



ASEAN Centre for Energy
One Community for Sustainable Energy

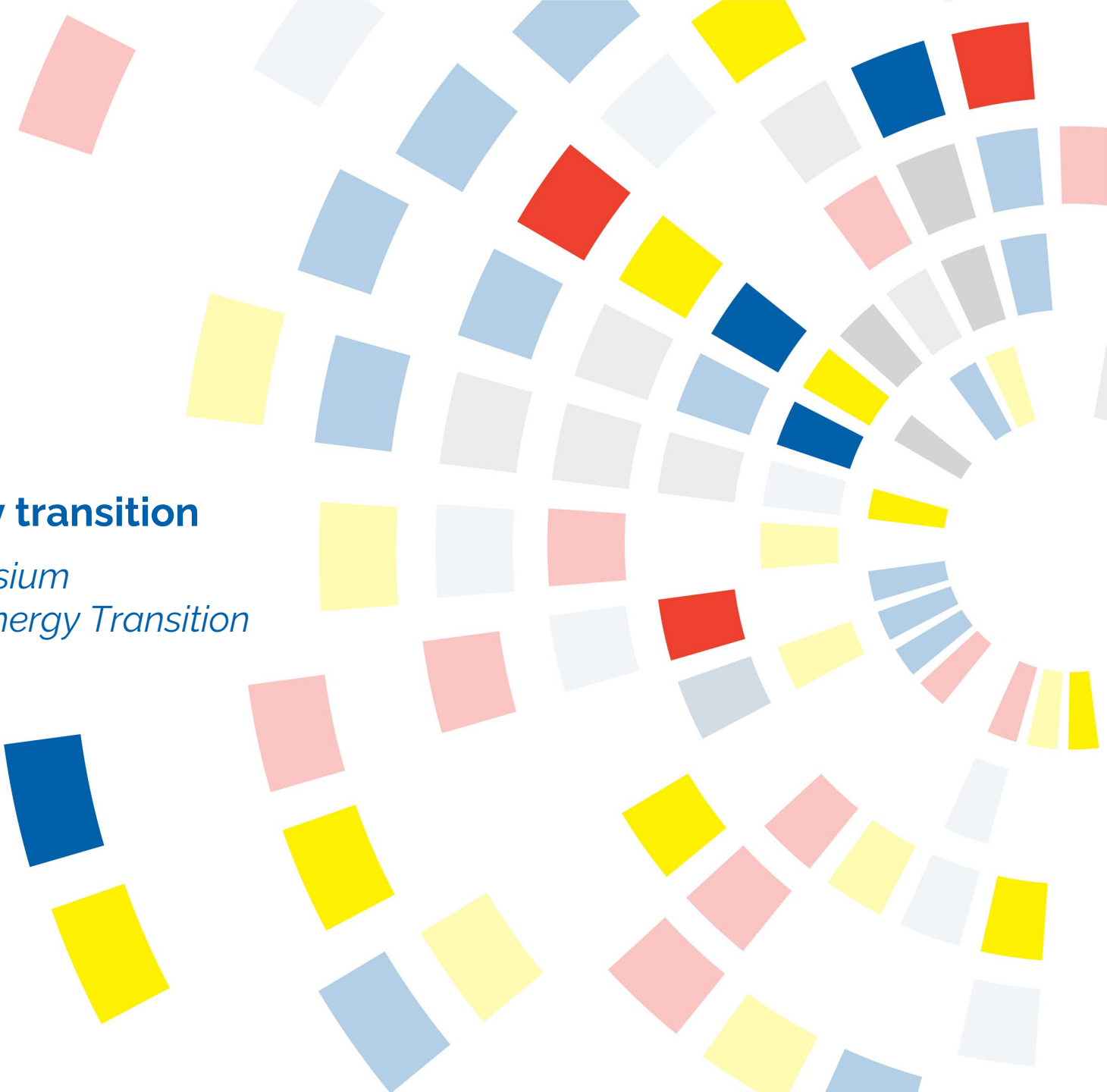
The roles of CCU/S in ASEAN's energy transition

The 35th Clean Coal Day International Symposium
Session 1: Energy Situation based on a Just Energy Transition
September 3rd, 2026

Dr Tubagus Aryandi Gunawan

Senior Research Analyst
Fossil Fuels, Hydrocarbons, & Minerals (FOM) Dept.
ASEAN Centre for Energy

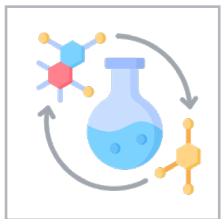
aryandi.gunawan@aseanenergy.org



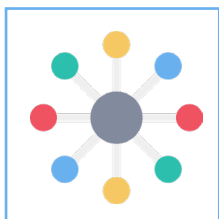
Introduction to ASEAN Centre for Energy (ACE)



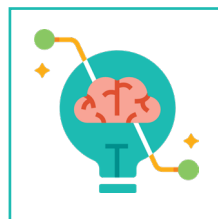
The **ASEAN Centre for Energy (ACE)** was established on **January 1, 1999**, and is headquartered in **Jakarta, Indonesia**. It serves as an intergovernmental organisation within the ASEAN framework, representing regional interests in the energy sector. ACE carries out its mission by fulfilling **three key roles**:



Catalyst



Knowledge Hub



Think Tank

Our regional energy cooperation blueprint, **ASEAN Plan of Action for Energy Cooperation (APAEC)**



APAEC is a series of guiding policy documents serve as the platform for cooperation within ASEAN as well as with dialogue partners and international organisations.

What does APAEC do?

Promoting multilateral cooperation and integration in the energy sector.

What is APAEC trying to achieve?

To attain the goals of the ASEAN Economic Community (AEC) by enhancing security, accessibility, affordability, and sustainability in the energy sector.

CCUS has a focused but critical role in ASEAN's energy transition

Rapid energy demand growth, persistent fossil dependence and a large industrial base leave residual emissions that are difficult to address through renewables and electrification alone.

Decarbonising the rising demand



698 Mtoe

ASEAN Primary Energy Supply in 2022



43%

TPES came from industry consumption



>5,000 MtCO₂e

Emission projected for 2050 (BAU)

- Economic growth, urbanization, and industrialization continue to increase energy demand.
- Industry is already the largest final energy-consuming sector in ASEAN.
- ASEAN need to decarbonize this growing energy system.

Complementing the bigger strategy

70.2%

Renewables share of TPES by 2050 in
AEO8 Carbon Neutrality Scenario

Primary transition measures



Energy
efficiency



Renewables



Electrification



Fuel
switching

- The 8th ASEAN Energy Outlook (AEO8) prioritise efficiency, renewables, electrification, and fuel switching to deliver the bulk of emissions reduction.
- However, residual emissions remain from hard-to-abate sectors (cement, iron & steel, chemicals), refining and processing.

CCUS to fill the gap



~40%

Power + heavy industry share of emission



~130 Gt

Estimated regional CO₂ potential

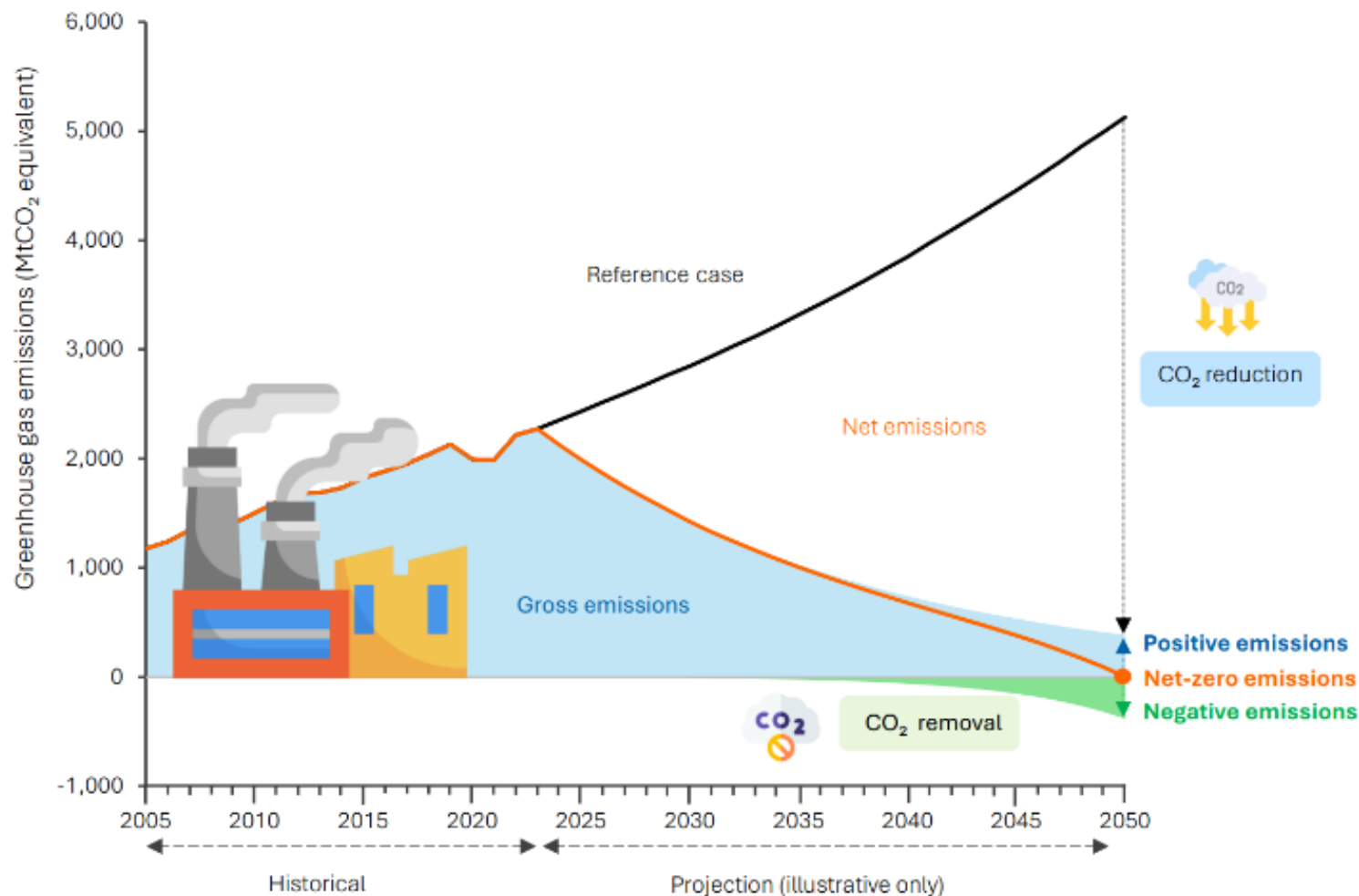


~8% contribution

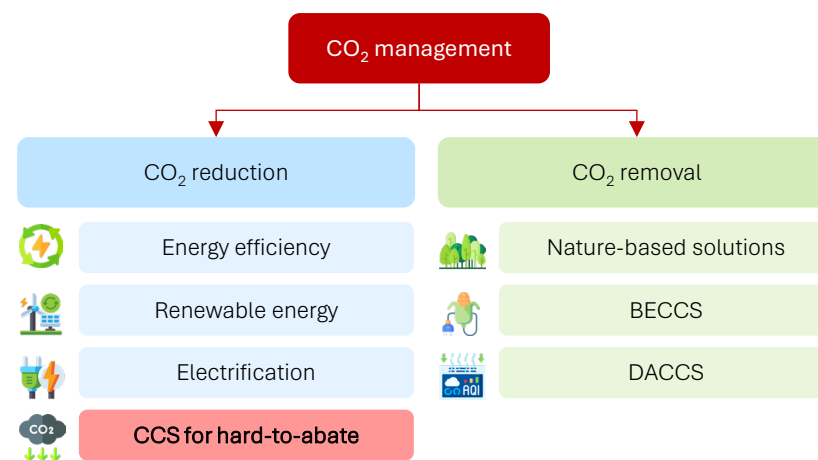
Potential to electricity supply by 2050

- CCUS can help these hard-to-abate industries and the remaining fossil-fuel-based power sector to decarbonise.
- ASEAN's existing oil & gas sector capabilities and storage resources create a pathway to scale
- There is a potential for a shared-hub/cross-border approach for regional-level decarbonisation.

Emissions in ASEAN are expected to double by 2050



In 2023, greenhouse gas (GHG) emissions in ASEAN reached 2,271 million tonnes of CO₂ equivalent. ASEAN will require carbon management, which includes both CO₂ reduction and CO₂ removal, to achieve net-zero emissions, as shown in the figure on the left.



CCS will be essential for industries that are difficult to decarbonize. ASEAN will also require CO₂ removal through nature-based solutions, such as afforestation, reforestation, and soil carbon sequestration. Industrial-scale engineering, such as bioenergy with CO₂ Capture and Storage (BECCS) and Direct Air CO₂ Capture and Storage (DACCS), will also be critical.

*) **Hard-to-abate sectors:** Economic sectors with higher abatement costs include heavy industries such as cement, steel, and chemicals, as well as heavy-duty transport, including road transport, shipping, and aviation, according to the [Energy Transition Commission](#).

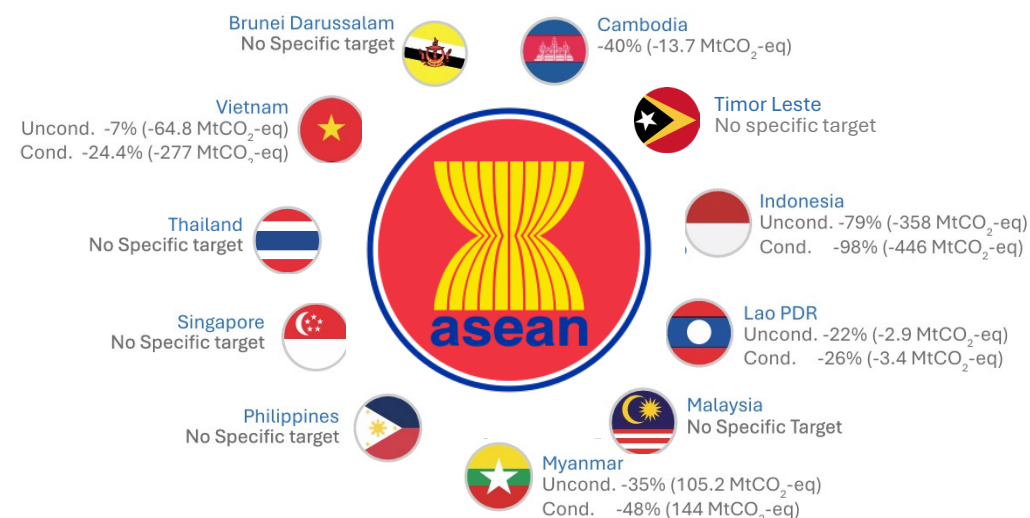
Most ASEAN countries commit to decarbonising power & industrial sectors

Countries around the world, including ASEAN Member States have submitted their **Nationally Determined Contributions (NDCs)** targets for **greenhouse gas (GHG) reduction and net-zero/carbon neutrality**, to tackle the effect of climate change.

Net-zero targets

Brunei Darussalam Net-zero by 2050	Myanmar Net-zero from forestry and other land use by 2040
Cambodia Net-zero and carbon neutrality by 2050	Philippines No specific target
Indonesia Net-zero by 2060 or sooner	Singapore Net-zero by 2050
Lao PDR Net-zero by 2050, conditionally	Thailand Carbon neutrality by 2050; net-zero by 2065
Malaysia Net-zero by 2050	Vietnam Net-zero by 2050
	Timor Leste No specific target

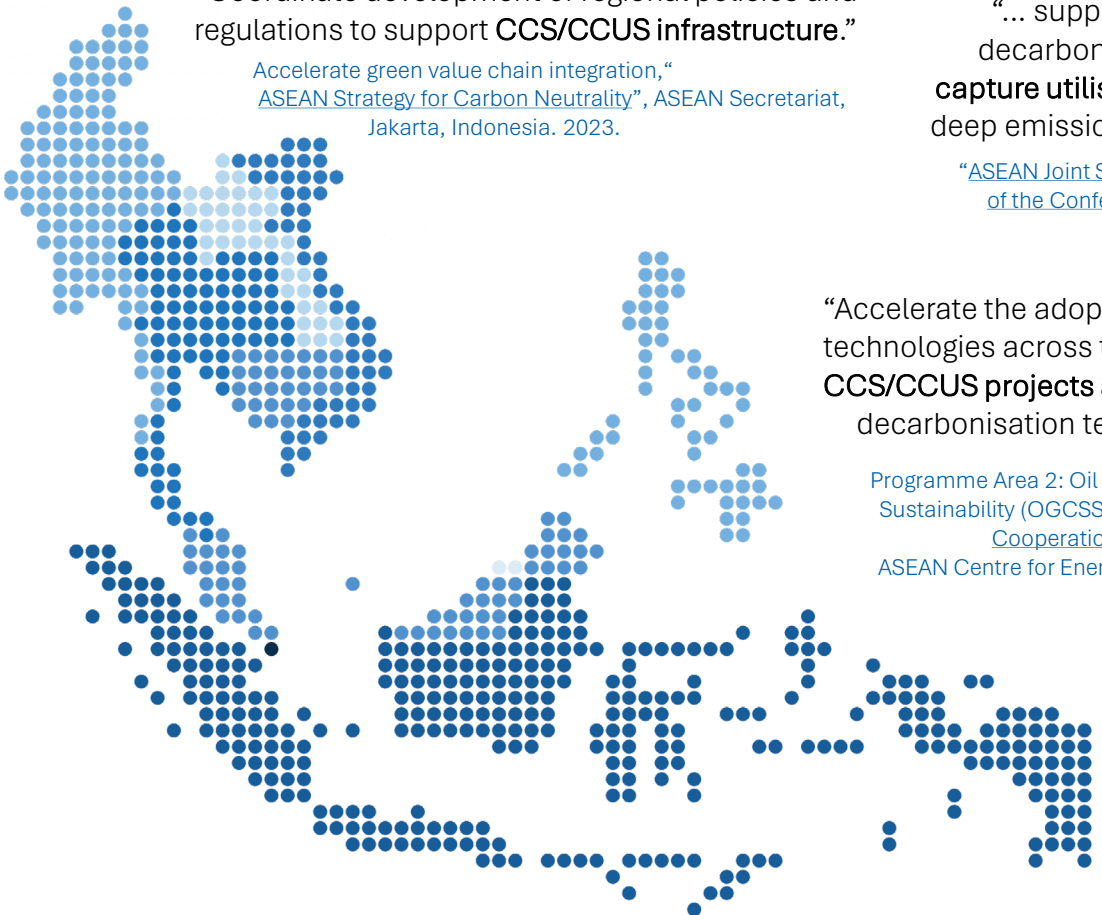
NDCs for GHG reduction targets



Reference: ACE (2024) – The 8th ASEAN Energy Outlook

Almost 77% of the GHG emissions in ASEAN are generated by the energy sector, industrial processes, and land use. To support the achievement of those targets and meet the rapid growth in energy demand, countries are investigating ways to integrate hard-to-abate power and industry sectors with decarbonisation technologies, such as **Carbon Capture, Utilisation and/or Storage (CCU/S)**.

A growing recognition of CCU/S as a key decarbonisation technology



“Coordinate development of regional policies and regulations to support **CCS/CCUS infrastructure**.”

[Accelerate green value chain integration, “ASEAN Strategy for Carbon Neutrality”, ASEAN Secretariat, Jakarta, Indonesia. 2023.](#)

“... support the scaled-up deployment of key decarbonization technologies such as **carbon capture utilisation and storage (CCUS)** ...to facilitate deep emission reductions in hard-to-abate sectors*”

[“ASEAN Joint Statement on Climate Change to the 30th Session of the Conference of the Parties to the UNFCCC COP30,” Belém, Brazil. 2025.](#)

“The Meeting further encouraged the advancement of innovative solutions such as ... emission reduction technologies such as **carbon capture utilisation and storage (CCUS)** ...”

[“Joint Media Statement of the Forty-Third ASEAN Ministers on Energy Meeting \(43rd AMEM\),” Kuala Lumpur, Malaysia. 2025.](#)

“Accelerate the adoption of decarbonisation technologies across the operations, particularly **CCS/CCUS projects** and other emerging decarbonisation technologies.”

Programme Area 2: Oil and Gas Connectivity, Security, and Sustainability (OGCSS), “[ASEAN Plan of Action for Energy Cooperation \(APAEC\) 2026-2030,](#)” ASEAN Centre for Energy (ACE), Jakarta, Indonesia. 2025.

“... accelerate the adoption of emerging and decarbonisation technologies, such as hydrogen, **carbon capture and storage (CCS)**, and **carbon capture, utilisation and storage (CCUS)**, in oil and gas sector.”

Aspiration, “[The ASCOPE Charter,](#)” ASEAN Council on Petroleum and Energy (ASCOPE), Jakarta, Indonesia. 2025.

“Strategies (in developing low-carbon hydrogen) vary ... countries with abundant renewable energy prioritise green hydrogen production, while others focus on **blue hydrogen using fossil fuels with CCS.**”

[“ASEAN Low-Carbon Energy Technologies Roadmap \(ALERT\) – Phase I: ASEAN’s Long-Term Strategy on Hydrogen and Ammonia,”](#) Economic Research Institute for ASEAN and East Asia (ERIA), and ASEAN Centre for Energy (ACE), Jakarta, Indonesia. 2025.

Source: Handbook for CO₂ Capture, Transportation, Utilisation, and Storage: A Practical Guide to Key CO₂ Technologies for Decarbonising Power and Industry (publication is in preparation)

Targeted applications for CCU/S in the ASEAN region

ASEAN's policy goals go beyond oil and gas, encompassing industry and, in certain countries, the power sector as well.

	Country	O&G-led application	Industry / hard-to-abate focus	Power sector application
	Brunei Darussalam			
	Cambodia		✓ Industrial / food-grade CCU	✓ CFPP
	Indonesia	✓ Upstream O&G; EOR	✓ Hard-to-abate industries	✓ Coal power; BECCS / biomass-coal co-firing
	Lao PDR			
	Malaysia	✓ Oil & Gas	✓ Manufacturing industry	
	Myanmar			
	Philippines			
	Singapore		✓ Hard-to-abate sectors	
	Thailand	✓ Upstream O&G; natural gas separation plants	✓ Petrochemicals; cement	
	Timor Leste	✓ Upstream O&G		
	Viet Nam			✓ LNG-to-power with CCS

ASEAN-level

- **Hard-to-abate sector:** Scale up CCUS to enable deeper emission reductions in sectors where emissions are difficult to abate
ASEAN Joint Statement on Climate Change to the 30th Session of the Conference of the Parties to the UNFCCC (COP30), 2025
- **Oil & gas sector:** Accelerate CCS/CCUS deployment across O&G operations as an emerging decarbonisation technology
ASEAN Plan of Action for Energy Cooperation (APAEC) 2026–2030, Programme Area 2: Oil and Gas Connectivity, Security, and Sustainability (OGCSS); The ASCOPE Charter, 2025
- **Low-carbon hydrogen:** Enable blue hydrogen production using fossil fuels with CCS as one pathway for low-carbon hydrogen development
ASEAN Low-Carbon Energy Technologies Roadmap (ALERT) – Phase I; ASEAN's Long-Term Strategy on Hydrogen and Ammonia, 2025

★ **Three sectoral priorities stand out: oil and gas, hard-to-abate industry, and power-sector applications.**

Sources: Cambodia – NDC 3.0; LTS-LCCR 2050. Indonesia – MEMR Net Zero Roadmap; NDC 2.0; MEMR Reg. 2/2023; PR 14/2024. Malaysia – Updated NDC 1.0; NETR; NEP 2022–2040; NIMP 2030. Singapore – NDC 2.0. Thailand – Petroleum Act amendments; BOI Announcement 7/2564; NDC 3.0. Viet Nam – Decisions 893/QD-TTg (2023), 215/QD-TTg (2024), and 854/QD-BCT (2024).

Key policies and regulations for CCU/S across ASEAN countries

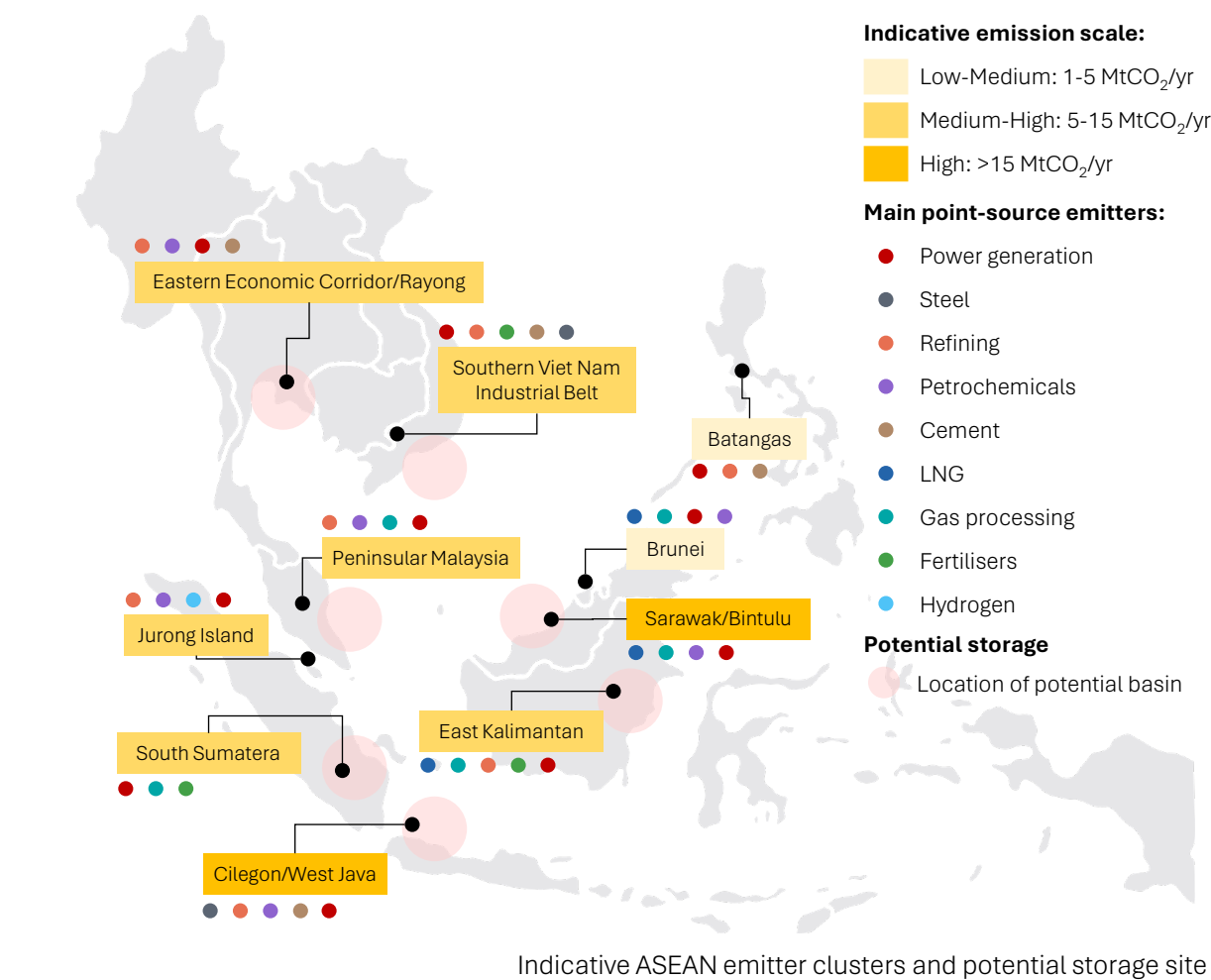
CCUS is increasingly recognised in national strategies. Dedicated, CCS-specific frameworks are also increasing

	Country	Supporting policy & regulation	CCS-specific regulation	Upcoming
	Cambodia	NDC 3.0 (CFPP, industrial, food)		
	Indonesia	- Long-term Strategy for Low Carbon and Climate Resilience 2050 (LTS-LCCR 2050) (CFPP, BECCS) - MEMR Roadmap to Net Zero Emissions by 2060 in the Energy Sector (industry, upstream O&G, CFPP) - MEMR Regulation No. 13/2024, Government Regulation No. 19/2025, Government Regulation No. 28/2025, ISO/TC 265 adoption to SNI, Presidential Regulation No. 110/2025.	- MEMR Regulation No. 2/2023; - Presidential Regulation No. 14/2024; - MEMR Regulation No. 16/2024; - PTK-070/SKKIA0000/2024/S9	Full operationalisation of the national carbon market, including SRUK and additional implementing regulations
	Malaysia	- National Energy Transition Roadmap (NETR) (industry) - National Energy Policy (NEP) 2022–2040 (oil and gas) - New Industrial Master Plan 2030 (NIMP 2030) (industry)	- CCUS Act 2025 (Act 870) - Sarawak Land Code and Land (Carbon Storage) Rules 2022	Carbon tax for energy, iron and steel sectors with national MRV (2026); National Climate Change Bill / National Climate Change Authority Bill
	Singapore	NDC 2.0 (hard-to-abate industry)		
	Thailand	- NDC 3.0 (industry such as petrochemical, cement) - BOI Announcement No. Sor. 7/2564 (2021) (gas separation) - Petroleum Act B.E. 2514 (1971) Amendments		Further development of CCS governance framework following approval of National CCS Guidelines
	Timor Leste	Programme of the IX Constitutional Government (oil and gas)		
	Viet Nam	- Decision 893/QD-TTg (2023) (LNG-to-power) - Decision 215/QD-TTg (2024); Decision 854/QD-BCT (2024)		

Note: *Supporting policy* refers to broader climate, energy, and industrial policy documents that recognise CCUS; *Specific regulation* refers to CCS/CCUS-specific legal or regulatory instruments; *Upcoming* reflects publicly announced developments as of June 2026.

Distribution of CO₂ sources and sinks

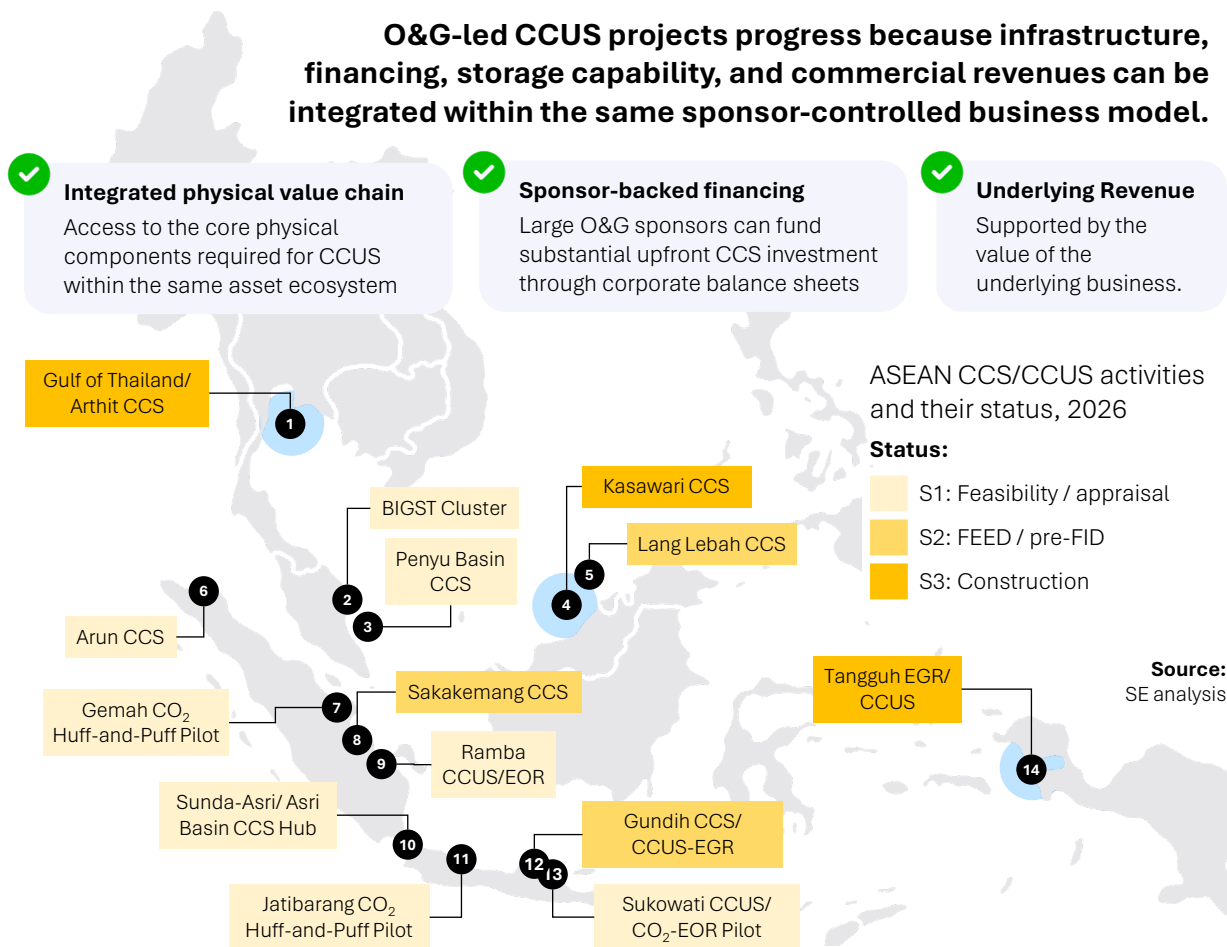
Some emissions-intensive industrial facilities are collocated with geological CO₂ storage sites



Country	Saline aquifers Storage Capacity (Gt CO ₂)	Oil & gas reservoirs Storage Capacity (Gt CO ₂)	Assessment level
Indonesia	~30–700+	~1–10	Saline aquifers: theoretical to effective (basin & field scale); O&G: effective
Malaysia	~65–140	~3–4	Effective (basin and field scale)
Thailand	~9–35	~1–1.5	Saline aquifers: theoretical & effective; O&G: effective
Vietnam	~10–23	~0.6–0.9	Saline aquifers: theoretical & effective; O&G: effective
Philippines	~20–25	<1	Saline aquifers: theoretical; O&G: effective
Myanmar	~5–12	~0.7–0.8	Effective (basin scale)
Brunei Darussalam	~4–28	~1–1.5	Effective
Cambodia	~0.09 (90 Mt)	Included in total	Theoretical
Lao PDR	Not assessed	Not assessed	No published assessment
Singapore	Not assessed	Not assessed	No domestic geological storage
Timor-Leste	Not assessed	Not assessed	No published national storage assessment; Project specific assessments ongoing

Distribution of CCU/S projects in ASEAN

Most CCUS activities in ASEAN are in feasibility studies, storage appraisal, injection tests, and are led by O&G companies



Only three large-scale CCUS projects (>1 MtCO₂/year) have progressed to construction phase: *Tangguh, Kasawari, and Arthit.*

1. Indonesia – Tangguh UCC Project in West Papua

Operator	: bp-operated Tangguh production-sharing contract
Core model	: CO ₂ separated from produced gas at Tangguh LNG in Ubadari Field → processed and compressed → transported offshore → reinjected into Vorwata field for storage and Enhanced Gas Recovery.
Scale	: 15 MtCO ₂ for initial phase; up to 30 MtCO ₂ by 2035
Timing	: Ubadari field production expected to start in 2028

2. Malaysia – Kasawari CCS in Sarawak

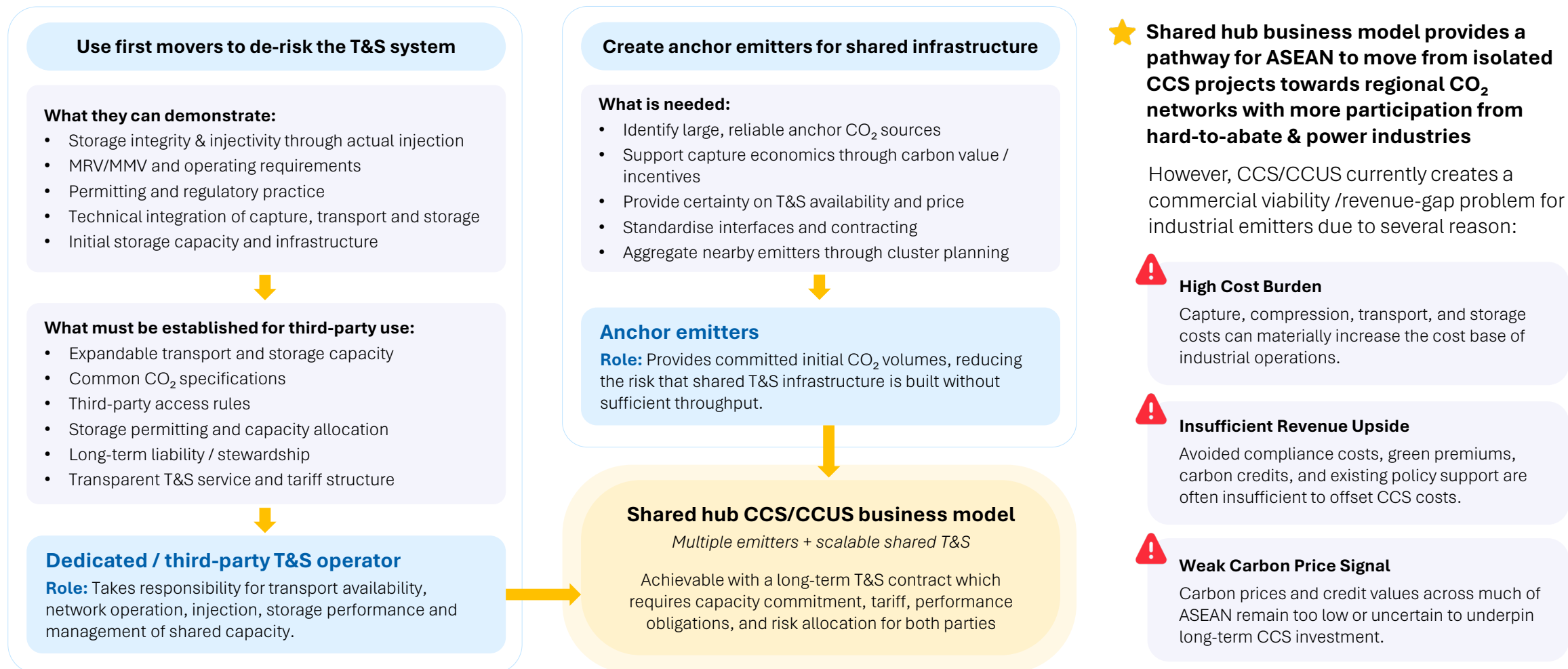
Operator	: PETRONAS Carigali Sdn Bhd, wholly owned subsidiary of PETRONAS
Core model	: CO ₂ associated from Kasawari gas field is captured → conditioned offshore → transported by subsea pipeline → injected into a depleted offshore reservoir.
Scale	: 3.3 MtCO ₂ e/y once operational
Timing	: FID reached in 2022; project remains in development / pre-injection

3. Thailand – Arthit CCS Project in Gulf of Thailand

Operator	: PTT Exploration and Production Public Company Limited (PTTEP)
Core model	: CO ₂ from petroleum production processes at the Arthit Gas Field is captured → processed → injected into subsurface reservoirs associated with the existing offshore field.
Scale	: up to ~1 MtCO ₂ /y once operational
Timing	: FID reached in 2025; CCS operation expected to commence in 2028

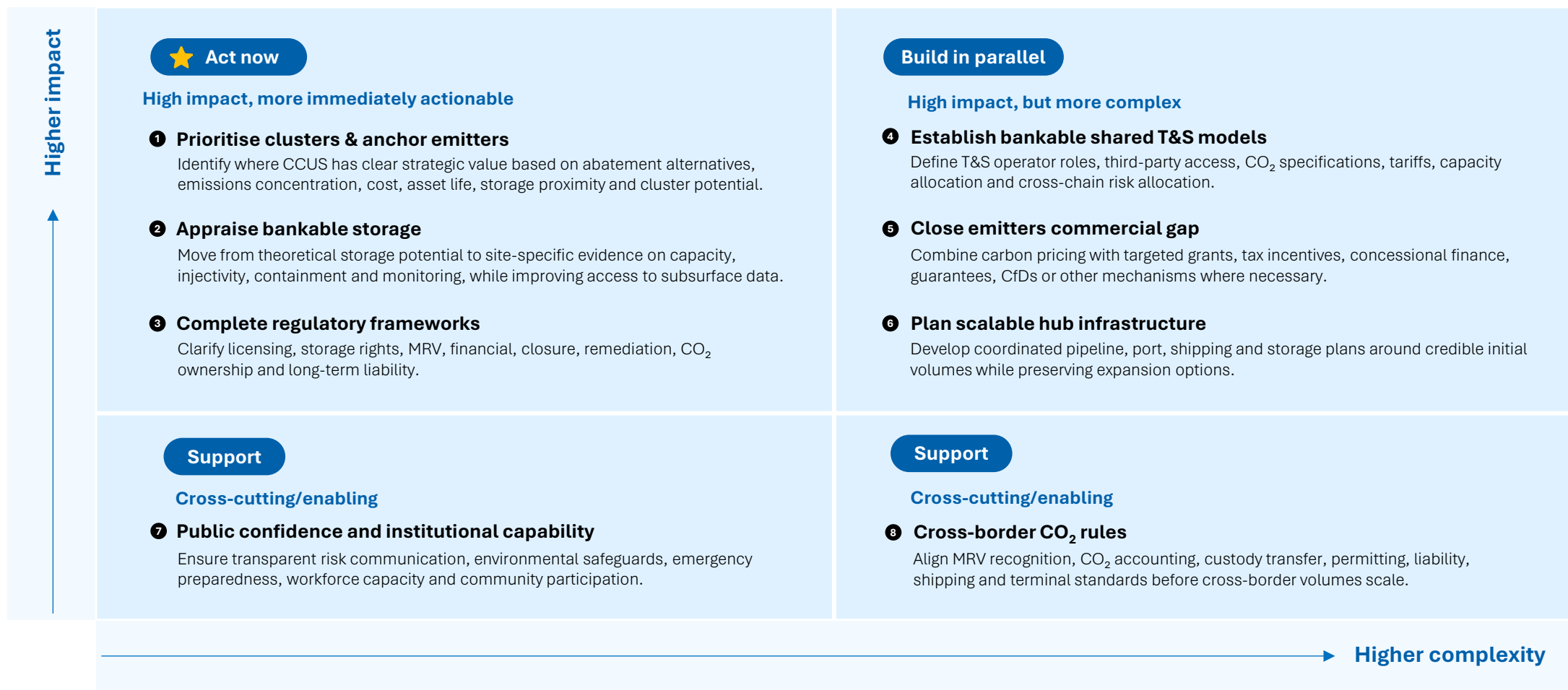
How do we move from projects to hubs?

O&G first movers can become the foundation for shared T&S, but hubs also require bankable anchor emitters.



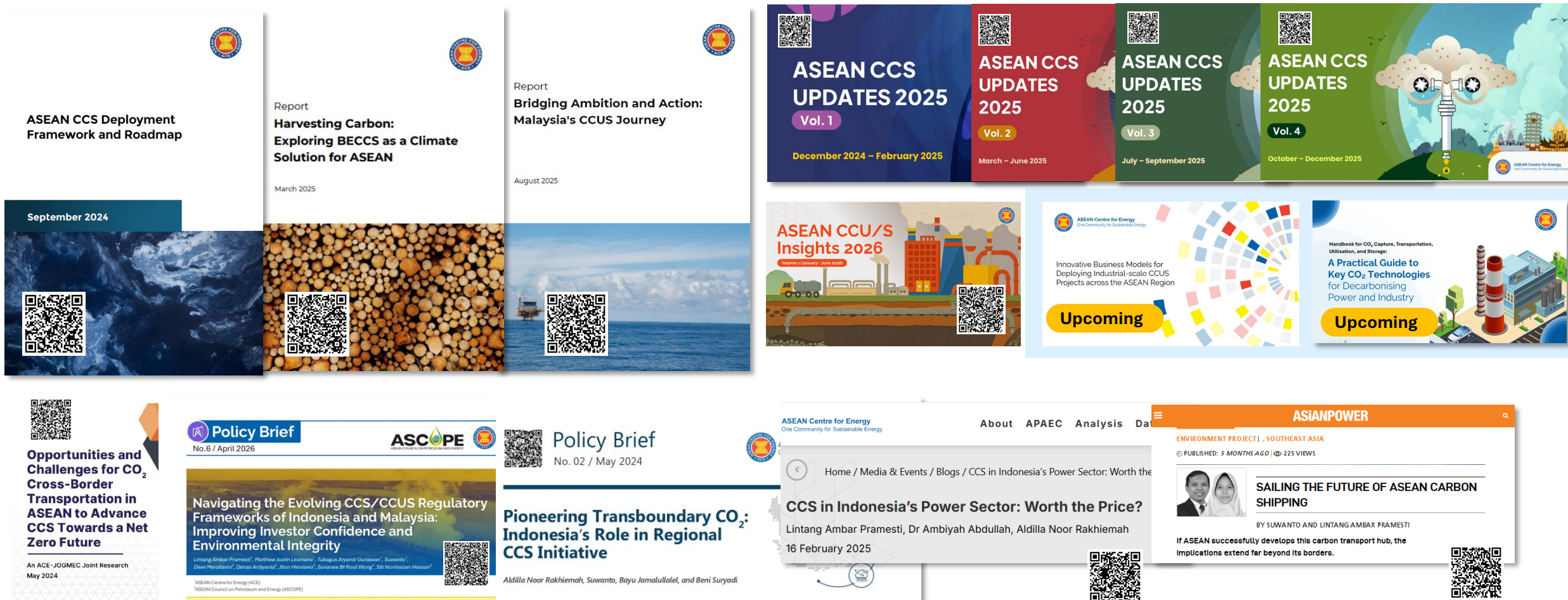
What should ASEAN prioritise?

ASEAN should prioritise actions that de-risk shared infrastructure and close the commercial gap for emitters



ACE supports the region's efforts towards CCU/S adoption

through joint studies, projects, and publications





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