETRONAS reinforced its commitment to sustainability by establishing the Carbon Management Division (CMD). This division is to spearheading **key low-carbon initiatives, with a primary focus on managing carbon dioxide (CO_2) emissions and advancing the development of our Carbon Capture and Storage (CCS) business.**

CCS has been identified as one of the pillar that will propel Malaysia to realize its aspirations in the NETR and support the NIMP targets

National Energy Transition Roadmap (NETR)



- CCUS is 1 of the **10 flagship catalyst projects** in the NETR roadmap.
- By 2030:
  - 3 CCUS hubs (2 in Peninsular Malaysia, 1 in Sarawak)
- By 2050:
  - 3 carbon capture hubs
  - Storage capacity between 40 to 80 MTPA
- The NETR is build upon the National Energy Policy (NEP) 2022-2040

New Industrial Master Plan 2030

- Deploy large scale CCUS solutions to decarbonize hard-to-abate sectors
- Focus on **4 key** components:
  - Capture CO_2 from industrial processes
  - Transport by ship, pipeline and land transport
  - CO_2 storage in depleted oil fields
  - Utilization of captured CO_2 and aligned with circular economy principles
- CCUS framework and regulations is key to execute Mission Based Project (MBP) 3.3 in pushing for net zero

The CCUS Act and what is happening next

Status

- On 5 March 2025, the first reading of the CCUS Bill was tabled in Malaysian Parliament's House of Representatives (Dewan Rakyat), with the second and third readings on 5 – 6 March 2025. The CCUS Bill was passed with a majority voice vote in Dewan Rakyat on 6 March 2025.
- On 10 March 2025, the CCUS Bill was tabled for first reading in the Senate (Dewan Negara), with the second and third readings on 25 March 2025. The CCUS Bill was unanimously passed in Dewan Negara on 25 March 2025.
- On 22 July 2025, the Bill received Royal Assent and subsequently was gazetted as the "Act 870 Carbon Capture, Utilization and Storage Act 2025" (**CCUS Act**) on 1 August 2025.

What is next

- As of 5 August 2025, the CCUS Act is yet to be in force, with such enforcement date to be determined by the Government soon.
- More granular details about the permitting and licensing regime will be spelled out in the Regulations, which are expected to be gazetted and visible after the Act has come into force.
- The Ministry of Economy has commenced discussions for bilateral arrangements with MTI Singapore in April 2025 and is progressing discussions with MOTIE South Korea. The MOC with METI Japan is expected to be signed within Q4 2025.

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What is in the CCUS Act?

Purpose

Development of CCS industry as a new source of income

An Act to provide for matters relating to the capture, transportation, utilization and permanent storage of carbon dioxide, to reduce carbon dioxide emissions and mitigate the effects of climate change, to catalyse the development of the carbon capture, utilization and storage industry as a new source of economic growth, and to provide for related matters.

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PART VIII	**Post-Closure Stewardship Fund**
PART IX	Enforcement
PART X	General Provisions

Application

Application

2. This Act shall apply to Peninsular Malaysia and the Federal Territory of Labuan.

Recognition of Paris Agreement Obligations

WHEREAS the United Nations Framework Convention on Climate Change was done at New York on 9 May 1992, where Malaysia deposited her instrument of ratification on 13 July 1994 and therefore in accordance with Article 23 of the Convention, the said Convention entered into force as far as Malaysia is concerned on 11 October 1994;

AND WHEREAS the Paris Agreement was done at Paris on 12 December 2015, where Malaysia deposited her instrument of ratification on 16 November 2016 and therefore in accordance with Article 21 of the Agreement, the said Agreement entered into force as far as Malaysia is concerned on 16 December 2016;

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STORAGE

GATHER

TRANSPORT

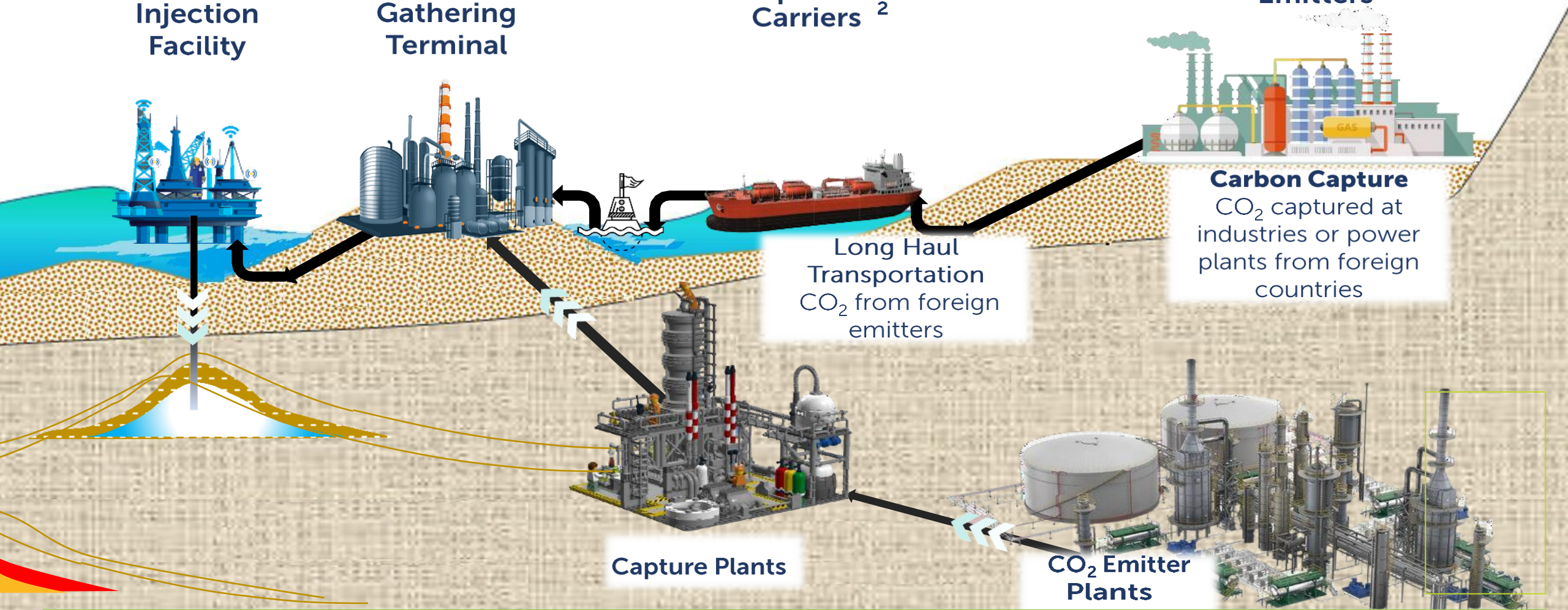
CAPTURE & PROCESSING

CO_2 Injection Facility

Onshore Gathering Terminal

Liquid CO_2 Carriers

Foreign Industrial Emitters



Carbon Capture
CO_2 captured at industries or power plants from foreign countries

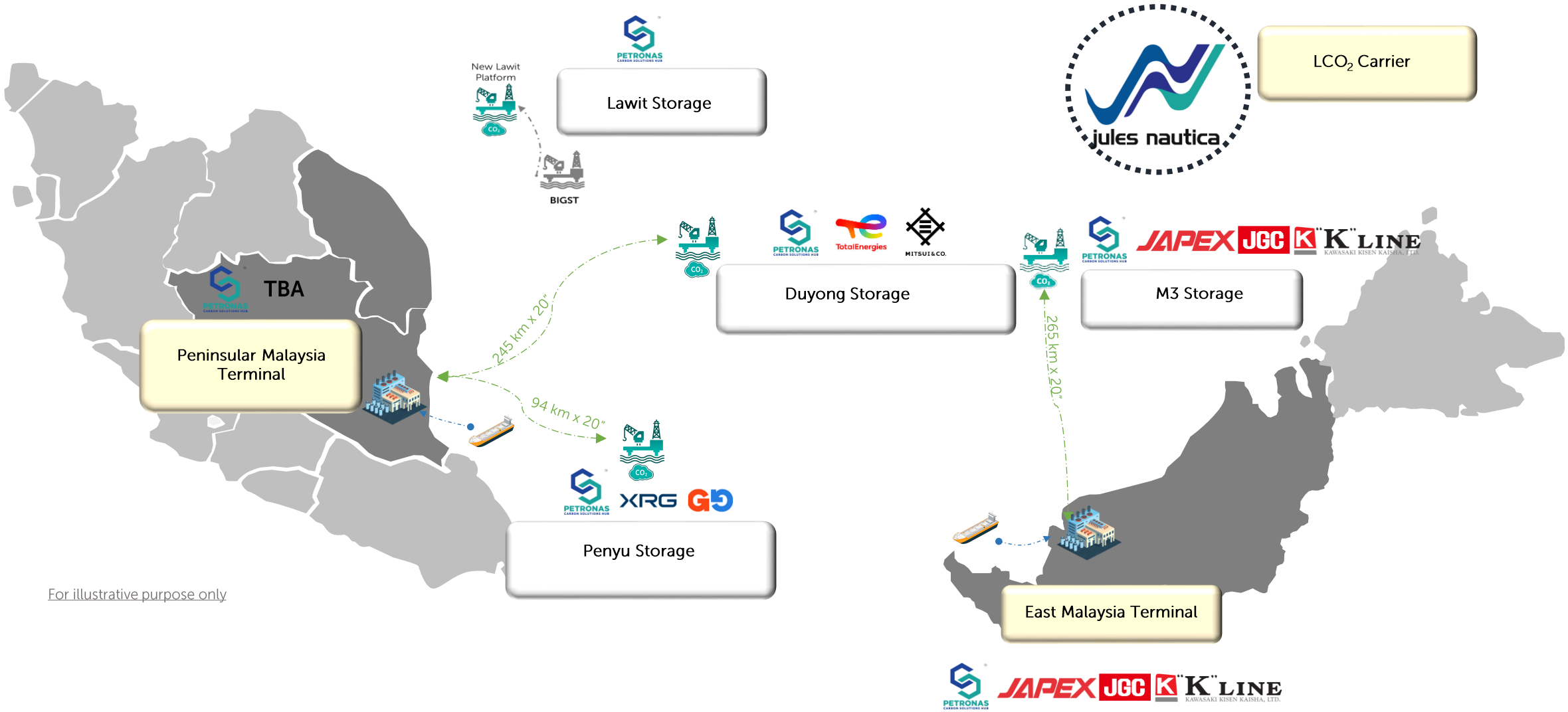
Long Haul Transportation
CO_2 from foreign emitters

Capture Plants

CO_2 Emitter Plants

Domestic Emitters

Overview of Malaysia CCS Hubs, Capacity & Partnership Shaping



For illustrative purpose only

Value Driven Development of Malaysia's CCS Hub

Eastern

M3 Storage

PETRONAS CARBON SOLUTIONS HUB | JAPEX | JGC | K LINE KAWASAKI KISEN KAISHA, LTD.

Development Overview:
Onshore CO_2 terminal will receive liquefied CO_2 from foreign emitters and transport via pipeline to offshore for injection in depleted reservoir.

Partnership	50%
Storage Classification	Depleted Reservoir
CO_2 Source	Foreign & Local
Water Depth	116 m
Distance Pipeline	265 KM
CO_2 Capacity	5 MTPA (20 storage years)
No. of Wells	3 wells (Injectors)
Injection Depth (TVD)	1800–2100 m

Northern

Lawit Storage

PETRONAS CARBON SOLUTIONS HUB | TBA

Development Overview:
New offshore injection platform will receive dense-phase CO_2 from high-CO_2 fields for injection in the Lawit depleted reservoir.

Partnership	100%
Storage Classification	Depleted Reservoir
CO_2 Source	Local Emitter
Water Depth	70 m
Distance Pipeline	114 KM (Scope by Others)
CO_2 Capacity	2.5 MTPA (20 storage years)
No. of Wells	4 (Injectors) & 1 (Observer)
Injection Depth (TVD)	1860 m

Southern

Duyong Storage

PETRONAS CARBON SOLUTIONS HUB | TotalEnergies | MITSUI&CO.

Development Overview:
Onshore CO_2 Terminal will receive liquefied CO_2 from foreign and local emitters and transport via subsea pipeline to offshore for injection at Duyong.

Partnership	40%
Storage Classification	Depleted Reservoir
CO_2 Source	Foreign & Local
Water Depth	75m
Distance Pipeline	245 KM
CO_2 Capacity	5 MTPA (20 storage years)
No. of Wells	6 (Injectors)
Injection Depth (TVD)	1,350-1850m

Penyu Storage

PETRONAS CARBON SOLUTIONS HUB | XRG | GG

Development Overview:
Onshore CO_2 Terminal will receive liquefied CO_2 from foreign and local emitters and transport via subsea pipeline to offshore for injection at Penyu.

Partnership	40%
Storage Classification	Saline Aquifer
CO_2 Source	Foreign & Local
Water Depth	49 – 52 m
Distance Pipeline	94 KM
CO_2 Capacity	10 MTPA (for 2 platform staggered)
No. of Wells	10 wells (2 platforms))
Injection Depth (TVD)	~ 1700 m

Eastern Malaysia Terminal

Terminal

PETRONAS CARBON SOLUTIONS HUB | JAPEX | JGC | K LINE KAWASAKI KISEN KAISHA, LTD.

Development Overview:
Onshore CO_2 terminal will receive liquefied CO_2 from foreign emitters and transport via pipeline to offshore for injection in depleted reservoir.

Partnership	50%
Location	Samalaju (TBC)
FID Target	Q2 2027
Ready to Comm	Q3 2030
Land Size	82,500 m^2
No of Storage Tank	8 nos (8,333 m^3/tank)

Peninsular Malaysia Terminal

Terminal

PETRONAS CARBON SOLUTIONS HUB | TBA

Development Overview:
Onshore CO_2 terminal will receive liquefied CO_2 from foreign emitters and transport via pipeline to offshore for injection in depleted reservoir.

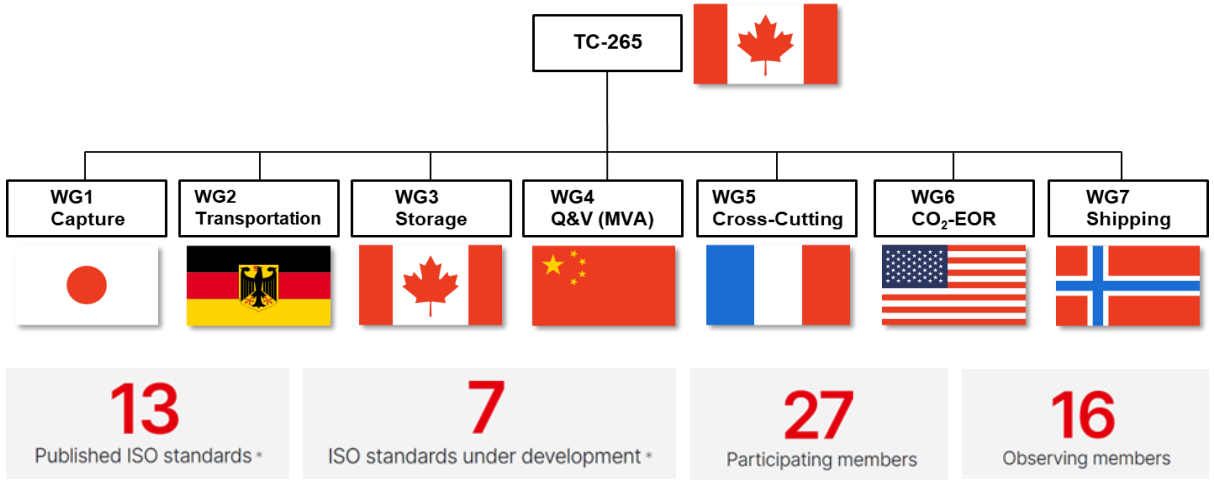
Partnership	TBC
Location	Kuantan, Pahang
FID Target	Q3 2026
Ready to Commence Commisioning	Q4 2029
Land Size	65,000 m^2 (Lot 1)
No of Storage Tank	6 nos (16,500 m^3/tank)

International standards & best practices as reference for development of Project Governance Documents for CCS Business

ISO/ TC 265

CO_2 capture, transportation, and geological storage

Scope: Standardization of design, construction, operation, environmental planning and management, risk management, quantification, monitoring and verification, and related activities in the field of **CO_2 capture, transportation, and geological storage (CCS).**

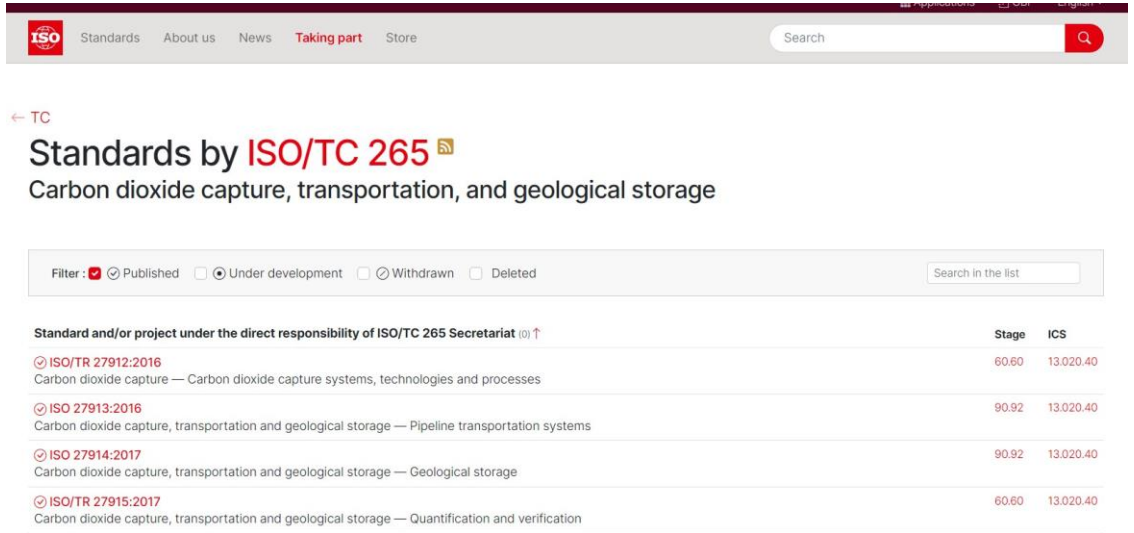


* number includes updates

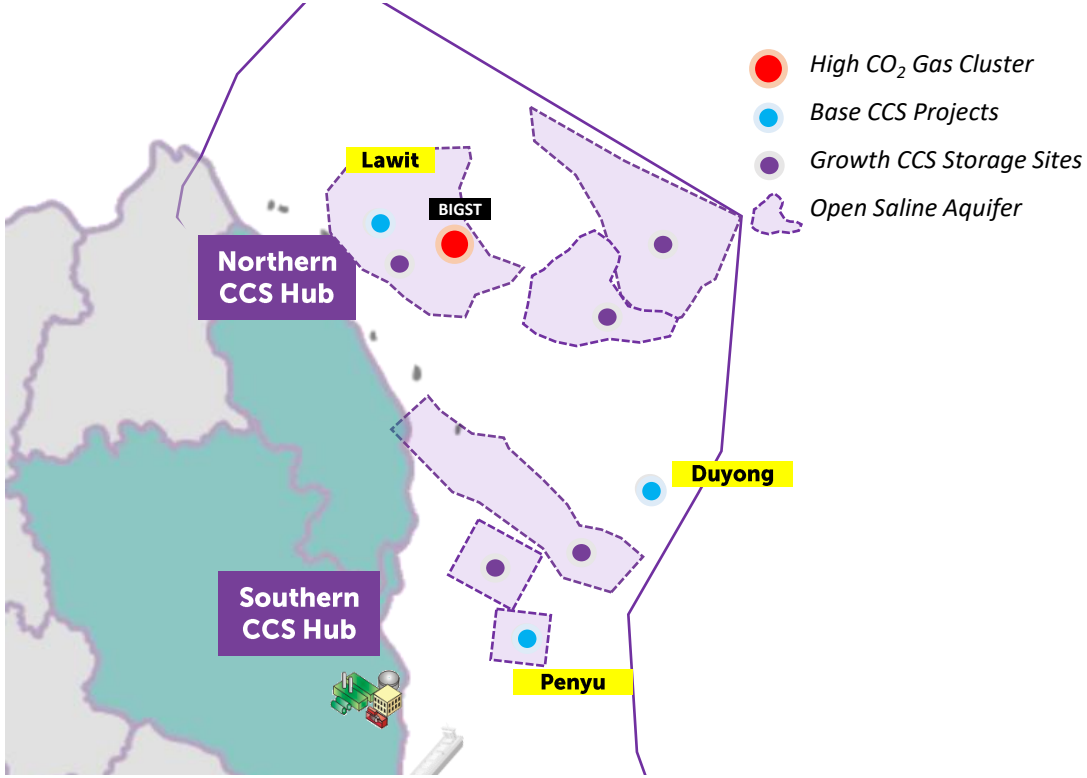
DNV Research/ Joint Industry Project

- ✓ CO_2 RISKMAN – Guidance on CCS CO_2 Safety and Environment Major Accident Hazard Risk Management
- ✓ CO_2 PIPETRANS – Guidance on transportation component of CCS projects
- ✓ CO_2 SAFEARREST – Guidance on the efficient design of CO_2 pipelines
- ✓ CO_2 QUALSTORE – Guidance for the selection and qualification of CO_2 storage sites
- ✓ CO_2 WELLS – Guidance on the risk management of existing wells at CO_2 storage sites
- ✓ CO_2 CAPTURE – Guidance on procedure for capture technology qualification
- ✓ HiPerCap – Development of novel Capture technologies
- ✓ ECO_2 – Best environmental practice for offshore CO_2 injection

DNV Recommended Practice	**DNV GL-RP-J201** Qualification procedures for CO_2 capture technology	**DNV GL-RP-F104** Design and operation of CO_2 pipelines	**DNV GL-RP-J203** Geological storage of CO_2
International Standard	**ISO 27919-1** CO_2 capture – Performance evaluation methods for post - combustion CO_2 capture integrated with a power plant	**ISO 27913** CO_2 capture, transportation and geological storage - Pipeline transportation system	**ISO 27914** CO_2 capture, transportation and geological storage - Geological storage



CCS Storage Sites for Base Projects and Growth Portfolio

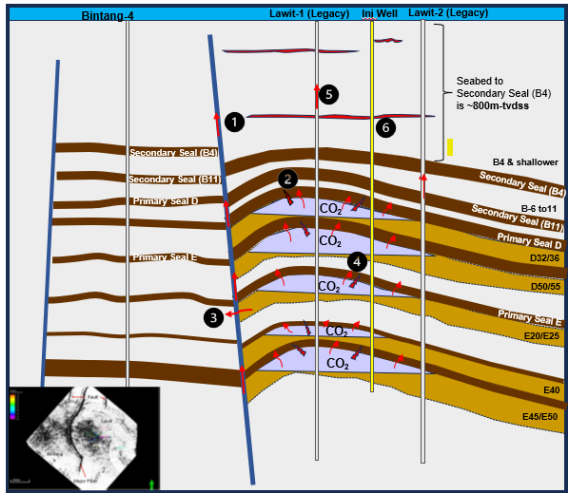


CCS Site Screening Guideline for Saline Aquifers and Depleted Reservoirs

Risk element		Risk definition
Capacity	Reservoir Storage & Effectiveness	The probability that sand exists with sufficient porosity, permeability and continuity to contain CO2.
Containment	Seal Presence & Effectiveness	The probability that adequate vertical and lateral seals exist which could confine CO2 within adjacent reservoir rock.
	Trap Presence & Effectiveness	The probability that CO2 trapping mechanism works & fault sealing is effective to prevent CO2 leaking along faults
Injectivity	Reservoir Storage Injectivity	The probability that sand/reservoir quality with sufficient net thickness & permeability and capable to inject CO2.

Containment Risk Assessment (CRA) & MMV Strategy

Plumbing Diagram of Lawit CCS



Plumbing Diagram + Integrated Coupled Model

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Well Integrity (Legacy, Producers, Injectors)

↓

Fault Seal, Fault Reactivation & Fracture Analysis

↓

Containment Risk Assessment (CRA) for Geological & Well Leakage Scenarios

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Bow Tie Risk Register (Probability, Severity)

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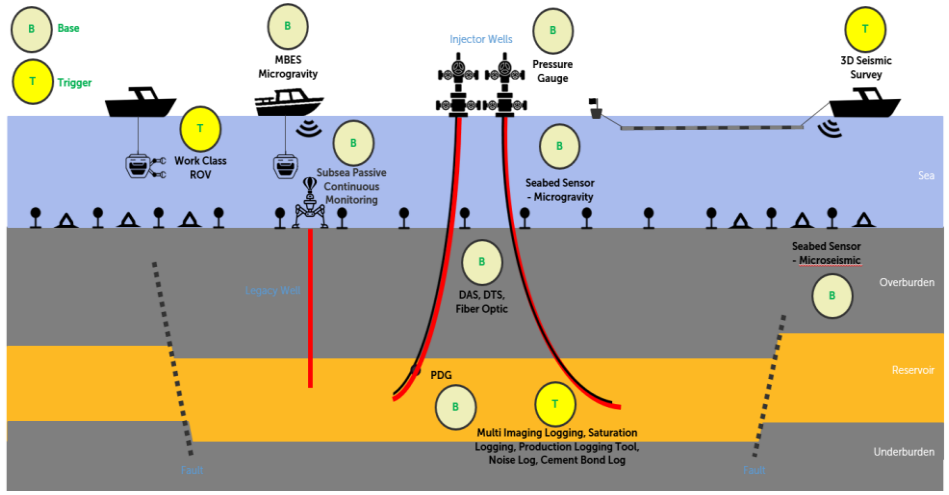
3rd Party Storage Endorsement & Site Certificate

Trigger Based MMV Program



Fit for Purpose MMV Covers

- Seawater and seabed (ROV)
- Well integrity
- Pressure & plume (seismic & non seismic)
- MMV containment

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Southern CCS Hub – Kuantan Terminal

Project Background

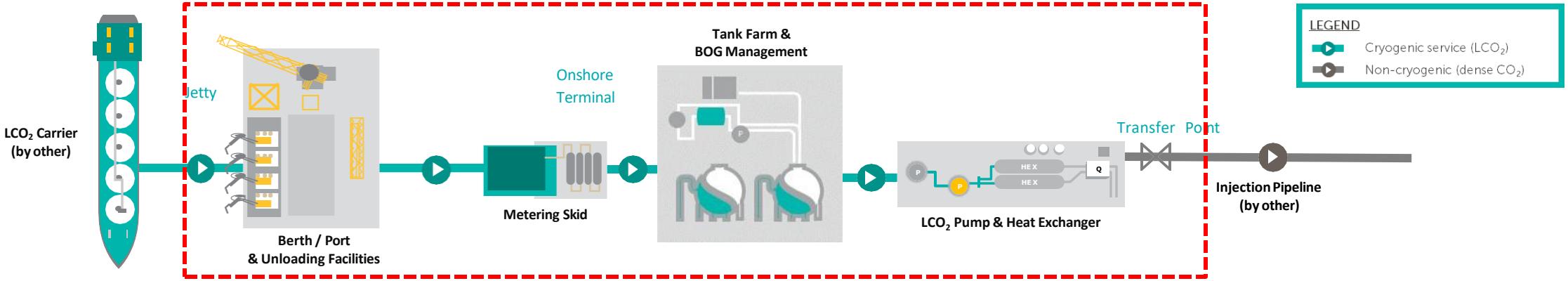
Southern CCS Hub project scope covers the receival of liquified CO_2 from **third party** via LCO_2 carrier at **onshore CO_2 terminal in Kuantan**, and the transportation of CO_2 via new subsea pipeline for injection in Duyong storage site with capacity of **5 MTPA** for **20 years**

The basis is to build unloading facilities on top of a new berth (berth scope by Others) and build new onshore terminal to receive, handle and temporarily store CO_2 from LCO_2 ship

Highlights

- Pre-FEED study by 3rd Party Engineering Consultant completed.
- Issuance of Letter of Intent (LOI) to Kuantan Port Consortium for onshore terminal plot reservation
- Continuous engagement with Key Stakeholders i.e. Pahang State Government, Kuantan Port Consortium, Lembaga Pelabuhan Kuantan, etc.
- FEED study by 3rd Party Engineering Consultant expected to start by Q3 2025.

General Layout



The attainment of several ship approvals further strengthens PETRONAS' commitment in building an integrated CCS value chain

Terminal to Terminal LCO_2 Carrier Design

Short Haul LCO_2 Carrier	Long Haul LCO_2 Carrier
7,500 to 15,000 m³ LCO_2 Carrier	**40,000 to 90,000 m³ LCO_2 Carrier**
Medium Pressure LCO_2 Carrier	Low Pressure LCO_2 Carrier
Min Design Temperature: **-35 to -25°C**	Min Design Temperature: **-55 to -45°C**
Max Operating Pressure: **15-20 barg**	Max Operating Pressure: **7-10 barg**

The 62k m^3 LCO_2 Carrier completed FEED, being 1st of its size in the world and obtained GASA certification on 26th December 2024

MOU signed between PETRONAS and MOL

Commencement of LCO_2 Carrier Conceptual Design

Completion of LCO_2 carrier Conceptual Design

Achieved Approval in Principle (AIP)

Signed Term Sheet Agreement with MOL and MISC

Commencement of FEED for LCO_2 carrier

Signed JV Agreement with MOL and MISC

Completion of LCO_2 carrier FEED and Achieved General Approval Ship Application (GASA)

jules nautica

LCO_2 Ship JV Incorporation

Marketing initiatives and preparation for FID

2022 2023 2024 2025

Note: MoU on Cross Border Transportation of CO_2 between PETRONAS and the METI of Japan and JOGMEC on 27th September 2023.

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The LCO_2 carrier plays a crucial role in CCS transportation. With advanced features designed for competitive unit costs and flexible provisions like Onboard CCS (OCCS) and Green Port infrastructure, paving the way for sustainable and efficient CO_2 transportation.

Key Innovative Features

Fit for Purpose CO_2 Transportation Solutions

1) Low Pressure Low Temperature (LPLT) : Innovations in large-scale CO_2 transportation to enable more competitive unit cost.
2) Medium Pressure Medium Temperature (MPMT): Available to accommodate various volumes and distances.

Innovative Low Carbon Features

1) LNG as primary alternative fuel
2) Efficient Reliquefaction System
3) Energy saving devices
4) Efficient hull design and propulsion system

Options for Low Carbon Strategies

Onboard Carbon Capture Storage (OCCS)

LCO_2 carrier has design with provision of OCCS. This allows capture of CO_2 emissions from the ship's propulsion system and capable to be offloaded at CCS Receiving Terminal.

Green Onshore Power Connection

Option to be connected to onshore power is available. This provides the capability for the ship to connect to green onshore power systems, reducing emissions while the vessel is at berth.

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CO_2 Spec

Component	Unit	Shipping (LPLT)	Pipeline (Dense)
Carbon Dioxide (CO_2) R	mol %	> 99.9	> 95
Water (H_2O) R	ppm-mol	≤ 2	≤ 100
Hydrogen sulphide (H_2S) R C	ppm-mol	≤ 5	≤ 9
Sulphur oxides (SOx) R	ppm-mol	≤ 10	≤ 10
Nitrogen oxides (NOx) R	ppm-mol	≤ 1.5	≤ 1.5
Oxygen (O_2) R	ppm-mol	≤ 10	≤ 10
Amine I	ppm-mol	≤ 10	≤ 10
Ammonia (NH_3) I	ppm-mol	≤ 0.2	≤ 10
Carbon monoxide (CO) C	ppm-mol	≤ 100	≤ 1000
Methanol (CH_3OH) NR	ppm-mol	≤ 30	≤ 500
Ethanol (C_2H_5OH) NR	ppm-mol	≤ 1	≤ 20
Glycols NR	ppm-mol	0	≤ 50
Aldehydes NR	ppm-mol	≤ 20	Not specified
Hydrogen fluoride (HF) R	ppm-mol	≤ 10	Not specified
Hydrogen chloride (HCl) R	ppm-mol	≤ 40	Not specified
Hydrogen cyanide (HCN) R	ppm-mol	≤ 10	Not specified
BTEX (Aromatic HC) NR	ppm-mol	≤ 0.5	≤ 100
Mercury (Hg) R C	ppb-mol	≤ 0.04	≤ 5 ng/L
C2+ (Aliphatic HC) NR	ppm-mol	≤ 1500	≤ 2000
Hydrogen (H_2) C	ppm- mol	≤ 50	≤ 1 mol%
Total non-condensable (eg: CH_4, N_2, Ar, H_2) NR	ppm - mol	≤ 850	≤ 4 mol%
Total Sulphur R C	ppm-mol	≤ 20	≤ 20
Solid (eg: Cadmium, Thallium) S	micron	≤ 1	≤ 1 ppmwt (≤ 40 micron)

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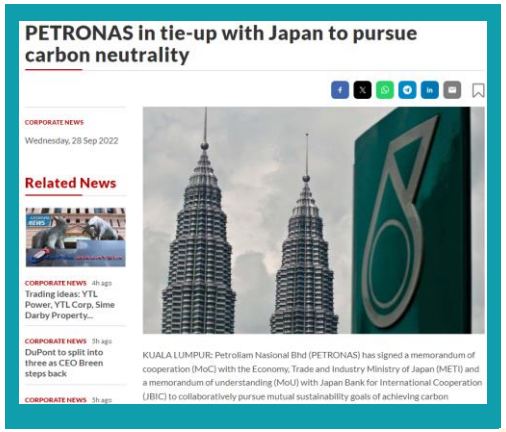
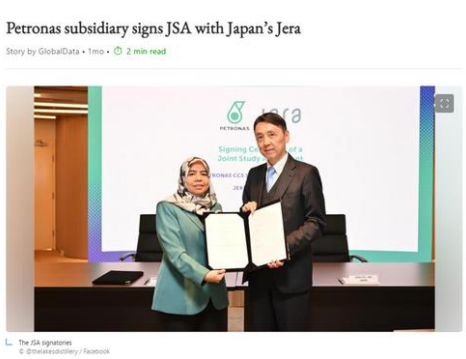
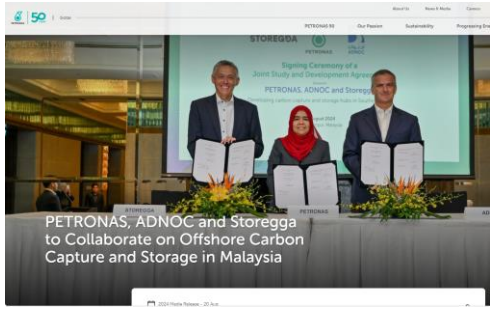
R Reactive NR Non-reactive C Cracking I Inhibitors S Solids

PETRONAS is building the CCS value chain through strategic partnerships and collaborations with industry players, leveraging our collective experience and expertise







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The ecosystems development are as critical as the infrastruction development in ensuring the delivery of CCS Development at the right pace.

POLICY & REGULATION

Industry-led policy and regulatory actions that create certainty, open markets, and strengthen the legal foundations needed for bankable CCS investments.

TECHNICAL & TECHNOLOGY

Advancing proven and innovative CCS technologies to enhance efficiency, reduce costs, and improve long-term project viability.

SUPPLY CHAIN

Building a competitive, CCS-ready supply chain to lower execution risk, ensure quality, and improve investment returns.

COMMUNICATIONS & ADVOCACY

Shaping public, industry, and investor perception to build confidence, accelerate adoption, and attract market participation in CCS.

FUNDING

Mobilising diverse financing solutions and partnerships to unlock capital, share risks, and sustain large-scale CCS deployment.

Together, these efforts not only contribute to the climate impact mitigation but also a new industry that will spur economic growth for the future

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Passionate about Progress