MINISTRY OF ECONOMY

MALAYSIA CCUS ROADMAP 2050

Towards Green Economy



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Foreword by **Minister of Economy**

Malaysia's journey towards net zero emissions by 2050 is not merely an environmental undertaking, but also an economic opportunity. The low-carbon transition must serve as a catalyst for economic restructuring, an opportunity to build new industries, attract quality investment and raise the complexity of our economy. Carbon capture, utilisation and storage (CCUS) sits at the heart of this vision, offering a credible pathway to decarbonise our hard-to-abate industries while positioning Malaysia as a regional CCUS leader.

The Malaysia CCUS Roadmap 2050: Towards Green Economy arrives with strong foundations in place. The CCUS Act 2025 provides the legal and institutional architecture for this industry and our enhanced Nationally Determined Contribution reflects a heightened level of national ambition. This Roadmap translates that ambition into a clear and sequenced strategy, charting the path towards Malaysia's first CO_2 injection as early as 2030 for non-petroleum operations.

Malaysia's advantages are substantial. We hold vast geological storage potential, decades of oil and gas expertise, a strategic location at the heart of ASEAN and industrial clusters ready to anchor early deployment. The development of CCUS hubs, particularly along the east coast of Peninsular Malaysia, will drive industrial decarbonisation while spreading investment, employment and socio-economic prosperity across the region. Beyond decarbonisation, CCUS strengthens our energy security and opens new frontiers for Malaysian companies to compete in a growing regional market for carbon storage services.

Delivering this Roadmap demands a whole-of-government and whole-of-nation effort. The Government will provide regulatory clarity, coordinated governance and an investment climate that de-risks early movers, while industry, financiers, academia and technology providers must invest, innovate and forge partnerships that turn storage potential into operating projects. Malaysia remains an attractive and competitive destination for such investment, and we intend to keep it that way.

I record my appreciation to all ministries, agencies, industry partners and stakeholders whose deliberations and contributions have shaped this Roadmap. The work ahead is substantial, but so is the opportunity. I am confident that, with disciplined execution and unity of purpose, this Roadmap will secure Malaysia's position as a regional CCUS leader and advance our transition towards a green economy for generations to come.



YB Tuan Haji Akmal Nasrullah bin Mohd Nasir
Minister of Economy
24 November 2026

Executive **Summary**

Global climate change, manifested through accelerating greenhouse gas (GHG) emissions and extreme weather events, poses a growing threat to national ecosystems, infrastructure and economic stability. Globally, carbon capture, utilisation and storage (CCUS) deployment has accelerated significantly, with investment growing more than 15-fold since 2020 to exceed USD5 billion in 2025. Leading economies such as the European Union (EU), the United Kingdom (UK), Norway and the United States (US) have introduced various efforts to scale up CCUS deployment in their respective countries to achieve climate goals.

Malaysia faces similar global climate pressures. Malaysia's updated Nationally Determined Contribution (NDC 3.0) commits to an economy-wide absolute emissions reduction target of 15 to 30 million tonnes of carbon dioxide equivalent ($MtCO_2eq$) by 2035 from projected peak levels. This reinforces the necessity for immediate structural interventions and proactive decarbonisation. CCUS has emerged as a critical enabler for emissions reductions, particularly for hard-to-abate industries as the country advances its low-carbon economy. The case for CCUS in Malaysia is anchored by two main drivers, namely meeting international climate commitments and unlocking new opportunities through a low-carbon economy. Realising this potential requires overcoming challenges such as high capital costs, limited market mechanisms, technology maturity and the need for skilled talent and public awareness, underscoring the urgency of a coordinated national strategy.

Malaysia's commitment to advancing CCUS development was initially established under the National Energy Transition Roadmap (NETR), which identifies CCUS as one of its six key energy transition levers, and further reinforced under the Thirteenth Malaysia Plan (RMK13), which emphasises accelerating CCUS industry development as a new source of economic growth. Therefore, the **Malaysia CCUS Roadmap 2050: Towards Green Economy** (Malaysia CCUS Roadmap) has been developed to provide strategic direction and strengthen investor confidence, while positioning Malaysia as a regional CCUS hub.

Malaysia has the foundations in place to develop as a regional CCUS leader, drawing on four key strengths. First, the nation holds abundant geological storage potential in depleted oil and gas fields and saline aquifers, exceeding domestic storage demand. Second, its strategic location in the Asia Pacific outside the Pacific Ring of Fire offers proximity to regional emitters alongside geological stability suited to long-term storage. Third, a mature oil and gas industry provides transferable subsurface, engineering and project management expertise, along with infrastructure that can be repurposed for carbon dioxide (CO_2) transport and storage. Fourth, an enabling ecosystem, anchored by the CCUS Act 2025 and a coordinated value chain of government and industry stakeholders, provides the regulatory certainty and collaboration needed to attract investment.

Central to the Malaysia CCUS Roadmap is a clear strategic direction, anchored in four Strategic Thrusts, four Enablers, 27 Initiatives and four Flagship Projects, drawing on global best practices and tailored to Malaysia's context. Four Flagship Projects have been identified to showcase early progress towards CCUS deployment in Malaysia. Together, these establish a coordinated framework to accelerate CCUS deployment, foster innovation and position Malaysia as a regional CCUS hub in support of its climate goals and green economy ambitions.

Introduction

Key Messages:

- *Carbon capture, utilisation and storage (CCUS) has emerged globally as an essential decarbonisation solution, particularly for emissions-intensive and hard-to-abate industries.*
- *Malaysia's CCUS development is supported by national policies including the National Energy Transition Roadmap (NETR), New Industrial Master Plan 2030 (NIMP 2030), National Climate Change Policy 2.0 (NCCP 2.0), Long-Term Low Emission Development Strategies (LT-LEDS) and the Carbon Capture, Utilisation and Storage Act 2025 (CCUS Act 2025).*
- *The roadmap adopts a whole-of-nation approach involving extensive stakeholder engagements, benchmarking and cross-sector collaboration.*
- *Malaysia's focus on CCUS reflects a balanced strategy that supports both emissions reduction and economic value creation.*

Background

Climate change has led to increasingly frequent and severe weather events, driven by rising greenhouse gas (GHG) emissions and long-term shifts in temperature and precipitation patterns.[1] These changes are impacting ecosystems, infrastructure and economies across regions, including Malaysia,[2,3] therefore underscoring the urgent need for decisive mitigation strategies. Achieving global climate goals and securing a sustainable future for both people and planet require rapid and deep decarbonisation across all sectors. The 28th Conference of the Parties (COP28) to the United Nations Framework Convention on Climate Change (UNFCCC) has recognised the need to accelerate the deployment of zero- and low-emission technologies, including GHG removal technologies such as CCUS, particularly from hard-to-abate industries. While many industries are making strides in reducing emissions, hard-to-abate industries continue to face unique challenges. In this context, CCUS has emerged as a critical enabler, offering a viable pathway to decarbonise emissions-intensive activities, alongside and complementing other solutions, while acting as a potential contributor to the green economy.

Globally, countries are advancing CCUS deployment through dedicated legal frameworks, national roadmaps and pilot projects. Operational carbon capture and storage (CCS) facilities have demonstrated the technology's potential, while carbon capture and utilisation (CCU) applications are gaining traction across industrial value chains. Malaysia is committed to the deployment of CCUS through a suite of national policies and strategic documents. These include the CCUS Act 2025, the Thirteenth Malaysia Plan (Thirteenth Plan), NETR, NIMP 2030, Nationally Determined Contribution Roadmap and Action Plan (NDC RAP), LT-LEDS, NCCP 2.0 and National Carbon Market Policy (NCMP). Notably, the NETR has outlined CCUS as one of the six levers integral to Malaysia's transition to a more sustainable and low-carbon economy.

Malaysia has achieved a significant milestone with the enforcement of the CCUS Act 2025 on 1st October 2025. CCUS development in Malaysia is progressing under the leadership of various ministries and agencies; however, it remains constrained by fragmented policies across ministries, high implementation costs, as well as the absence of clear and consistent investment signals. These challenges create regulatory uncertainty and limit private sector participation, slowing the deployment of CCUS as a key decarbonisation solution. Therefore, the Ministry of Economy has developed the Malaysia CCUS Roadmap. The roadmap is essential to channel resources towards high-impact initiatives that will spur job creation and generate economic benefits for the country, positioning Malaysia as a regional low-carbon economy and CCUS leader.

1 (Seneviratne et al., 2021)
2 (Malaysian Meteorological Department, n.d.)
3 (Department of Statistics Malaysia, 2025b)

Moving forward, the implementation of the roadmap will be supported by a dedicated, cross-ministerial project team tasked with coordinating efforts across government agencies, industry stakeholders and research institutions. This team will play a central role in ensuring policy alignment, facilitating investments, addressing regulatory gaps and driving the timely execution of priority initiatives under the Malaysia CCUS Roadmap.

At the global level, the outlook for CCUS is increasingly positive, underpinned by growing policy support, technological advancements and rising demand for decarbonisation solutions in hard-to-abate industries. As more countries strengthen their climate commitments and introduce carbon management frameworks, CCUS is expected to scale significantly, supported by improved cost efficiencies, development of carbon transport and storage infrastructure and the emergence of international carbon markets. This positions CCUS not only as a critical climate mitigation tool, but also as a key component of the future low-carbon economy worldwide.

Objectives

The Malaysia CCUS Roadmap outlines our pathway to realising CCUS as a new source of economic growth for Malaysia. It aims to provide strategic guidance and alignment of various initiatives across ministries, government agencies and industry players for the successful implementation of CCUS across the value chain, which is in line with the national commitment towards sustainability and a low-carbon economy.

In addition, the Malaysia CCUS Roadmap provides clarity for domestic industry players as well as potential investors by outlining implementation pathways and investment opportunities for CCUS in Malaysia.

Document Methodology & Outline

The Malaysia CCUS Roadmap was developed through a collaborative, structured approach to ensure alignment with national priorities, industry needs and long-term sustainability objectives. The methodology began with a comprehensive review and mapping of existing and planned CCUS-related policies, strategies and initiatives across relevant ministries and agencies, including NETR, NIMP 2030, NCCP 2.0, NDC RAP, LT-LEDS and other supporting frameworks. International benchmarking against leading CCUS countries was also undertaken to identify best practices, implementation models and enabling mechanisms relevant to Malaysia's context.

Based on these assessments, a strategy house was developed to organise the roadmap into key Strategic Thrusts and Enablers that collectively support the development of the national CCUS ecosystem. The framework was designed to address challenges and opportunities across the entire CCUS value chain, including capture, transport, utilisation and storage, as well as its ecosystem, regulation, financing, infrastructure, technology and market development.

To validate and refine the proposed roadmap directions, extensive stakeholder engagement sessions were conducted involving ministries, government agencies, industry players, financial institutions and other relevant stakeholders across the CCUS value chain. This included a ministerial workshop involving key ministries and agencies, as well as an industry-focused workshop with representatives from sectors such as oil and gas, power, steel, cement and finance. Feedback and recommendations gathered from these engagements were incorporated into the roadmap to ensure practicality, alignment with stakeholder expectations and readiness for implementation.

Within this framework, it is important to distinguish between CCS, CCU and CCUS, where CCS focuses on permanent geological storage of CO_2, CCU focuses on converting captured CO_2 into useful products and CCUS integrates both pathways to maximise decarbonisation and economic value creation. Malaysia adopts the CCUS approach because it offers a more holistic and flexible system that supports both emissions reduction and the development of new low-carbon industries. This aligns with internationally recognised standards and best practices, ensuring consistency with global methodologies while enabling Malaysia to optimise both environmental outcomes and economic opportunities across the full CCUS value chain.

The resulting roadmap reflects a coordinated whole-of-nation approach aimed at accelerating CCUS deployment in Malaysia, strengthening cross-sector collaboration and positioning the country as a regional CCUS hub while supporting national climate and economic aspirations towards 2050. Moving forward, a subsequent review of the document will be conducted to assess the milestones and targets for this roadmap.

Global CCUS Landscape.

This section outlines the global CCUS development trends, highlighting the rapid growth in CCS and CCUS facilities, emerging large-scale projects and the key policy frameworks driving deployment across leading economies. Finally, it provides benchmarking insights by presenting three case studies and showcasing the availability of CCUS technologies across the value chain.

Malaysia's CCUS Landscape.

This section examines the case of CCUS through Malaysia's climate commitments and economic opportunities, demonstrating its role as both a decarbonisation solution and catalyst for new low-carbon industries and long-term economic growth. It also outlines Malaysia's competitive advantage in CCUS, highlighting the country's strong geological storage potential, strategic location, maturity of oil and gas industry and enabling ecosystem that collectively position it as a regional CCUS hub.

Malaysia CCUS Roadmap 2050: Towards Green Economy

This section presents the Malaysia CCUS Roadmap, outlining its strategic framework comprising four thrusts and four enablers designed to accelerate CCUS deployment and position Malaysia as a regional hub. It details the strategic direction across hub development, regional CCS services, technology innovation and regional growth, supported by enabling pillars in policy, financing, human capital and public awareness to ensure coordinated and scalable implementation.

CCUS Flagship Projects.

This section presents the CCUS Flagship Projects, which translate the Malaysia CCUS Roadmap into tangible, high-impact initiatives across industrial, energy and bio-based sectors to demonstrate feasibility and scalability. These projects, led by key national stakeholders, showcase early deployment opportunities, key impacts and upcoming milestones, collectively supporting Malaysia's ambition to achieve its first carbon dioxide (CO_2) injection as early as 2030 for non-petroleum operations.



Global **CCUS Landscape**

Key Messages:

- *Global CCUS deployment is accelerating rapidly due to stronger climate commitments, enabling policies and increasing demand for industrial decarbonisation solutions.*
- *The EU and countries such as the United Kingdom (UK), Norway and the United States (US) demonstrate that strong regulation, financing mechanisms and cluster-based infrastructure are critical success factors for CCUS scale-up.*
- *Cross-border CO_2 transport and storage arrangements are emerging as an important feature of the evolving global CCUS market.*
- *Malaysia can leverage international best practices while tailoring its roadmap to local strengths and regional opportunities.*

CCUS Development Trends

CCS has emerged as a key technology in global efforts to mitigate climate change by reducing CO_2 emissions from hard-to-abate industries. In recent years, the global CCS landscape has experienced significant growth, driven by increasingly ambitious climate targets, supportive government policies and rising investments from both the public and private sectors. Countries are expanding CCS deployment through the development of large-scale capture facilities, shared CO_2 transport and storage infrastructure and industrial carbon management hubs. Despite ongoing challenges related to costs, infrastructure and regulatory frameworks, the rapid increase in planned and operational CCS projects reflects its growing role as an essential component of strategies to achieve net-zero emissions and support the transition to a low-carbon economy.

Globally, CCS has entered a period of accelerated deployment underpinned by significant investment, robust policy frameworks and deepening national commitments to decarbonisation. Global investment in CCUS has grown more than 15-fold since 2020 to exceed USD5 billion in 2025, with over 30 projects reaching final investment decisions between 2024 and 2026.[4] According to Wood Mackenzie (2024), CCUS represents a USD196 billion investment opportunity over the next decade[5] and is projected to rise more than 10-fold by 2027.[6]

As of 2025, there were 734 CCS facilities globally at various stages of development, with 77 projects in operation, 47 under construction and 297 in advanced development, representing a substantial and rapid advancement of CCS as depicted in Figure 2.1.

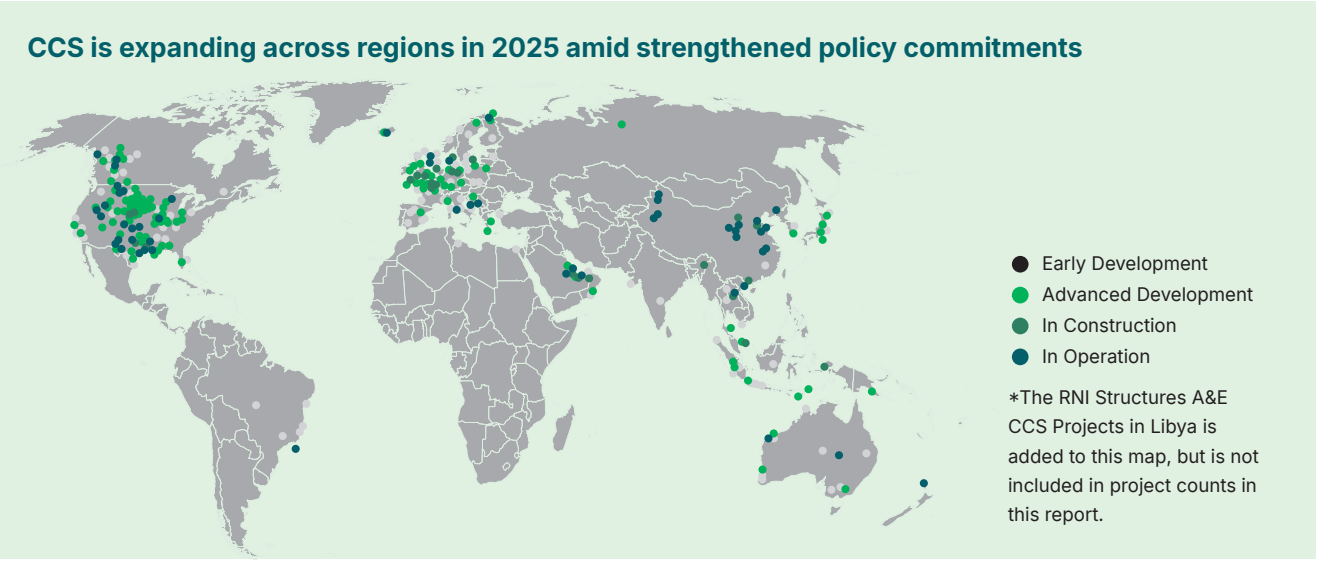


Figure 2.1: Global CCS Facilities in 2025

Source: Adopted from Global Status of CCS 2025, Global CCS Institute, 2025

[4] (International Energy Agency, 2026)
[5] (Gandhi, 2024)
[6] (International Energy Agency, 2025)

On a global scale, several countries have committed substantial public investments and policy measures to accelerate the development and commercialisation of CCS technologies. Nearly USD80 billion was committed across five countries, with the US making up 50 per cent of the investment, followed by the UK at 33 per cent, Canada at 10 per cent, while Denmark and Australia account for the remaining 7 per cent.[5] In Norway, the government's investment is approximately USD2 billion for the full-scale CCS programme. Emerging economies are following suit, with India recently committing approximately USD2.3 billion to CCUS deployment across its heavy industrial sectors.[7]

The bankability of CCUS projects is increasingly determined by the clarity of policy and governance through enabling legislation, regulatory frameworks, strategic signalling and cross-border arrangements. Figure 2.2 shows several key global policies that enable CCS and CCUS development based on internal findings by the Ministry of Economy. These include Canada, Norway, United Kingdom, Norway, United States and countries in the Middle East and Northern Europe. Key policy measures and regulations employed in these selected examples include regulatory frameworks, incentives and tax credits, carbon pricing mechanisms, facilitation of cross-border CO_2 transport and storage, and the establishment of CCS hubs.

At the regional level, the EU demonstrates a mature and integrated CCS ecosystem, anchored by a long-established regulatory framework under the CCS Directive 2009/31/EC and a strong carbon pricing mechanism through the EU Emissions Trading Scheme (EU ETS). This is reinforced by substantial funding mechanisms, including the Innovation Fund and the Just Transition Fund, while CCS is embedded within broader industrial decarbonisation strategies to ensure policy coherence across sectors. The EU is also among the most advanced globally in implementation, with well-developed CO_2 transport and storage infrastructure, operational cross-border frameworks and established CCS hubs such as the Porthos project in the Netherlands, making it a global benchmark for end-to-end CCS maturity.

The United Kingdom, Norway and the United States are examined further in the following section as they represent some of the more advanced CCUS markets globally, each offering a distinct and proven pathway to deployment, namely a cluster-based model transitioning to large-scale execution, an offshore storage hub with open-access cross-border services, and an incentive-driven model supported by strong federal funding, with relevant insights for Malaysia.

[7] There is no authoritative global database that reports a single "CCS/CCUS budget" for every country in the world. Governments fund CCUS through many different mechanisms, including Direct grants and capital funding, Tax credits (e.g., the U.S. 45Q tax credit), Contracts for Difference (CfDs), Carbon Contracts for Difference (CCfDs), Carbon pricing revenues, Loan guarantees, Public-private investment funds, Innovation funds, State-owned enterprise investments.

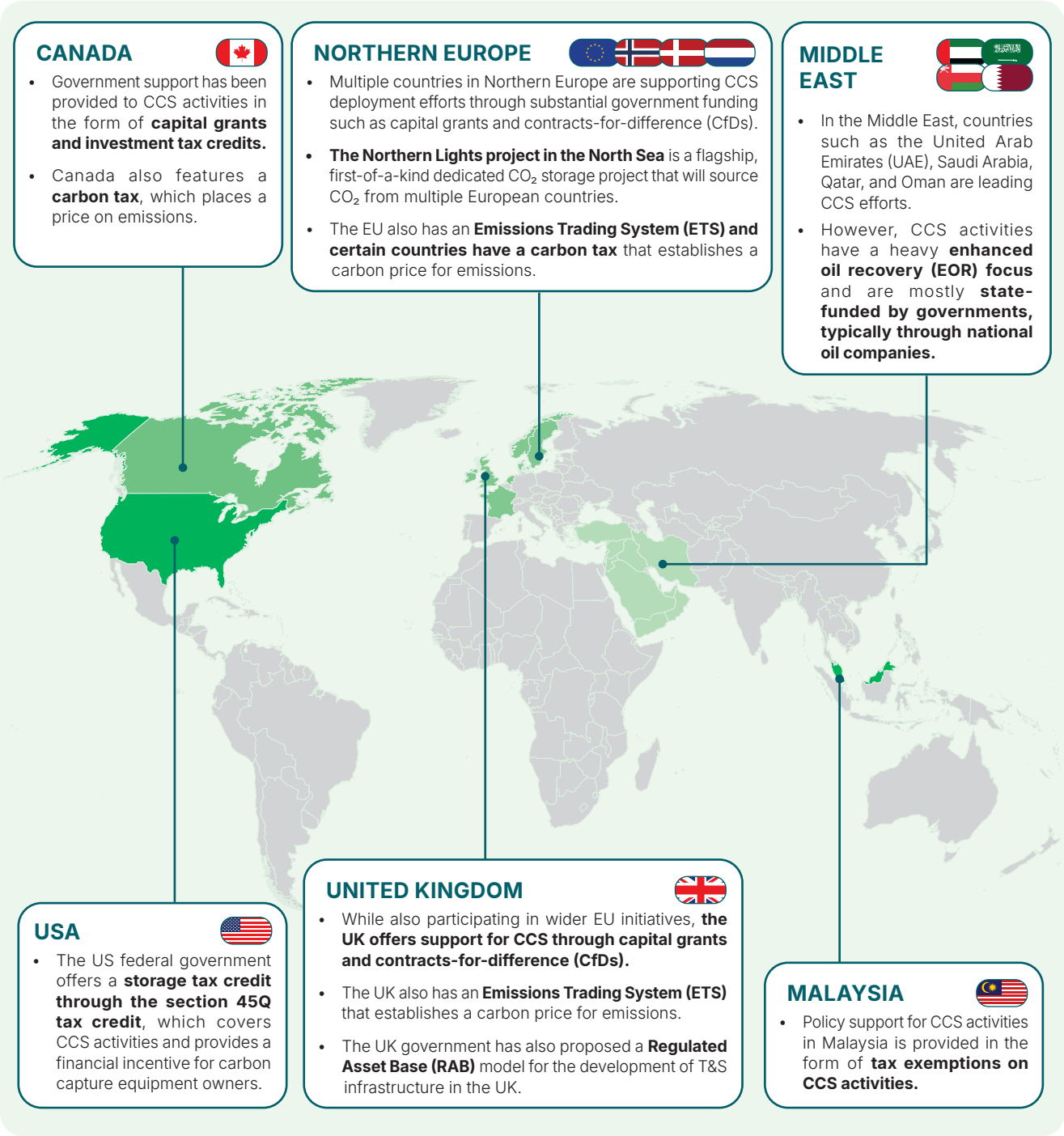


Figure 2.2: Key Global Policies That Enable CCS and CCUS Development

Case Studies

United Kingdom (UK) CCUS Experience

The UK has established a robust regulatory foundation and carbon pricing through the UK Emissions Trading Scheme (UK ETS), supported by a comprehensive CCS strategy. Financial incentives are particularly well developed, including the introduction of Contracts for Difference (CfDs), which provide clear revenue visibility and de-risk investment. The UK has made significant progress in developing industrial clusters and transport and storage business models, although some deployment timelines have experienced delays. While domestic CCS hubs and infrastructure are advancing, cross-border arrangements remain exploratory. Public engagement, government leadership and permitting frameworks are well defined, positioning the UK as a market that is transitioning from planning to large-scale execution, with a strong focus on industrial clusters.

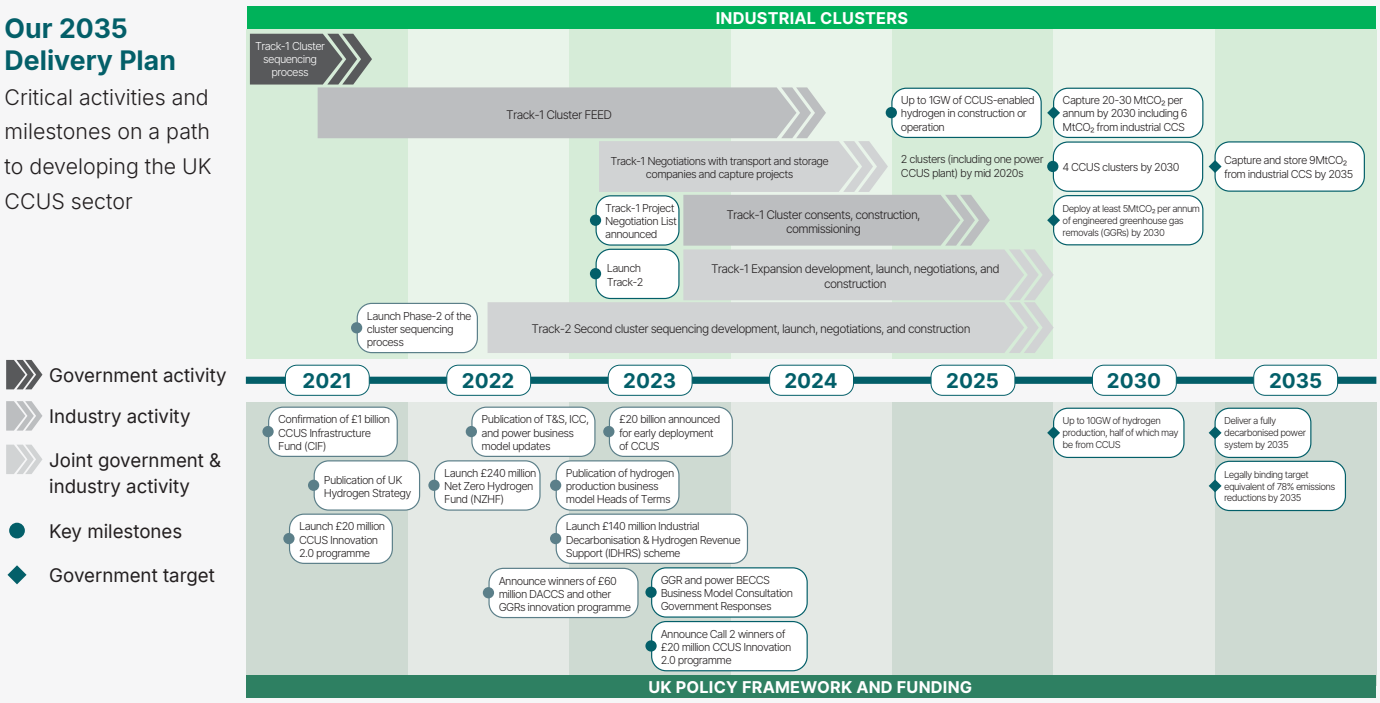
United Kingdom

Background

The UK's CCUS Net Zero Investment Roadmap (UK Roadmap) outlines a phased strategy to develop four industrial CCUS clusters by 2030 and expand towards a commercially sustainable market by 2035, as depicted in Figure 2.3. The UK Roadmap targets the capture and storage of 20–30 Mtpa of CO_2 by 2030 to support the UK's net-zero ambitions. The UK adopts a cluster-based approach, enabling multiple industrial emitters to share common transport and storage infrastructure to lower system costs and investment risks. Initial deployment focuses on the HyNet and East Coast Clusters under Track-1, with further expansion to additional clusters, namely Acorn and Viking, under Track-2.

Our 2035 Delivery Plan

Critical activities and milestones on a path to developing the UK CCUS sector



CCUS Net Zero Investment Roadmap: Capturing Carbon and a Global Opportunity

Figure 2.3: UK CCUS Net Zero Investment Roadmap Delivery Plan Towards 2035

Source: Adopted from CCUS Net Zero Investment Roadmap, the Department for Energy Security and Net Zero, UK Government, 2023

Enabling Mechanisms for CCS Implementation



Policies & Legislations

- Energy Act 2023 establishes the legal and licensing framework for CO_2 transport and storage.
- Storage of Carbon Dioxide (Access to Infrastructure) Regulations 2011 provide rules on third-party access to CO_2 storage sites and transport networks.
- Climate Change Act 2008 sets the UK's legally binding climate framework.



Financing

- CCS Infrastructure Fund (CIF) is a public funding mechanism established to support deployment of CCUS infrastructure, particularly shared CO_2 transport and storage networks.
- Transport and Storage Regulatory Investment (TRI) is an economic regulation funding model for CO_2 transport and storage operators.
- Industrial Carbon Capture (ICC) is a business model developed by the government to incentivise industrial emitters to invest in carbon capture projects.



Market-based Mechanisms

- UK ETS is the main compliance-based carbon pricing mechanism designed to cap and price emissions from regulated sectors.
- Climate Change Levy (CCL) is an environmental tax applied to non-domestic usage of electricity, gas and solid fuels to encourage energy efficiency and reduce carbon emissions.
- UK Carbon Border Adjustment Mechanism (UK CBAM) is a carbon tax imposed on selected imported goods produced with high carbon emissions.
- Voluntary Carbon Markets (VCMs) provide a complementary market mechanism to support investment in carbon removal solutions.

Highlighted Projects

The HyNet Cluster leverages shared CO_2 transport and offshore storage and demonstrates CCUS application in hard-to-abate cement production. Key projects include the Liverpool Bay Transportation & Storage Network and the Padeswood Cement Works Carbon Capture Project. HyNet was developed as an industrial cluster where multiple emitters share common transport and storage infrastructure to eliminate the need for individual company-specific CCS solutions. This reduces overall capital and operational costs, improves infrastructure utilisation and creates economies of scale.

The East Coast Cluster covers the industrial powerhouse regions of Teesside and the Humber, an area that accounts for around 50 per cent of the UK's industrial cluster emissions. Key projects include the Northern Endurance Partnership as the transportation and storage provider for the East Coast Cluster. The project highlights the importance of establishing a regional shared transport and storage network that serves multiple industrial emitters, while reducing costs, de-risking investment and accelerating industrial decarbonisation.

Note: The highlighted projects were selected for their demonstrated success or growing commercial traction, and their relevance to the Malaysian context

Norway CCUS Experience

Norway has more than 25 years of experience with CCS, supported by long-standing offshore storage regulations and strong government leadership. This is also supported by an early carbon pricing mechanism through its offshore petroleum carbon tax and participation in the EU ETS. Financial support is well established, particularly through the Longship CCS Project, which received substantial public funding to de-risk first-mover projects across the whole CCS value chain. Norway has made significant progress in developing offshore CO_2 transport and storage infrastructure, enabling both domestic and cross-border CO_2 storage services for European industrial emitters. Norway's extensive offshore expertise, proven storage experience and open-access storage model position the nation as a leading regional CCS hub.

Norway

Background

Norway is a global pioneer in CCS, with offshore storage projects such as Sleipner (1996) and Snøhvit (2008) demonstrating long-term operational experience and storage reliability. CCS forms a central component of Norway's climate strategy, supporting national targets to reduce GHG emissions by 55 per cent by 2030 and 90 per cent to 95 per cent by 2050 compared to 1990 levels. Norway's extensive offshore oil and gas expertise, coupled with significant geological storage potential in the North Sea, positions the country as a regional CCS hub in Europe. The Norwegian CCS strategy covers future carbon dioxide removal (CDR) solutions such as bioenergy with CCS and direct air capture (DAC). Figure 2.4 illustrates the Northern Lights CO_2 transport and storage value chain.

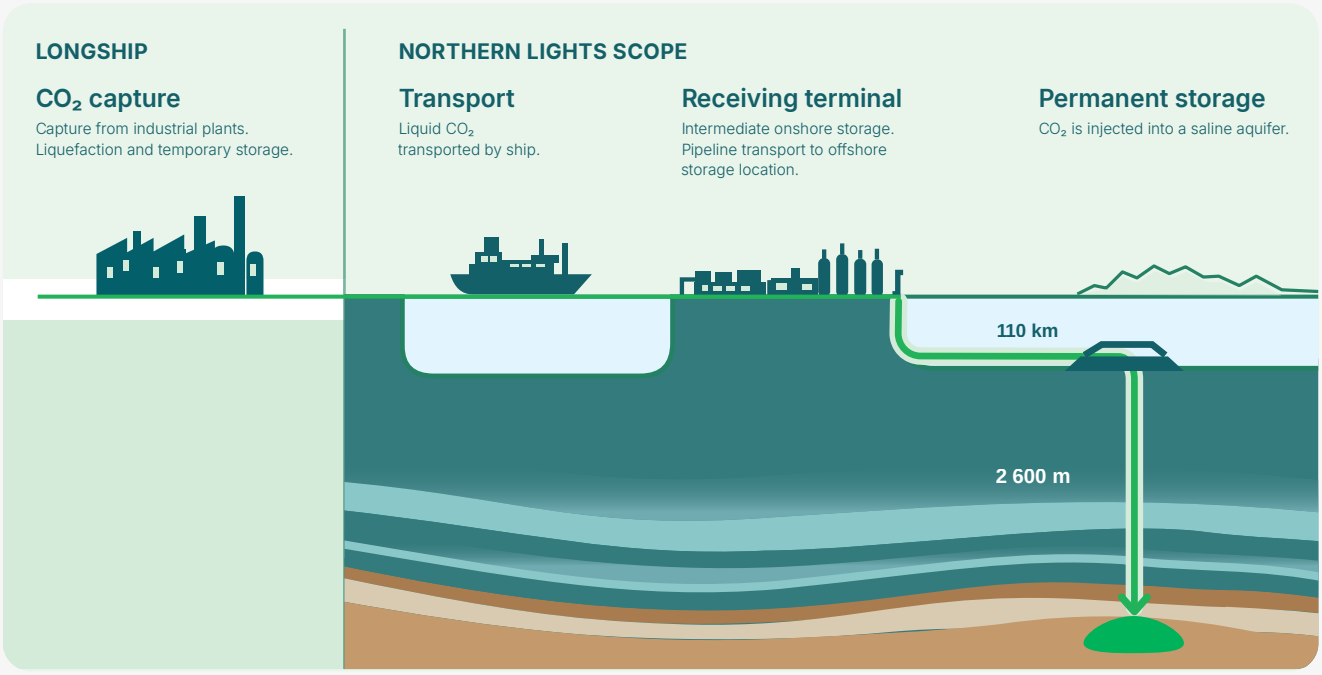


Figure 2.4: Northern Lights CO_2 Transport and Storage Value Chain

Source: Adopted from Northern Lights Joint Venture Annual Report 2023, Northern Lights, 2024

Enabling Mechanisms for CCS Implementation



Policies & Legislations

- Longship – Carbon capture and storage, Meld. St. 33 (2019–2020) report sets out Norway's full-scale CCS project framework, covering capture, transport and offshore storage under the Longship initiative.
- EU CCS Directive provides the regulatory framework for geological CO_2 storage, which Norway implemented as domestic law in 2014.
- Greenhouse Gas Emission Trading Act establishes Norway's emissions trading framework, supporting cost-effective emissions reduction.
- Pollution Control Act (1981) prescribes the environmental permitting and pollution control framework, including provisions for emissions and CCS-related activities.



Financing

- Longship State Support Agreements are public-private contracts where the Norwegian Government funds and absorbs the long-term risks to make large-scale CCS projects commercially viable.
- CLIMIT is the national programme for research, development and demonstration of CO_2 management technology.
- Northern Lights Joint Venture is privately funded by Equinor, Shell and TotalEnergies and aims to develop and expand open-access CO_2 transport and storage infrastructure.
- Connecting Europe Facility (CEF) Energy is an EU public funding programme supporting the Northern Lights Phase 2 expansion and additional CO_2 capacity.



Market-based Mechanisms

- Offshore Petroleum CO_2 Tax imposes a direct financial penalty on pollution related to offshore petroleum activities.
- The EU ETS operates a cap-and-trade carbon market mechanism by setting a cap on total emissions and requiring emitters to surrender allowances equivalent to their emissions.

Highlighted Projects

The Longship CCS Project is Norway's flagship project integrating carbon capture, transport and storage across the value chain. The project incorporates two CO_2 capture projects and one CO_2 transport and storage project. Longship resolved the interdependency challenge inherent in CCS by structuring the value chain into distinct capture as well as transport and storage subprojects. This approach enabled each industrial partner to operate within its core competence, de-risking the venture for all key stakeholders. The project's realisation was anchored by mutual trust and transparency between government and industry, which allowed progress to continue even as certain regulatory matters remained unresolved.

Note: The highlighted projects were selected for their demonstrated success or growing commercial traction, and their relevance to the Malaysian context

United States (US) CCUS Experience

The US exhibits a financially driven CCS model with strong federal incentives but less cohesive national policy alignment. The 45Q tax credit remains a globally leading mechanism, supported by significant federal funding and bipartisan infrastructure support. Nevertheless, regulatory frameworks are more fragmented, with state-level variations and the absence of a unified national carbon pricing system. Despite this, the US is progressing rapidly in infrastructure and project development, leveraging existing assets such as pipelines and offshore capabilities. Key regional hubs, particularly along the Gulf Coast, are emerging as major CCS centres. While partnerships and commercial agreements are actively expanding, challenges remain in permitting consistency and cross-border coordination.

United States of America

Background

The US is an active CCS market sustained by its large industrial emissions sources, significant geological storage potential, decades of CO_2 injection experience and a strong federal incentive framework. The carbon management strategy of the country adopts a comprehensive approach that integrates carbon capture, transport, storage, utilisation and CDR solutions, including DAC. Driven largely by incentives, the US model utilises federal tax credits, public funding and state-level permits to catalyse private investment, while deployment is increasingly focused on regional carbon management hubs that allow multiple emitters to share CO_2 transport and storage infrastructure. Figure 2.5 shows the industrial facilities and carbon capture and storage projects across the US.

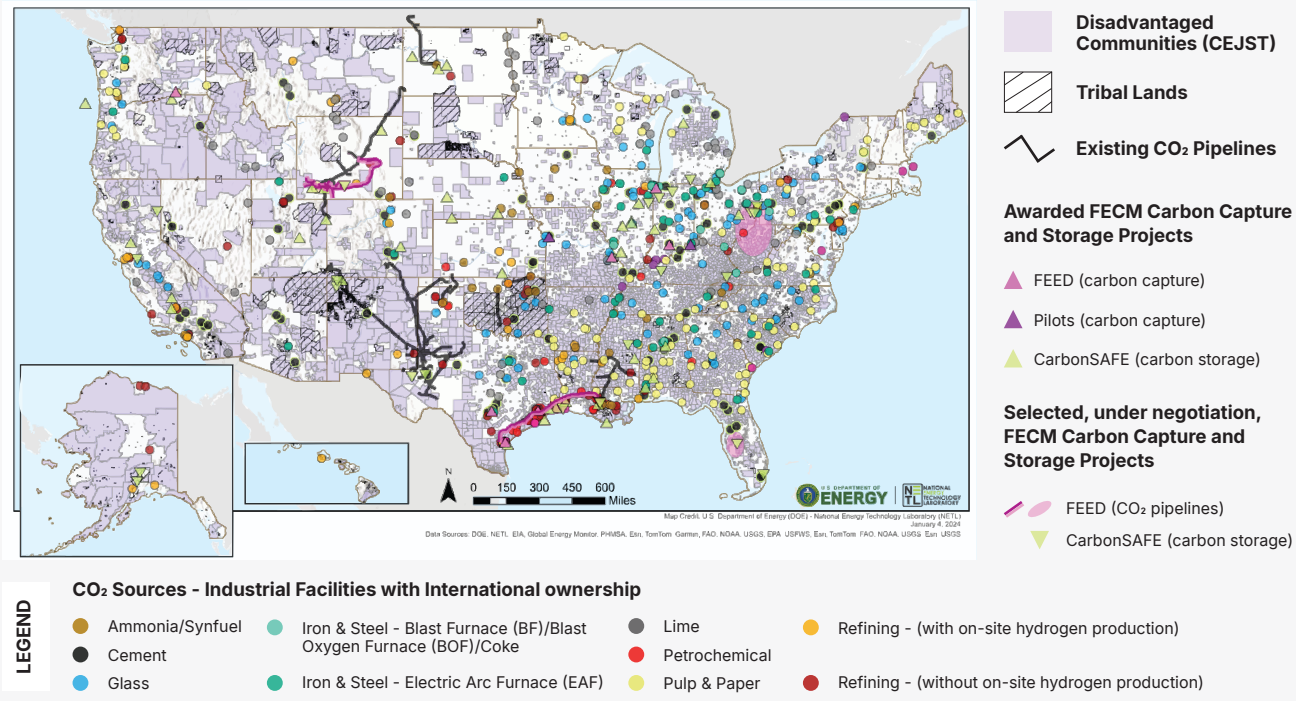


Figure 2.5: Industrial Facilities and Fossil Energy and Carbon Management (FECM) Carbon Capture and Storage Projects

Source: Adopted from Scaling Carbon Capture for Hard-to-Abate Industries in the United States and Globally, US Department of Energy, 2024

Enabling Mechanisms for CCS Implementation



Policies & Legislations

- Carbon Management Strategy by the Department of Energy provides a comprehensive roadmap outlining the deployment of technologies to capture, transport, utilise, store and remove CO_2 to reduce emissions and support industrial decarbonisation.
- US Environmental Protection Agency (EPA) Class VI well regulations for geological CO_2 storage establish the permitting and technical requirements for wells used to inject CO_2 into deep geological formations for long-term storage.



Financing

- Section 45Q Tax Credit is a federal tax incentive which provides a long-term revenue stream for each tonne of qualified CO_2 captured and permanently stored, utilised or used in eligible enhanced oil recovery (EOR).
- Inflation Reduction Act 2022 introduced additional financing mechanisms to strengthen the commercial viability of CCS and carbon removal projects across the US.
- Bipartisan Infrastructure Law 2021 provides public funding which supports large-scale carbon capture demonstrations, CO_2 transport infrastructure, storage validation and regional carbon management hubs.



Market-based Mechanisms

- VCMs provide a complementary market mechanism to support investment in carbon removal solutions, including DAC and geological storage.

Highlighted Projects

The Barnett Zero project leverages shared capture and compression infrastructure to demonstrate CCS application in natural gas processing. Key components include EnLink Midstream's Bridgeport processing plant and a 2 km dedicated transfer pipeline to BKV's injection facility. Barnett Zero was developed as an aggregated CCS model where midstream infrastructure concentrates emissions from multiple upstream producers, including BKV and third-party operations, into a single stream. This eliminates the need for individual producer-specific solutions, reducing overall cost and complexity while maximising operational efficiency.

The Louisiana Mississippi River Industrial Corridor functions as a CCS cluster, uniting heavy industrial facilities across the ammonia, steel, chemical and gas sectors under ExxonMobil's shared transport and storage network. Key projects include the CF Industries Donaldsonville CCS project as the anchor customer and the Nucor Convent steel facility. The corridor was developed as an aggregated industrial cluster where ExxonMobil provides common transport and storage infrastructure to eliminate the need for individual company-specific CCS solutions. This enables progressive emitter integration across diverse industries, using an initial anchor customer and 45Q tax credits to drive commercial expansion without direct government funding.

Note: The highlighted projects were selected for their demonstrated success or growing commercial traction, and their relevance to the Malaysian context



The rapid global scale-up of CCUS signals a clear shift towards large-scale deployment, positioning CCUS as a critical enabler of industrial decarbonisation. Early and proactive investment in CCUS secures competitiveness, unlocks new value chains and aligns national emissions reduction ambitions with emerging global standards.

CCUS Technologies Across Value Chain

The deployment of CCUS technologies across the value chain globally exhibits varying levels of technical maturity, with some already in commercial application and others still in nascent stages of development. Among the more mature technologies is geological storage, which has been successfully demonstrated in international projects such as Sleipner in Norway. Table 2.1 summarises the technologies available across the CCUS chain based on the internal findings by the Ministry of Economy. The availability of these technologies demonstrates technical readiness, enables project developers to mitigate early-stage operational risks and accelerates the deployment of large-scale CCUS initiatives. In addition, these technologies encourage innovation through research and development (R&D).

Technology		Detail	Technical Maturity
Capture	Post-combustion capture	Captures CO_2 from flue gas after fuel combustion using solvents, membranes or separation technologies	Ranges from pilot test to commercial application
	Pre-combustion capture	Converts fuel into hydrogen and CO_2 before separating the CO_2	Commercial application
	Oxy-fuel combustion	Burns fuel in pure oxygen to produce a concentrated CO_2 stream for easier capture	Pilot test
	Direct air capture (DAC)	Removes CO_2 directly from ambient air using chemical filters or sorbents	Commercial application
	Industrial process capture	Captures CO_2 from industrial processes such as cement, steel and chemical production	Commercial application
Transport	Pipelines	Transports compressed CO_2 through high-pressure pipelines for large-scale movement	Commercial application
	Shipping	Transports liquefied CO_2 using specialised tanker ships	Commercial application
	Rail & road transport	Uses insulated tanks on trucks or railcars to transport liquefied CO_2 over land	Commercial application
	Liquefaction, pumps & compressors	Compresses and liquefies CO_2 for transport and storage	Commercial application
Storage	Geological storage	Stores CO_2 deep underground in rock formations such as saline aquifers or depleted oil and gas fields	Commercial application
	Mineral storage	Converts CO_2 into stable solid minerals for permanent storage	Commercial application
Utilisation	Mineralisation	Uses CO_2 to produce stable carbonate materials such as concrete products	Commercial application
	Chemical conversion	Converts CO_2 into fuels, plastics or industrial chemicals	Commercial application
	Biological utilisation	Uses algae or microbes to convert CO_2 into biomass or biofuels	Commercial application

Table 2.1: CCUS Technologies Across the Value Chain

Note: Technical Maturity is categorised into five maturity categories, ranging sequentially: concept, basic research, pilot test, industry demo and commercial application.

Malaysia's CCUS Landscape

Key Messages:

- *Malaysia is strategically positioned to become a regional CCUS hub due to its substantial offshore storage potential, existing infrastructure, concentrated industrial clusters and favourable geographical advantages.*
- *Regional demand for cross-border CO_2 storage presents opportunities for Malaysia to develop "storage-as-a-service" offerings and strengthen its role within the regional low-carbon economy.*
- *Malaysia's CCUS agenda is driven by the dual imperative of achieving climate commitments while unlocking new economic opportunities, particularly in hard-to-abate industries.*
- *Beyond decarbonisation, CCUS can catalyse new industries including low-carbon products, hydrogen, ammonia and carbon management services.*
- *A growing governance framework, cross-ministry coordination, industry participation and coordinated national strategies will be critical to address financing, technology, talent and public awareness challenges.*

Case for Change

The case for change for CCUS in Malaysia is driven by two strategic priorities:

- The commitment to decarbonise, anchored in its international climate pledges and national sustainability goals.
- The opportunity as a new source of economic growth.

Together, these priorities underscore the growing importance of CCUS as Malaysia transitions towards a low-carbon and resilient future.



Climate Commitment

Malaysia continues to strengthen its climate ambition in accordance with the objectives of the Paris Agreement. Under the Nationally Determined Contribution 3.0 (NDC 3.0), Malaysia intends to strengthen its climate action pathway by targeting an absolute greenhouse gas emissions reduction of approximately 15 to 30 million tonnes of CO_2 equivalent ($MtCO_2eq$) by 2035 from peak emissions levels. This comprises an unconditional reduction of up to 20 $MtCO_2eq$ and an additional 10 $MtCO_2eq$ conditional reduction, subject to the availability of international climate finance, technology transfer and capacity-building support. The updated NDC target marks an important progression from Malaysia's previous intensity-based commitment of a 45 per cent reduction in economy-wide carbon intensity against gross domestic product (GDP) by 2030 compared to 2005 levels.

In realising the NDC targets, a series of roadmaps, strategic plans and legislative instruments were introduced to support the national climate action agenda. These documents outline sector-specific pathways, policy levers and implementation mechanisms to support decarbonisation, with CCUS featured as a critical enabler. Policies as summarised in Table 3.1 demonstrate Malaysia's increasingly integrated approach towards CCUS development.

Thirteenth Malaysia Plan (Thirteenth Plan) — 2025

by the Ministry of Economy

Description

Positions CCUS as one of the strategies for green economy and industrial decarbonisation, focusing on governance, financing and investment, technology and talent development, cross-border collaboration and local industry participation across the CCUS value chain.

Establishes a carbon emissions trading scheme as a mechanism to facilitate carbon trading. This scheme will strengthen the CCUS investment case for developers and emitters alike, creating a revenue stream for captured and stored emissions.

National Carbon Market Policy (NCMP) — 2026

by the Ministry of Natural Resources and Environmental Sustainability

Description

Establishes the framework for carbon pricing, carbon trading and market-based mechanisms that support CCUS deployment and investment through carbon market participation.

Nationally Determined Contribution Roadmap (NDC RAP) — 2025

by the Ministry of Natural Resources and Environmental Sustainability

Description

Outlines medium-term strategies to achieve Malaysia's emissions reduction targets by 2030, with CCUS identified as one of the decarbonisation measures for hard-to-abate industries.

Long-Term Low Emission Development Strategies (LT-LEDS) — 2025

by the Ministry of Natural Resources and Environmental Sustainability

Description

Provides Malaysia's long-term pathway towards net-zero emissions by 2050, recognising CCUS as an important technology to support decarbonisation and industrial emissions reduction.

National Climate Change Policy 2.0 (NCCP 2.0) — 2024

by the Ministry of Natural Resources and Environmental Sustainability

Description

Establishes Malaysia's overarching climate policy framework and promotes investment in low-carbon technologies, including CCUS, to support national climate resilience and emissions reduction efforts.

National Energy Transition Roadmap (NETR) — 2023

by the Ministry of Economy

Description

Identifies CCUS as one of the levers to achieve Malaysia's energy transition and net-zero ambitions, including the development of CCS hubs, supporting infrastructure and enabling regulatory frameworks.

New Industrial Master Plan 2030 (NIMP 2030) — 2023

by the Ministry of Investment, Trade and Industry

Description

Identifies CCUS as a decarbonisation solution for hard-to-abate industries and a new economic growth sector.

Hydrogen Economy Technology Roadmap (HETR) — 2023

by the Ministry of Science, Technology and Innovation

Description

Recognises the role of CCUS in enabling blue hydrogen production and supporting the development of Malaysia's hydrogen economy.

Table 3.1: Overview of National Policies Supporting CCUS Deployment

Note: National policies as of June 2026.

In addition to the policies outlined above, the upcoming National Climate Change Bill (RUUPIN) will establish Malaysia's overarching legal framework for climate governance, including setting national GHG targets and facility-level measurement, reporting and verification (MRV). A robust MRV system ensures credible accounting of captured and stored CO_2 counted towards Malaysia's climate goals.

Economic Opportunity

The second driver for implementing CCUS in Malaysia lies in the agenda of developing the nation into a green economy. Global annual GHG emissions reached 53.2 Gt CO_2eq in 2024, marking a 1.3 per cent or 665 Mt CO_2eq increase compared to 2023 levels, excluding land use, land-use change and forestry (LULUCF). As illustrated in Figure 3.1 below, Malaysia accounted for approximately 0.33 GTPA or around 0.7 per cent of global emissions, closely mirroring the global pattern.

Malaysia's manufacturing sector contributed 23.1 per cent to national GDP in 2024,[8] which includes hard-to-abate industries such as cement, refining and iron and steel. Together with the power industry, these hard-to-abate industries contribute more than 50 per cent of national emissions. Decarbonisation measures such as electrification and energy efficiency are often insufficient to achieve significant emissions reductions. Therefore, decarbonising these sectors keeps them competitive as global carbon rules tighten and unlocks new business in low-carbon products and carbon management services.

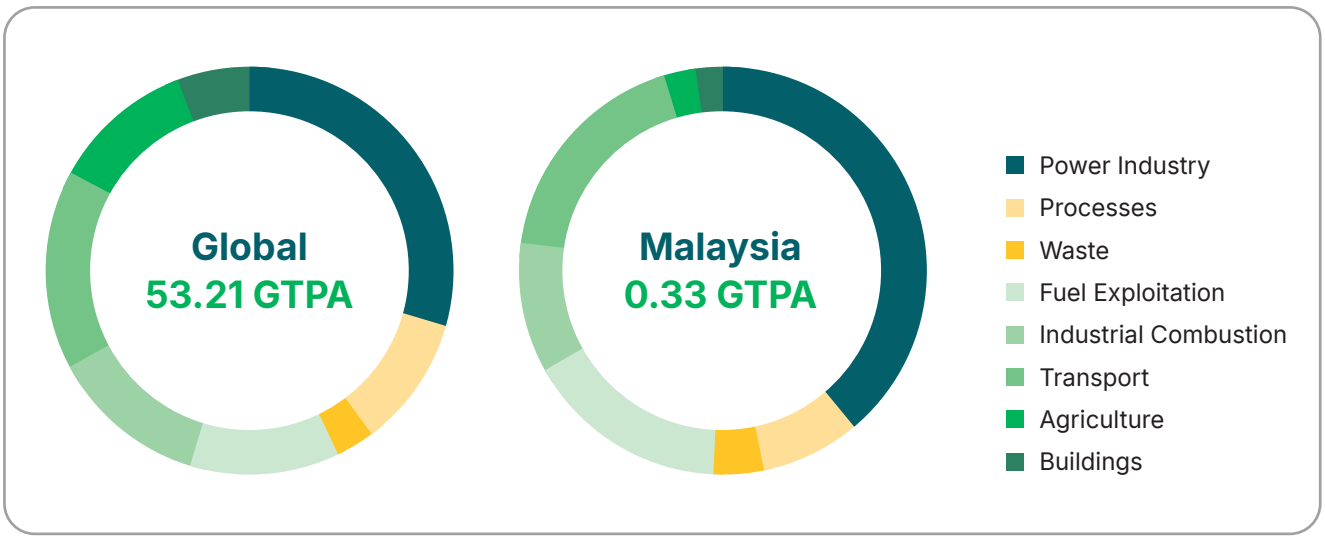


Figure 3.1: Malaysia's GHG Emissions Profile Against Global Trends, 2024

Source: Adopted from Emissions Database for Global Atmospheric Research, European Commission, 2025[9]

Based on internal findings by the Ministry of Economy, Figure 3.2 assesses the suitability of CCS, hydrogen and electrification as decarbonisation levers for hard-to-abate industries. CCS is highly suitable across nearly all industries assessed, with chemicals and primary iron and steel as the only exceptions due to their process emissions. CCUS presents a strategic pathway that allows these economically significant industries to decarbonise while continuing to operate and grow, safeguarding competitiveness and market access as trading partners tighten carbon-related requirements, while opening new economic opportunities in low-carbon products and carbon management services.

[8] (Department of Statistics Malaysia, 2025a)

[9] (Crippa et al., 2025)

High suitability Some challenges Unsuitable

Sector	CCS	Hydrogen	Electrification	Additional Notes
Power	●	●	—	Renewable power generation (such as wind, solar) is likely to be widespread but the sector will probably meet baseload power through the combustion of hydrogen or the combustion of fossil fuels with CCS.
Pulp & paper	●	●	●	Pulp & paper sites, which are highly integrated, can use CCS to capture unavoidable biogenic process emissions. Electrification may have limited use for some low-temperature processes but cannot abate process emissions.
Cement	●	●	●	CCS is critical to capturing unavoidable process emissions. The cement sector can switch its combustion systems to burn hydrogen or renewable natural gas (RNG) with modifications but process emissions will remain.
Chemicals	●	●	●	Internal fuel use can make fuel switching difficult. CCS enables continued operation but is only suitable for a portion of site streams.
Energy from waste	●	●	●	CCS is most suitable at energy from waste sites, when there is a significant fraction of biogenic feedstock.
Lime	●	●	●	Process emissions in the lime sector may necessitate CCS, particularly at large sites.
Primary iron & steel	●	●	●	CCS may be applicable to the blast furnace but companies may more widely deploy hydrogen and electrification in decarbonizing steel production.
Glass	●	●	●	Companies can retrofit CCS onto existing assets while continuing to allow the economic use of biological by-products.
Refining	●	●	●	High internal fuel use makes fuel switching difficult. CCS is only suitable for same site streams but is required to decarbonize process emissions.
Fertilizers	●	●	●	It is essential to capture process emissions from methane reforming. Reformer furnaces can switch fuels, most likely to RNG, or can use CCS. Alternatively, electrolysers or H2 imports can replace reformers entirely.
Oil and gas processing	●	●	●	Emissions from the extraction, processing and transport of oil and gas (such as from venting, flaring and fugitive emissions) are hard to abate. CCS can capture these emissions from multiple point sources as other decarbonization options are unlikely to be viable due to the nature of emissions in the sector.
Biomethane/ bioethanol	●	●	●	Upgrading biogas to biomethane and capturing the associated biogenic CO_2 can lead to negative emissions if a company stores the captured CO_2. It can also lead to additional revenue from selling the biomethane.

Figure 3.2: Decarbonisation Lever Suitability by Hard-to-Abate Industries

Note: *This table demonstrates the technical feasibility of abatement technologies for generalised industrial sectors, and not individual sites where site-specific factors can influence the preferred decarbonisation route.

The economic opportunity arising from CCUS is underpinned by storage-as-a-service and CO_2 utilisation. This positions Malaysia as a regional decarbonisation partner and a platform for attracting investment, fostering innovation and creating a vibrant business ecosystem.

The abundant geological storage capacity in Malaysia provides the foundation to establish the country as a carbon storage hub for both domestic emitters and neighbouring countries. This creates a new service-based industry centred on carbon management. As one of the early movers in the region, Malaysia has the opportunity to position itself as a preferred CCS hub.

CCUS also presents an opportunity to create economic value through utilisation. Captured CO_2 has the potential to be utilised to manufacture a range of low-carbon products. Malaysia aspires for CCUS to evolve from an emissions management solution into a driver of industrial innovation and the development of "Made by Malaysia" products. Based on internal analysis, Figure 3.3 categorises CCU applications into two main pathways, namely, conversion and non-conversion. Malaysia has an opportunity to develop these early-stage applications into new sources of economic value as the CCUS ecosystem matures.

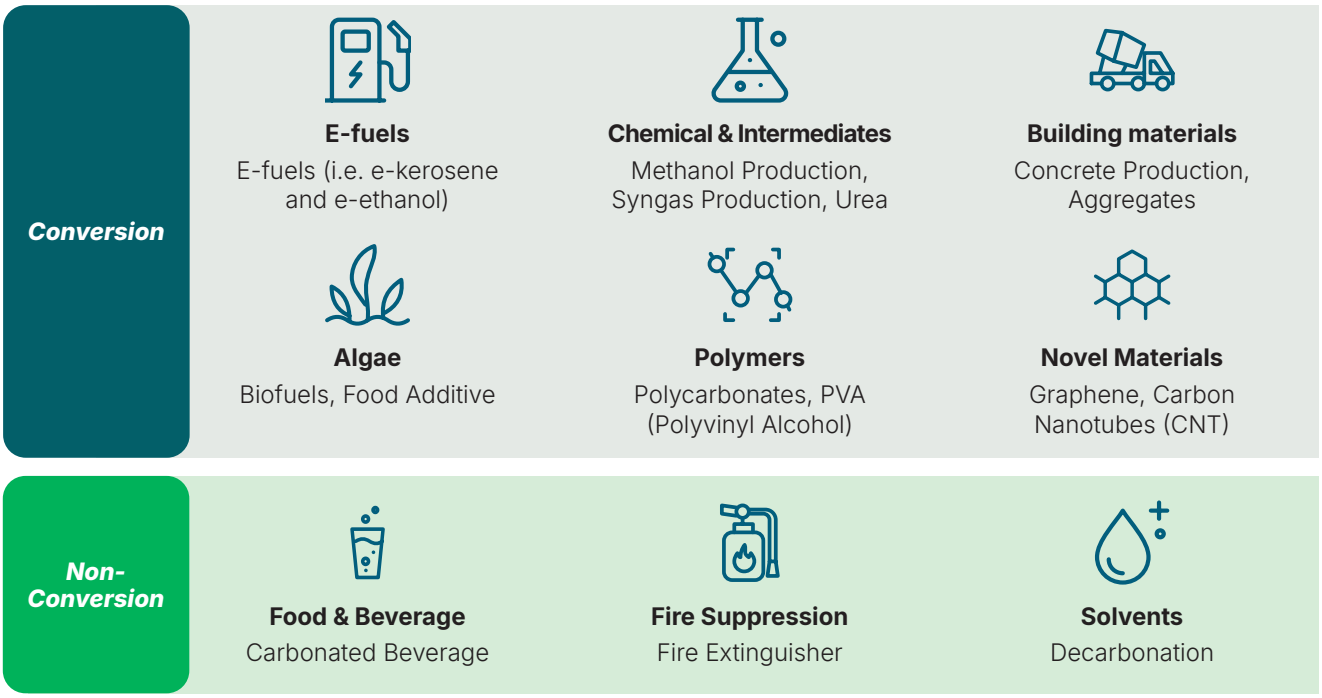


Figure 3.3: CCU Applications

Additionally, CCUS enables existing industries to expand operations and create new revenue streams. Businesses traditionally operating in oil and gas, engineering, logistics, maritime services, manufacturing and subsurface resource management are able to leverage existing capabilities and expertise to participate in emerging CCS value chains. CCUS also allows hard-to-abate industries to stay competitive in export markets by meeting emerging carbon-related trade requirements such as the Carbon Border Adjustment Mechanism (CBAM).

Amidst the evolving energy and economic landscape, CCUS also presents an opportunity to develop new skills, capabilities and talent to support the low-carbon economy. The growth of the CCUS value chain creates demand for high-value technical and non-technical roles, while driving workforce reskilling and upskilling. This enables Malaysia to build a future-ready workforce and support a just transition for workers and communities, ensuring inclusive social outcomes. Figure 3.4 provides insights into the benefits of CCUS to Malaysia's economic prosperity and the wider spillover effects it generates across industries.

Direct benefits to Malaysia

Grow Malaysia's economy and local offerings/expertise

*GVA contribution of **USD200-250 billion** accumulated **GVA** in 30 years

Petronas Analysis, 2022

Job creation and future proofing the workforce

*Create ~**150,000 - 200,000** direct & indirect jobs by 2050 and build knowledge in CCUS

Petronas Analysis, 2022

Develop new energies industries

Develop blue hydrogen and ammonia industries for domestic consumption and exports

Attraction of foreign investments

Market Malaysia as a growing CCUS hub and attract investments aligned with ambitious sustainability and green criteria

Figure 3.4: Direct Benefits of CCUS for Malaysia



Malaysia's Competitive Advantage in CCUS

Malaysia is strategically positioned to emerge as a leading regional CCUS hub due to its substantial geological storage resources, established oil and gas industry, strategic proximity to major regional emitters and the development of a dedicated regulatory framework. These enablers, each explored in the sections that follow, underpin Malaysia's potential to become a competitive CCUS destination.

Abundant Storage Potential

Malaysia possesses significant CO_2 storage potential in depleted oil and gas reservoirs and deep saline aquifers, providing storage capacity that exceeds domestic storage demands. Malaysia's total storage capacity stands at 153,300 million tonnes, including 13,300 million tonnes in depleted oil and gas fields as well as 140,000 million tonnes in saline aquifers.[10] Figure 3.5 illustrates Malaysia's storage capacity in depleted oil and gas fields against other nations globally.[11]

Malaysia's storage assets are geographically concentrated in offshore regions. This concentration is well suited to a hub and cluster model where shared transport and injection infrastructure deliver economies of scale and reduce logistical complexity. This in turn enables the development of a storage-as-a-service offering for domestic and international emitters.

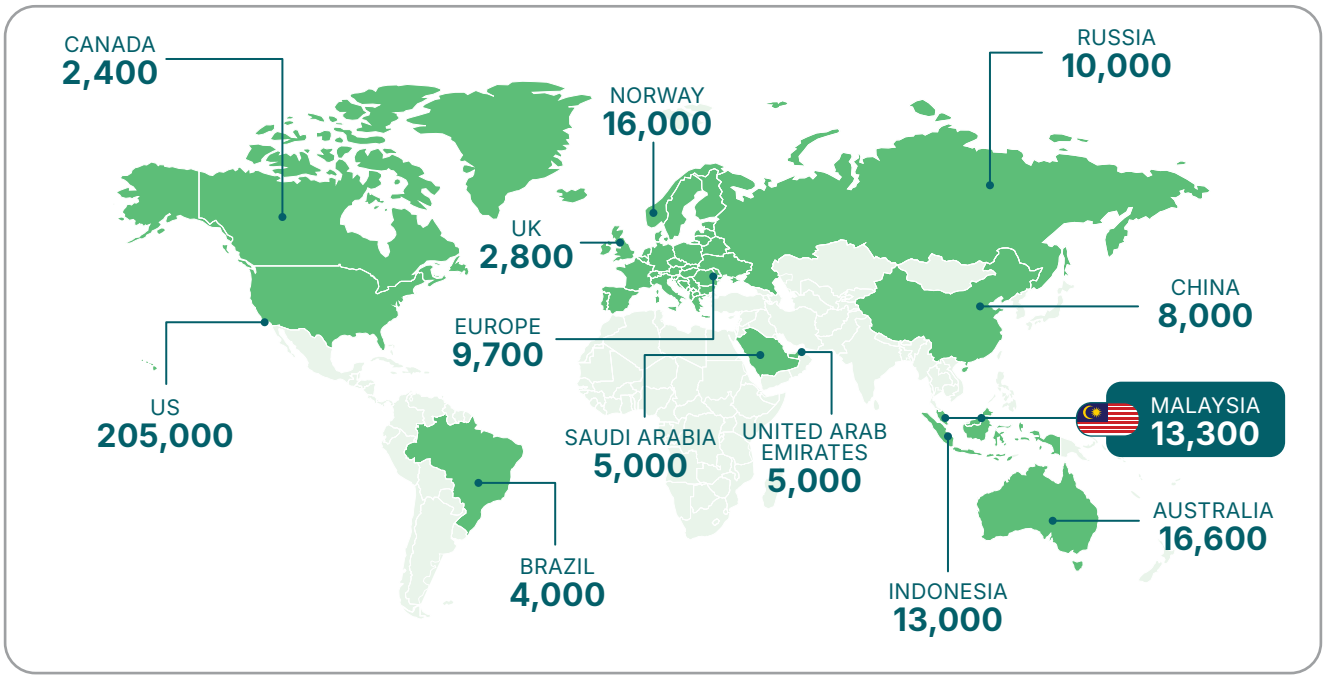


Figure 3.5: Malaysia's CO_2 Storage Capacity in Depleted Oil and Gas Fields (Million Tonnes)

Source: Adopted from Global Status of CCS 2020, Global CCS Institute, 2020

[10] (Junin & Hasbollah, 2016)

[11] (Global CCS Institute, 2020)

Strategic location in Asia Pacific

Malaysia's geographical location outside the Pacific Ring of Fire provides a degree of protection from intense seismic and volcanic activity, enhancing its suitability for long-term geological storage. However, the country is not entirely immune to natural hazards. According to the EU Index for Risk Management (INFORM), Malaysia's most significant natural disaster risks are river floods, coastal floods and tsunamis, as shown in Figure 3.6. These risks must be considered in site selection and infrastructure planning for CCUS projects.

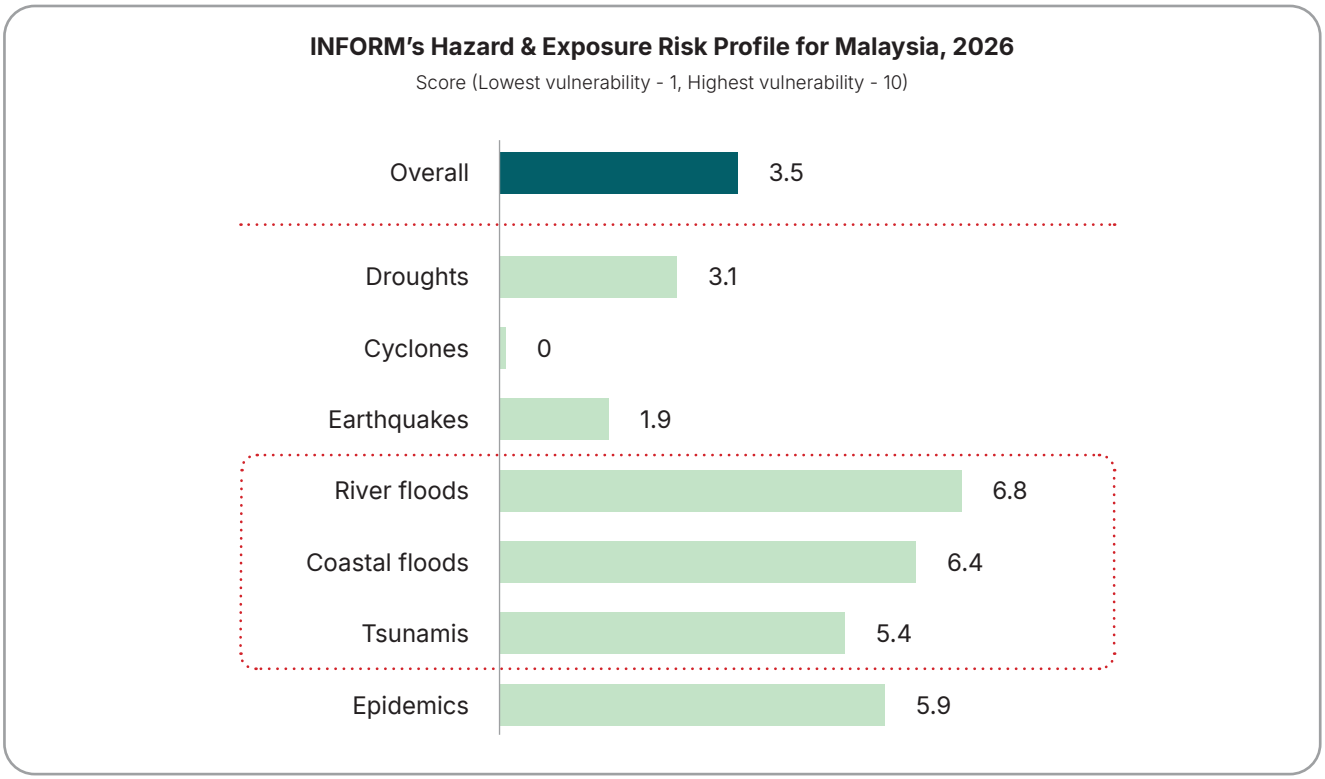


Figure 3.6: Hazard & Exposure Risk Profile for Malaysia

Source: Adopted from Malaysia Country Risk Profile, European Commission Inform Risk Index 2026



Mature Oil and Gas Industry

Malaysia's mature oil and gas industry provides a strong foundation for the development of CCUS. Decades of upstream and midstream activities have established extensive expertise in subsurface characterisation, offshore engineering, well drilling and project management, which are directly transferable to CCS operations. This is further supported by a well-developed ecosystem of contractors, service providers and equipment specialists, as well as a skilled workforce with deep oil and gas experience that can be readily deployed to support emerging CCS value chains. In addition, existing oil and gas infrastructure may be repurposed as part of decommissioning strategies to support CO_2 transport and storage activities. Leveraging these existing assets improves project economics and accelerates project deployment. Together, this combination of expertise and supply chain readiness positions Malaysia to develop a competitive and scalable CCS industry.

Enabling CCUS Ecosystem

Malaysia's competitive advantage in CCUS lies in an enabling ecosystem designed to unite public and private stakeholders while instilling strong investor confidence. This ecosystem rests on two core foundations, namely a clear regulatory framework that provides end-to-end legal certainty and an integrated value chain supported by government and industry stakeholders.

The regulatory foundation is anchored by the CCUS Act 2025, which is designed to balance economic growth with climate mitigation. The Act, enforced in October 2025, sets clear rules for licensing, CO_2 stream acceptance criteria and cross-border movement. The Act also defines operator obligations regarding monitoring, reporting and injection levies. Additionally, the Act secures long-term post-closure stewardship through a dedicated fund, as well as providing clear enforcement powers and appeal procedures. The Act establishes a streamlined governance structure that enables both regulators and private actors to initiate, manage and scale CCUS projects. At its core is the Malaysia Carbon Capture, Utilisation and Storage Agency (MyCCUS), serving as a central regulatory body supported by competent technical entities for the entire CCUS value chain.

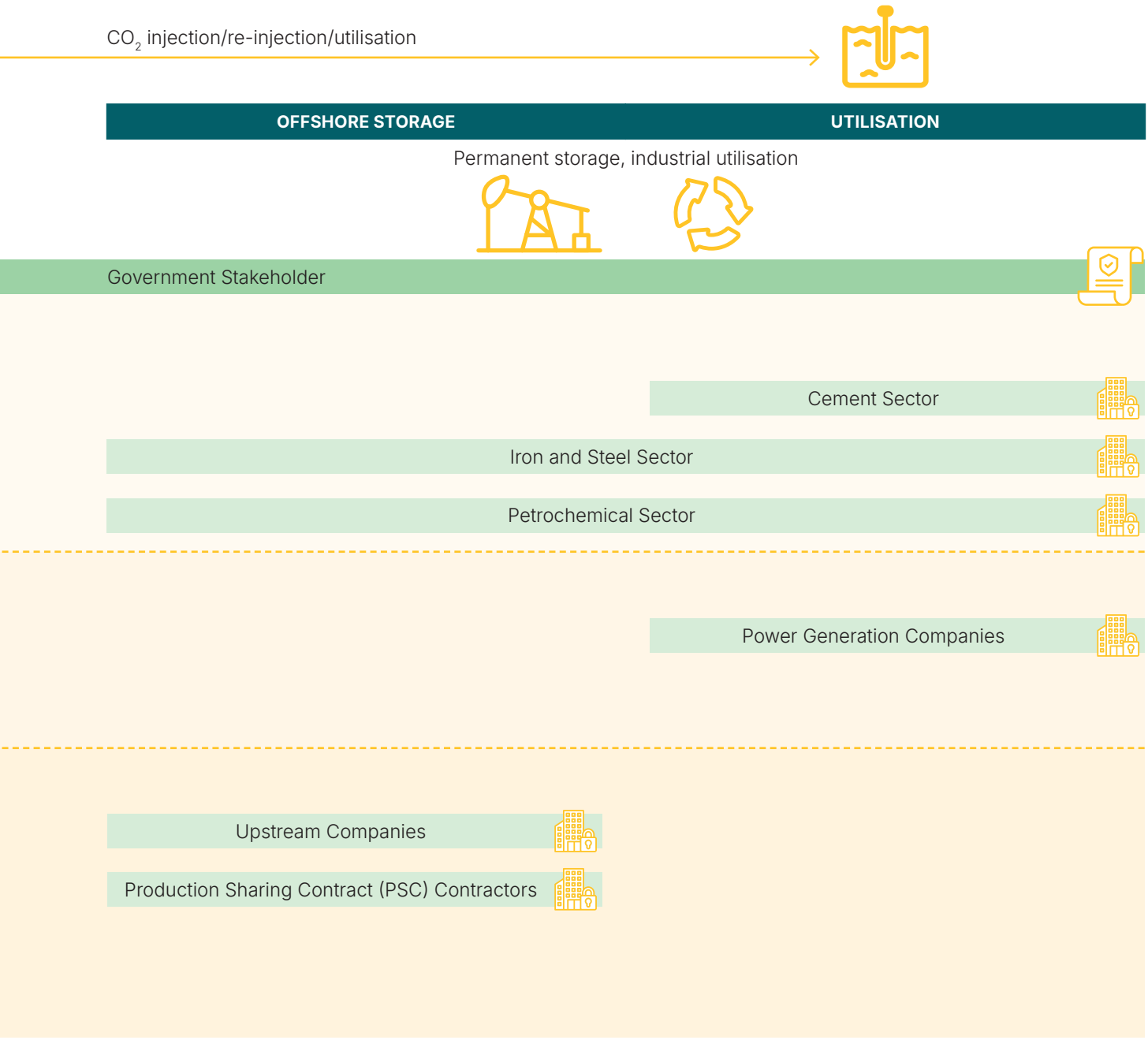


Malaysia's CCUS development is being shaped through coordinated efforts led by the *Mesyuarat Jawatankuasa Pemandu Inisiatif Pemerangkapan, Penggunaan dan Penyimpanan Karbon (CCUS) Kebangsaan*, which comprises the Ministry of Economy, Ministry of Finance (MOF), Ministry of Investment, Trade and Industry (MITI), Ministry of Science, Technology and Innovation (MOSTI) and the Ministry of Natural Resources and Environmental Sustainability (NRES). These ministries have been actively contributing to the national CCUS agenda, mainly in policy formulation and regulatory development, financing mechanisms, industry and talent development, technology innovation and international reporting obligations.



Figure 3.7: Stakeholders Across the CCUS Value Chain in Malaysia

In parallel, the private sector plays a critical role in advancing CCUS through active participation across the entire value chain. This includes emitters from hard-to-abate industries, transport and logistics providers enabling the movement of captured CO_2 and utilisation players developing commercial applications such as synthetic fuels, chemicals and building materials. These stakeholders contribute the technical capabilities, infrastructure and investment needed to strengthen project economics, create new commercial opportunities and accelerate the large-scale deployment of CCUS in Malaysia. Figure 3.7 illustrates the multi-stakeholder coordination enabling the CCUS value chain in Malaysia based on internal findings by the Ministry of Economy.



Malaysia CCUS Roadmap 2050: **Towards Green Economy**

Vision

Key Indicators

ST STRATEGIC THRUSTS

ST1
Development of CCUS Hubs through Cluster-based Approach

- 1.1 Development of pilot CCUS projects within the oil & gas, power and manufacturing sectors
- 1.2 Development of CCUS cluster and hub in the East Coast
- 1.3 Formation of industrial CCUS clusters and hubs
- 1.4 Facilitation of industrial parks to be CCUS-ready

ST2
Offering CCUS as a Solution for Regional Decarbonisation

- 2.1 Strengthen CCS solution to enable cross-border CCS activities via legal framework, agreement and standards
- 2.2 Development of infrastructure for cross-border CCS activities
- 2.3 Establishing Malaysia as a competitive and strategic CCUS market

E ENABLERS

E1
Policy, Regulation & Governance

- 1.1 Enactment of relevant legislations and regulations for CCUS activities implementation
- 1.2 Establishment of an agency to regulate activities under CCUS Act 2025
- 1.3 Formulation of carbon accounting policy and reporting
- 1.4 Establishment of standards for CCUS projects
- 1.5 Enforcement of regulations across value chain

E2
Financing & Incentives

- 2.1 Establishment and continuation of tax allowances and incentives
- 2.2 Facilitation of financing for CCUS projects

Figure 4.1: Malaysia CCUS Roadmap Strategic Framework

Overview of CCUS Strategic Framework

The Malaysia CCUS Roadmap has been developed to provide strategic direction and foster investor confidence, while positioning Malaysia as a regional CCUS hub. The CCUS Strategic Framework, as depicted in Figure 4.1, developed under the Malaysia CCUS Roadmap comprises of four Strategic Thrusts (ST) and four Enablers (E). The details of each ST and E, the targets and the associated actions are further elaborated in the subsequent sections.

Malaysia as the regional leader in CCUS to drive green economic growth

Three to six CCUS hubs by 2050; Cumulative GVA of USD200-250 billion and 150,000-250,000 direct & indirect jobs at peak operations by 2050; RM160-170 billion investments by 2050

ST3

Catalyse Proprietary Carbon Capture, Utilisation & Storage Technologies for Industrial Adoption

- **3.1** Development of local CCUS technologies for commercialisation and large-scale deployment
- **3.2** Facilitation of CCUS knowledge transfer through formation of partnerships and joint ventures
- **3.3** Deployment of regulatory sandbox to pilot & scale CCUS in the oil & gas, power and manufacturing sectors
- **3.4** Advancing CO_2 utilisation development

ST4

Driving East Coast Regional Development

- **4.1** Establishment of strategic planning and governance for East Coast development
- **4.2** Pilot CCUS cluster in the East Coast
- **4.3** Development of local companies as part of the CCUS value chain

E3

Human Capital

- **3.1** Projection of CCUS workforce demand
- **3.2** Upskilling and reskilling of existing talent in CCUS expertise
- **3.3** Curation of Science, Technology, Engineering and Mathematics (STEM) and skills programme with a focus on CCUS expertise leveraging on international collaboration
- **3.4** Cultivation of CCUS experts in the industry

E4

Communication, Education and Public Awareness

- **4.1** Advancement of CCUS leadership and stakeholder alignment
- **4.2** Promotion of national awareness on CCUS targeting key stakeholders

Strategic Thrusts

ST1 DEVELOPMENT OF CCUS HUBS THROUGH CLUSTER-BASED APPROACH

This thrust, as tabulated in Table 4.1 and depicted in Figure 4.2, focuses on the development of a CCUS hub and cluster that drives coordinated industrial decarbonisation while positioning Malaysia as a regional CCUS leader.

A CCUS hub, as defined by NETR, is a shared infrastructure system that captures carbon dioxide from multiple emission sources, such as hard-to-abate industries, and transports and stores it collectively. The establishment of a CCUS hub optimises capital, reduces project risks and enhances scalability. Meanwhile, a cluster-based model convenes multiple emitters in an industrial setting within a specific area to access common pipelines and storage sites at the CCUS hub.

The initiatives under this Thrust include:

ST1.1 Development of pilot CCUS projects within the oil and gas, power and manufacturing sectors

Pilot CCUS projects across the oil and gas, power and manufacturing sectors serve as the foundational step in demonstrating technical feasibility, as well as validating the cost and performance for large-scale deployment. These projects enhance regulatory frameworks, commercial models, supply-chain readiness, local capability and investment confidence in future hubs and clusters formation.

ST1.2 Development of CCUS hub and cluster in the East Coast

The East Coast is strategically positioned to serve as a CCUS hub, due to the availability of offshore geological storage, close proximity to major industrial clusters and existing oil and gas infrastructure. The East Coast CCUS hub and cluster serves as a scalable anchor project, aggregating CO_2 volumes from multiple industrial emitters into a shared transportation and storage network that leverages the proximity to offshore storage site in the region.

ST1.3 Formation of industrial CCUS hubs and clusters

The formation of industrial CCUS hubs and clusters across Peninsular Malaysia's high-emission corridors enables multiple emitters to consolidate CO_2 volumes, as well as share transport and storage infrastructure. This approach drives economies of scale, reduces per-tonne abatement costs and unlocks long-term investment for accelerated decarbonisation.

ST1.4 Facilitation of industrial parks to be CCUS-ready

The transition of industrial parks to become CCUS-ready requires coordinated facilitation in integrating CCUS infrastructure. This facilitation enables accelerated investment and deployment of low-carbon industries such as hydrogen and ammonia, driving scalable decarbonisation and sustainable economic growth.

KEY STAKEHOLDERS

MITI, Ministry of Economy, NRES, MOF, Ministry of Energy Transition and Water Transformation (PETRA), the Energy Commission (ST), Unit Perancang Ekonomi Negeri (UPEN), PETRONAS, TNB and relevant industry players.

CASE FOR CHANGE

Globally, the development of CCUS hubs and clusters through shared infrastructure, is observed to enable cost-efficient and scalable decarbonisation initiatives. Key national policies, including the NETR, NIMP 2030, NDC RAP and LT-LEDS underscore the importance of developing CCUS hubs within industrial clusters as a decarbonisation lever. Under the Thirteenth Plan, CCUS is recognised as a new source of economic growth, supporting Malaysia's transition to a low-carbon future through the formation of CCUS hubs and clusters.

Key Initiatives		Action Plans	Key Stakeholders
ST1.1	Development of pilot CCUS projects within the oil and gas, power and manufacturing sectors	• Map emission sources and prioritise based on emission volumes and technological readiness. • Facilitate funding support for pilot implementation. • Monitor and publish findings from pilot projects. • Refine regulations and development plans based on pilot project findings.	Ministry of Economy (Oil & Gas), PETRA (Power), MITI (Manufacturing), MOF, TNB, PETRONAS, ST, industry players
ST1.2	Development of CCUS hubs and clusters in the East Coast	• Develop CCUS projects in the east coast, Peninsular Malaysia, focusing on heavy- emitting industrial players to form a CCUS cluster. • Develop infrastructure needed to support CCUS with the potential for scaling up in the future. • Determine the optimal transportation method for CO_2 from the cluster to the storage hub. • Evaluate performance to scale up CCUS activities in the future.	MITI, Ministry of Economy, PETRONAS, industry players
ST1.3	Formation of industrial CCUS hubs and clusters	• Determine a champion for hub development. • Map and engage with industrial stakeholders in targeted clusters. • Develop a local and actionable CCUS development plan and cluster decarbonisation plan.	MITI, NRES, Ministry of Economy, UPEN, PETRONAS, industry players
ST1.4	Facilitation of industrial parks to be CCUS-ready	• Identify and develop existing industrial parks and equip future industrial parks to support the transition to a low-carbon economy, including production of low-carbon products such as blue and green hydrogen and ammonia. • Facilitate the transition of industrial parks to be CCUS-ready through access to carbon capture, transportation and storage facilities and tax incentives. • Establish an ecosystem (financing, technology, R&D, human capital) that enables the industrial parks to be CCUS-ready.	MITI, Ministry of Economy, MOF, UPEN, industry players

Table 4.1: Key Initiatives and Action Plans for Strategic Thrust 1

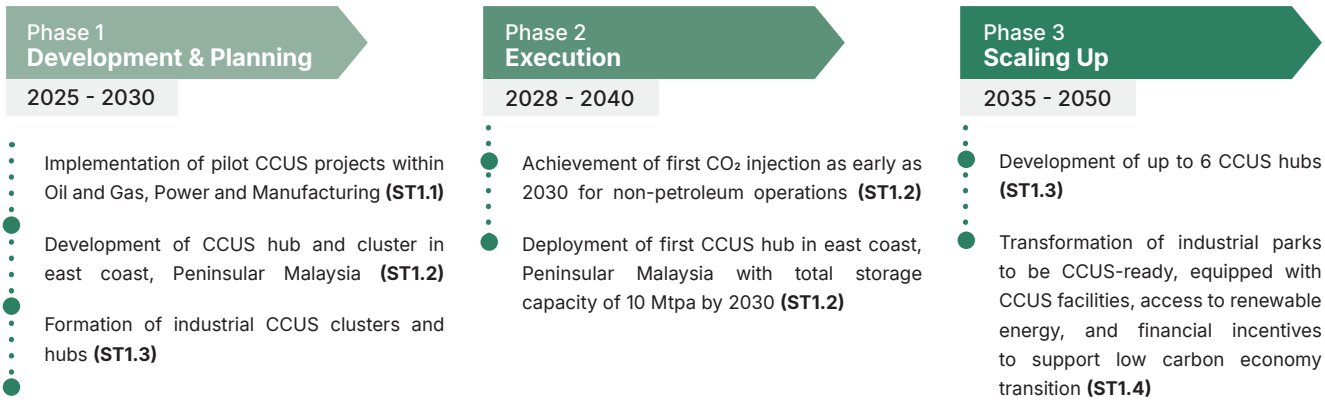


Figure 4.2: Key Milestones & Execution Plan for ST1

ST2 OFFERING CCS AS A SOLUTION FOR REGIONAL DECARBONISATION

This thrust, as tabulated in Table 4.2 and depicted in Figure 4.3, focuses on positioning Malaysia as a regional hub for cross-border CO_2 storage services by establishing the necessary regulatory, logistical and commercial mechanisms. It entails establishing comprehensive regulatory and commercial frameworks as well as bilateral agreements to define roles and liabilities to govern transboundary movement of CO_2. These measures will promote Malaysia as a preferred CCS destination, supporting regional decarbonisation while creating new economic opportunities.

The initiatives under this Thrust include:

ST2.1 Strengthening CCS solutions to enable cross-border CCS activities via legal frameworks, agreements and standards

Clear and harmonised legal, regulatory and governance frameworks address the complexities involving CCS activities across multiple jurisdictions, such as licensing, bilateral agreements and carbon accounting mechanisms. Strengthening CCS solutions through these initiatives enables safe, transparent and commercially viable cross-border CCS activities.

ST2.2 Developing infrastructure for cross-border CCS activities

Integrated CO_2 transport and storage infrastructure supported by viable investment models is required to facilitate the efficient and reliable movement of CO_2 across jurisdictions. This enables cross-border CCS activities at scale while supporting long-term investment and accelerating decarbonisation.

ST2.3 Establishing Malaysia as a competitive and strategic CCUS market

Driving growth across the regional CCUS industry hinges on offering competitive investment conditions, swift regulatory pathways and seamless global cooperation to mobilise capital. Establishing a highly competitive market in Malaysia enhances investor confidence, sharpens the nation's regional edge and accelerates the development of CCUS projects and partnerships within the country.

KEY STAKEHOLDERS

Ministry of Economy, MOF, MITI, Ministry of Foreign Affairs (MOFA), NRES, PETRA, Ministry of Transport (MOT), Attorney General's Chambers of Malaysia (AGC), UPEN, PETRONAS, investors, financial institutions and foreign ministerial counterparts.

CASE FOR CHANGE

Malaysia is uniquely positioned to become a key CCS provider given its suitable geological features, competitive costs and a sizeable storage capacity. The development of infrastructure needed to facilitate cross-border CCS activities will establish Malaysia as the preferred CCS destination. Supporting this ambition requires the establishment of legal frameworks, government-to-government agreements and CCUS standards to unlock economic potential in CCUS.

Key Initiatives		Action Plans	Key Stakeholders
ST2.1	Strengthening CCS solutions to enable cross-border CCS activities via legal frameworks, agreements and standards	• Operationalise the CCUS Act 2025. • Harmonise CCS implementation processes for nationwide consistency. • Establish a licensing regime for cross-border transport operators, storage site owners and third-party service providers. • Establish a cross-border CCS agreement.	Ministry of Economy, NRES, MITI, MOF, AGC, PETRONAS
		• Establish a national carbon accounting task force to align standards for CO_2 storage. • Establish emissions reduction methodology under cross-border arrangements, e.g. accounting, ownership, leakage management and reporting obligations.	NRES, Ministry of Economy, MITI, PETRONAS
ST2.2	Developing infrastructure for cross-border CCS activities	• Conduct infrastructure planning for CO_2 transport and storage, including leveraging existing infrastructure. • Explore funding and investment through public-private models, engaging with potential investors and equity partners.	Ministry of Economy, PETRA, MOF, ST, PETRONAS, investors, financial institutions
ST2.3	Establishing Malaysia as a competitive and strategic CCUS market	• Streamline licensing processes through a one-stop agency for CCUS. • Leverage ASEAN platforms to promote Malaysia's readiness as a regional CCS leader. • Explore Government-to-Government (G2G) agreements. • Collaborate with international partners to explore CCS partnership opportunities and promote Malaysia as a competitive CCS market. • Attract investments to develop CCUS projects in Malaysia by organising investor roadshows and pitch sessions to showcase Malaysia's CCUS project pipeline and readiness.	Ministry of Economy, MOF, PETRA, MITI, MIDA

Table 4.2: Key Initiatives and Action Plans for Strategic Thrust 2

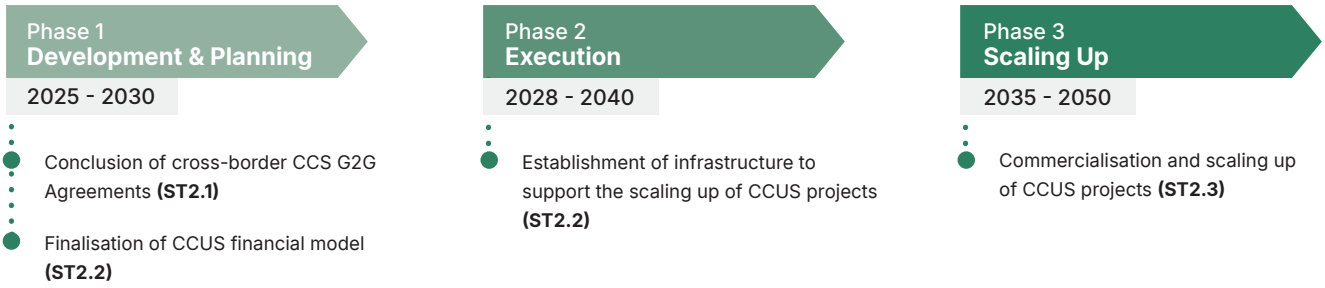


Figure 4.3: Key Milestones & Execution Plan for ST2

ST3 CATALYSE PROPRIETARY CARBON CAPTURE, UTILISATION & STORAGE TECHNOLOGIES FOR INDUSTRIAL ADOPTION

This thrust, as tabulated in Table 4.3 and depicted in Figure 4.4, aims to foster the development and deployment of homegrown proprietary technologies tailored to local and regional industrial needs. It focuses on building a collaborative platform that brings together government, research institutions and industry players to coordinate R&D and pilot projects. These initiatives drive the adoption of domestic CCUS technologies, including CO_2 utilisation solutions.

The initiatives under this Thrust include:

ST3.1 Developing local CCUS technologies for commercialisation and large-scale deployment

Large-scale deployment of local CCUS technologies depends on academia-industry collaborations and access to R&D support. Developing local CCUS technologies and commercialisation capabilities will accelerate innovation and enhance domestic expertise.

ST3.2 Facilitating CCUS knowledge transfer through formation of partnerships

Facilitating knowledge transfer between domestic and international CCUS technology providers unlocks partnership opportunities. These collaborations strengthen local capabilities and technical expertise as well as accelerate technology adoption and the commercial maturity of the domestic CCUS industry.

ST3.3 Deploying regulatory sandbox to pilot and scale CCUS in the oil and gas, power and manufacturing sectors

Implementing a CCUS regulatory sandbox allows the oil and gas, power and manufacturing industries to test technologies, business models and frameworks in a controlled environment while mitigating risks. This structured approach accelerates institutional learning, de-risks private investment and provides the empirical insights needed to develop robust policies for commercial-scale deployment.

ST3.4 Advancing CO_2 utilisation development

Driving CO_2 utilisation development focuses on scaling technologies that use captured carbon to produce valuable products, creating new revenue streams and improving CCUS project economics. This accelerates market creation for domestic CO_2-derived products and creates revenue opportunities that encourage industry investment in carbon capture.

KEY STAKEHOLDERS

MOSTI, Ministry of Economy, MITI, MOF, MOFA, NRES, PETRA, Ministry of Higher Education (MOHE), PETRONAS, academia and industry players.

CASE FOR CHANGE

Malaysia has potential to build its CCUS innovation ecosystem, however, the necessary technological maturity, local capability and scale to support industrial development are still at the nascent stage. Advancing local proprietary CCUS technologies strengthens supply chain resilience and equip industries with scalable solutions for decarbonisation. Domestic CCUS technologies and solutions serve as alternatives and contribute to a more dynamic industry.

Key Initiatives		Action Plans	Key Stakeholders
ST3.1	Developing local CCUS technologies for commercialisation and large-scale deployment	• Explore R&D grants for local firms or startups focused on CCUS. • Collaborate with industry players and academia on CCUS-related research and launch a national research platform involving universities and industry leaders. • Develop a centralised platform to share research findings and technology roadmaps.	MOSTI, Ministry of Economy, NRES, MOFA, MOF, MOHE, Academia, industry players
ST3.2	Facilitating CCUS knowledge transfer through formation of partnerships	• Engage with domestic and international CCUS technology providers for joint venture opportunities.	MOSTI, Ministry of Economy, PETRONAS, industry players
ST3.3	Deploying regulatory sandbox to pilot and scale CCUS in the oil and gas, power and manufacturing sectors	• Test and validate standards and protocols for monitoring, verification and liability within the sandbox framework.	Ministry of Economy, NRES, MITI, PETRA, MOSTI
ST3.4	Advancing CO2 utilisation development	• Enhance the utilisation of captured CO_2 to create high-value and low-carbon products. • Establish CO_2 product certification for local products to be recognised globally. • Promote and market locally produced CCU products. • Facilitate the uptake of CO_2 utilisation by domestic players.	MITI, MOF, MOSTI, industry players

Table 4.3: Key Initiatives and Action Plans for Strategic Thrust 3

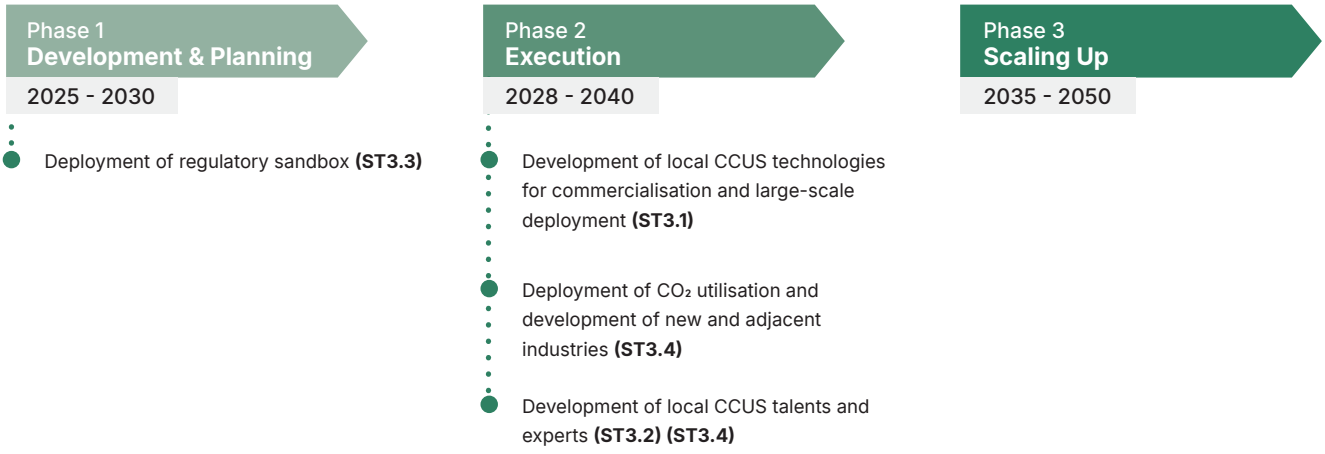


Figure 4.4: Key Milestones & Execution Plan for ST3

ST4 DRIVING EAST COAST REGIONAL DEVELOPMENT

This thrust, as tabulated in Table 4.4 and depicted in Figure 4.5, focuses on catalysing regional development in the east coast of Peninsular Malaysia through CCUS. Regional growth hinges on establishing strategic planning and governance, piloting a CCUS cluster and integrating local companies into the value chain. The development brings balanced national growth and socio-economic prosperity in the East Coast.

Developing pipelines, hubs and storage infrastructure in the region will not only enable large-scale decarbonisation but also catalyse new investment, job creation and industrial growth.

The initiatives under this Thrust include:

ST4.1 Establishing strategic planning and governance for East Coast development

Robust governance, public awareness and unified federal-state-industry collaboration are essential to building a viable East Coast CCUS ecosystem. These initiatives align infrastructure development and accelerate deployment to drive regional economic transformation.

ST4.2 Piloting CCUS cluster in the East Coast

The pilot CCUS cluster in the East Coast focuses on building an integrated CCUS ecosystem anchored by strategic planning, infrastructure development and investment mobilisation to demonstrate its commercial viability. This accelerates the growth of regional CCUS activities, strengthens industrial decarbonisation efforts and supports sustainable economic development within the East Coast region.

ST4.3 Developing local companies as part of the CCUS value chain

The growth of the CCUS industry is anchored on participation from local companies and expertise, as well as effective R&D partnerships. Integrating local businesses into the CCUS value chain generates sustainable long-term economic opportunities across the region.

KEY STAKEHOLDERS

MITI, Ministry of Economy, Ministry of Entrepreneur and Cooperatives Development (MECD), MOF, MOSTI, East Coast Economic Region Development Council (ECERDC), MPRC, SME Corp, state governments, industry players and educational institutions.

CASE FOR CHANGE

The east coast region of Peninsular Malaysia is strategically located in close proximity to heavy industries and possesses abundant depleted offshore oil and gas reservoirs suitable for CO_2 storage. These advantages provide opportunities to pilot Malaysia's first CCUS hub and cluster on the East Coast. This development brings socio-economic spillover effects that contribute to the local development of small and medium enterprises (SMEs), job creation and spur new sources of economic growth.

Key Initiatives		Action Plans	Key Stakeholders
ST4.1	Establishing strategic planning and governance for East Coast development	• Establish an East Coast development task force including government agencies, state representatives and industry players. • Develop a comprehensive East Coast development master plan, outlining the CCUS cluster activities, ecosystem and integration with local community development. • Accelerate CCUS development through facilitation of investment and approval processes by state governments. • Promote local community upliftment through income-generating activities and capacity building. • Deploy Communication, Education and Public Awareness (CEPA) activities.	Ministry of Economy, State Government, ECERDC, MITI, industry players
ST4.2	Piloting CCUS cluster in the East Coast	• Design and establish a master plan, including potential incentives for the development of the CCUS cluster. • Develop infrastructure needed to support the CCUS cluster. • Promote investment into the East Coast to develop the CCUS cluster.	Ministry of Economy, MITI, industry players, ECERDC
ST4.3	Developing local companies as part of the CCUS value chain	• Promote and facilitate local companies to participate in CCUS value chain activities. • Promote R&D activities and strategic partnerships in the CCUS value chain. • Explore a financing framework to support local players to participate in CCUS activities. • Establish upskilling programmes for the local workforce to support CCUS activities.	Ministry of Economy, MOF, MOSTI, MECD, MPRC, ECERDC, SME Corp, local companies

Table 4.4: Key Initiatives and Action Plans for Strategic Thrust 4

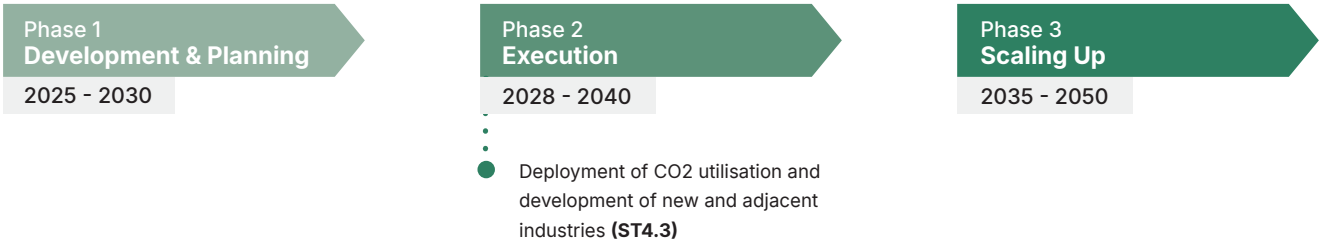


Figure 4.5: Key Milestones & Execution Plan for ST4

Enablers

E1 POLICY, REGULATION AND GOVERNANCE

This enabler, as tabulated in Table 4.5 and depicted in Figure 4.6, focuses on building a robust and coherent policy and regulatory ecosystem to support the effective implementation of CCUS in Malaysia. It involves establishing a comprehensive legal and governance framework to ensure safe, transparent and effective deployment of CCUS activities, both domestically and across borders. These initiatives strengthen investor confidence and create an enabling environment for scalable and commercially viable CCUS development.

The initiatives under this Enabler include:

E1.1 Enacting relevant legislations and regulations for the implementation of CCUS activities

Enacting relevant CCUS legislation and regulations involves introducing enabling provisions for carbon pricing mechanisms, engaging industrial sectors to determine appropriate pricing levels and exploring insurance frameworks to support CCUS projects. This establishes clear regulatory signals, enhances risk management and provides the economic and policy certainty needed to drive investment and accelerate the deployment of CCUS at scale.

E1.2 Establishing an agency to regulate activities under the CCUS Act 2025

A dedicated regulatory body under the CCUS Act 2025 strengthens governance, streamlines approval processes and supports the effective administration of Malaysia's CCUS activities. This enables coordinated oversight, efficient implementation and clear institutional responsibilities across the CCUS value chain.

E1.3 Formulating carbon accounting policy and reporting

Credible and transparent carbon accounting mechanisms support accurate emissions tracking, reporting and verification across the CCUS value chain. Formulating carbon accounting policies and reporting frameworks strengthens accountability, supports alignment with international standards and improves interoperability across markets.

E1.4 Establishing standards for CCUS projects

Establishing standards for CCUS projects involves developing national technical and operational standards across the CO_2 value chain through industry engagements and alignment with international frameworks. This ensures consistency, enhances safety and environmental integrity, facilitates cross-border collaboration and builds investor confidence to support the scalable deployment of CCUS.

E1.5 Enforcement of regulations across the value chain

Establishing a compliance audit mechanism for the CCS value chain involves identifying the relevant ministries, agencies and personnel responsible for enforcement. This enhances the credibility and integrity of CCUS operations.

CASE FOR CHANGE

The CCUS Act 2025 establishes the legal foundation governing CCUS activities in Malaysia. A centralised governance structure, underpinned by a coherent and comprehensive legal framework, is essential to facilitate infrastructure development, provide investment certainty and regulatory oversight. In addition, a standardised carbon accounting and MRV protocol serves to enhance transparency and alignment with international climate commitments.

KEY STAKEHOLDERS

Ministry of Economy, NRES, PETRA, MITI, MOF, Ministry of Human Resources Malaysia (KESUMA), AGC, PETRONAS and industry players.

Key Initiatives		Action Plans	Key Stakeholders
E1.1	Enacting relevant legislations and regulations for the implementation of CCUS activities	• Introduce enabling provisions for carbon tax and ETS. • Consult with industrial sectors for the introduction of carbon tax at an appropriate level. • Explore the development of an insurance framework for CCUS projects and activities.	MOF, Ministry of Economy, NRES, PETRA, MITI, AGC, Royal Malaysian Customs Department (RMCD), Bank Negara Malaysia (BNM)
		• Develop guidance to assist proponents in navigating Federal-level and State-level regulatory frameworks.	Ministry of Economy, AGC
E1.2	Establishing an agency to regulate activities under the CCUS Act 2025	• Establish the Malaysia CCUS Agency and harmonise the roles between the relevant agencies for seamless regulatory oversight. • Appoint the relevant ministries, agencies and personnel to be part of the governance structure. • Streamline the approval processes for CCUS activities.	Ministry of Economy, NRES, Department of Environment (DOE), Malaysia Petroleum Management PETRONAS (MPM)
E1.3	Formulating carbon accounting policy and reporting	• Adopt international MRV (Monitoring, Reporting, Verification) frameworks for carbon accounting. • Pilot a joint carbon accounting scheme with international partners to test application.	NRES, MITI, industry players
E1.4	Establishing standards for CCUS projects	• Establish national technical standards for CO_2 capture, transport, injection and storage. • Engage industry players in establishing the standards. • Harmonise the regional standard for CCUS with ASEAN countries. • Set standards for operational, maintenance, environmental, health and safety practices for CCUS activities.	MITI, Ministry of Economy, KESUMA, Department of Standards Malaysia (DSM), Department of Occupational Safety and Health (DOSH), Standards and Industrial Research Institute of Malaysia (SIRIM), PETRONAS, industry players
E1.5	Enforcement of regulations across the value chain	• Establish a compliance audit mechanism for the CCS value chain. • Determine relevant ministries, agencies and personnel that will act as the enforcement parties.	Ministry of Economy, NRES, MOF, Royal Malaysian Customs Department (RMCD)

Table 4.5: Key Initiatives and Action Plans for Enabler 1

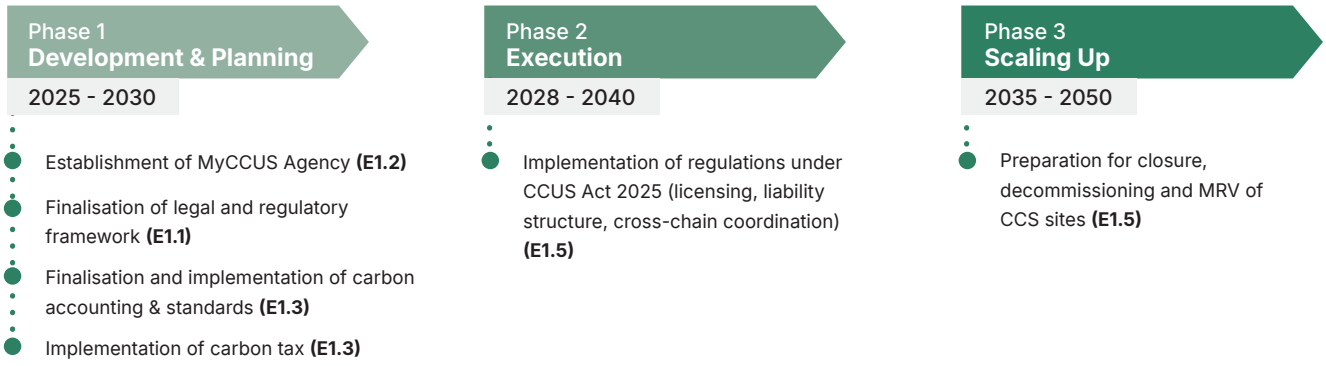


Figure 4.6: Key Milestones & Execution Plan for E1

E2 FINANCING & INCENTIVES

This enabler, as tabulated in Table 4.6 and depicted in Figure 4.7, focuses on establishing financial mechanisms that support CCUS deployment. It includes the introduction of targeted fiscal incentives and the development of a clear CCUS taxonomy. These initiatives reduce investor risk, increase project bankability and unlock private capital for CCUS projects.

The initiatives under this Enabler include:

E2.1 Establishing tax allowances and incentives

The development of fiscal support mechanisms involves benchmarking global best practices to tailor tax incentives, relief or rebates to support CCUS infrastructure and technology deployment. This lowers capital intensity while improving project economics and investment confidence to accelerate CCUS adoption.

E2.2 Facilitating financing for CCUS projects

Strengthening financial enablement for CCUS involves collaborating with financial institutions to integrate CCUS into sustainable financing products, developing a dedicated taxonomy and exploring carbon credit generation from CCUS projects. This enhances access to capital and improves project viability.

KEY STAKEHOLDERS

MOF, NRES, MITI, investors, financial institutions, industry players and BNM.

CASE FOR CHANGE

Malaysia requires infrastructure development and investment to accelerate the development of CCUS. Globally, CCUS projects have progressed past investment stages through financial mechanisms. Similar measures are needed in Malaysia to improve project bankability, reduce investor risk and attract private capital for CCUS developments.

Key Initiatives		Action Plans	Key Stakeholders
E2.1	Establishing tax allowances and incentives	• Benchmark and adapt successful fiscal models from other countries. • Provide targeted tax incentives, relief or rebates for CCUS infrastructure and technology deployment. • Periodically review and extend incentive frameworks to ensure continued relevance and uptake. • Consult with industry to understand the need for intervention at different stages of the project lifecycle.	MOF, MITI, MIDA, BNM, industry players
E2.2	Facilitating financing for CCUS projects	• Collaborate with financial institutions to include CCUS projects in sustainable financing products. • Develop a CCUS taxonomy with financial institutions for sustainable financing frameworks. • Explore carbon credit issuance for CCUS projects.	MOF, NRES, BNM, Bursa Carbon Exchange (BCX), investors, financial institutions, industry players

Table 4.6: Key Initiatives and Action Plans for Enabler 2

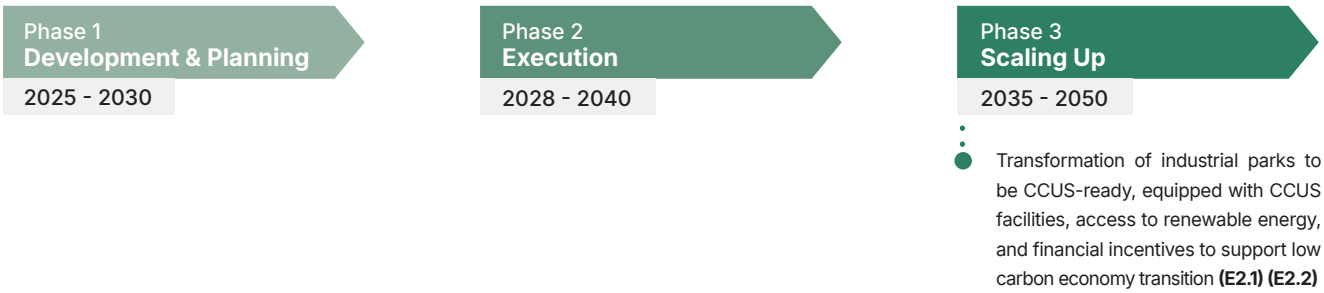


Figure 4.7: Key Milestones & Execution Plan for E2

E3 HUMAN CAPITAL

This enabler, as tabulated in Table 4.7 and depicted in Figure 4.8, focuses on building a skilled, future-ready workforce to meet the demands of Malaysia's growing CCUS sector. It entails aligning education and workforce transition programmes with industry needs across the CCUS value chain. These initiatives address emerging job market demands enabling the workforce to benefit from the low-carbon transition.

The initiatives under this Enabler include:

E3.1 Projecting CCUS workforce demand

Skills mapping allows future CCUS talent demands to be identified while informing targeted training programmes and talent pipeline development. This strengthens workforce readiness and builds critical capabilities for the sector.

E3.2 Upskilling and reskilling existing talent in CCUS expertise

CCUS-specific programmes and training modules, supported by funding, equip engineers, technicians and workers from existing industries with the capabilities needed to participate in the CCUS value chain. This accelerates workforce transition, strengthens industry readiness and builds a skilled talent pool.

E3.3 Curating STEM and skills programmes with a focus on CCUS expertise, leveraging on local and international collaboration

Collaboration with local and international higher-learning and research institutions supports the development of CCUS-related STEM programmes, including specialised curricula, sponsorships and exchange opportunities. This empowers local expertise and expands access to CCUS knowledge and research.

E3.4 Cultivating CCUS experts in the industry

Development of capability and professional certification pathway supports the cultivation of CCUS experts across technical, operational and regulatory functions. This builds in-house expertise and improves industry competitiveness.

KEY STAKEHOLDERS

MOSTI, Ministry of Economy, KESUMA, MOHE, MOE, MITI, Prime Minister's Department of Malaysia (JPM), educational institutions and industry players.

CASE FOR CHANGE

CCUS in Malaysia is expected to create up to 200,000 direct and indirect jobs by 2050, at peak operations. Building a strong talent pipeline and developing specialised CCUS capabilities ensure the workforce is equipped to meet emerging industry demands. Reskilling and industry collaboration support a just transition for workers and strengthen Malaysia's competitiveness in the growing low-carbon economy.

Key Initiatives		Action Plans	Key Stakeholders
E3.1	Projecting CCUS workforce demand	• Undertake a nationwide skills mapping study to estimate CCUS workforce by 2027. • Develop talent pipeline and curate programmes to fulfil CCUS market demands.	MOSTI, Ministry of Economy, KESUMA, MOHE, MOE, MPRC
E3.2	Upskilling and reskilling existing talent in CCUS expertise	• Launch targeted upskilling and reskilling programmes for engineers and technicians in existing oil & gas and manufacturing industries. • Leverage Human Resource Development Corporation (HRD Corp) funding for CCUS-specific modules and certification courses.	KESUMA, Ministry of Economy, MOSTI, MOHE, MOE, JPM, the National TVET Council (MTVET), MPRC, educational institutions
E3.3	Curating STEM and skills programmes with a focus on CCUS expertise, leveraging on local and international collaboration	• Collaborate with local and international higher-learning and research institutions to co-develop CCUS curricula. • Explore sponsorship opportunities and exchange programmes for Malaysian students, workforce, academia and employers alike in CCUS fields.	MOHE, KESUMA, MOSTI, MOE, MTVET, JPM, educational institutions
E3.4	Cultivating CCUS experts in the industry	• Promote companies to appoint CCUS champions and form in-house expert teams to support project development. • Coordinate an industry-recognised certification track for CCUS professionals in Malaysia.	Ministry of Economy, MOSTI, MITI, KESUMA, MOHE, MOE, JPM, MTVET, MPRC, Malaysia Board of Technologists (MBOT)

Table 4.7: Key Initiatives and Action Plans for Enabler 3

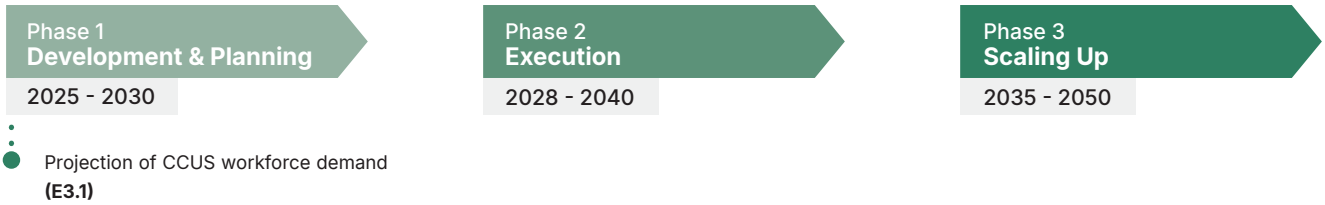


Figure 4.8: Key Milestones & Execution Plan for E3

E4 COMMUNICATIONS, EDUCATION AND PUBLIC AWARENESS

This enabler, as tabulated in Table 4.8 and depicted in Figure 4.9, focuses on building public trust and aligning key stakeholders to support Malaysia's CCUS strategic goals. It involves implementing national awareness campaigns, educational outreach, and collaborative platforms to engage communities including industry leaders and policymakers. This creates a unified and well-informed community that supports decarbonisation efforts through CCUS.

The initiatives under this Enabler include:

E4.1 Advancing CCUS leadership and stakeholder alignment

Structured national coordination and stakeholder engagement align policies and actions across government, industry and the public on CCUS development. This enhances leadership, improves cross-sector collaboration and supports effective implementation of CCUS initiatives in Malaysia.

E4.2 Promoting national awareness of CCUS targeting key stakeholders

Coordinated education and communication increase awareness across communities, including industry leaders and policymakers. This builds public acceptance, addresses concerns around safety and environmental risks and supports broader stakeholder buy-in for CCUS development in Malaysia.

KEY STAKEHOLDERS

Ministry of Economy, ministries and agencies, media platforms, the public, industry associations and civil society organisations.

CASE FOR CHANGE

Leadership, alignment and public trust are imperative for the successful deployment of CCUS. CCUS stewardship brings communities toward shared strategic goals while actively mitigating social and environmental misconceptions. Continuous efforts build national awareness and unify stakeholders to drive momentum and secure long-term societal support.

Key Initiatives		Action Plans	Key Stakeholders
E4.1	Advancing CCUS leadership and stakeholder alignment	• Establish a high-level national task force to align ministries, agencies, industry leaders and the general public on CCUS priorities. • Develop a stakeholder engagement communication plan to coordinate inputs from key sectors.	Ministry of Economy, ministries & agencies, media platforms, MPRC
E4.2	Promoting national awareness of CCUS targeting key stakeholders	• Implement a nationwide public education campaign on CCUS benefits and safety based on credible information to enhance societal awareness, understanding and acceptance of CCUS. • Maintain an integrated communication platform for CCUS-related information. • Collaborate with CSOs, academia and media to address the general public's concerns around leakage, environmental risks and transparency.	Ministry of Economy, ministries & agencies, media platforms, public, industry associations, civil society organisations, MPRC

Table 4.8: Key Initiatives and Action Plans for Enabler 4

Phase 1 Development & Planning	Phase 2 Execution	Phase 3 Scaling Up
2025 - 2030	2028 - 2040	2035 - 2050
Promotion of national awareness on CCUS targeting key stakeholders **(E4.1)**		

Figure 4.9: Key Milestones & Execution Plan for E4



Malaysia to Achieve the First CO_2 Injection as Early as 2030 for Non-Petroleum Operations

Figure 4.10 outlines the critical actions and milestones that underpin this ambition, serving as a visual summary of Malaysia's pathway towards becoming a regional CCUS leader.

GOVERNMENT

Phase 1
Development & Planning
2025 - 2030

1 Establishment of MyCCUS Agency **(E1.2)**
2 Finalisation of legal and regulatory framework **(E1.1)**
3 Finalisation and implementation of carbon accounting & standards **(E1.3)**
4 Implementation of carbon tax **(E1.3)**
5 Conclusion of cross-border CCS G2G Agreements **(ST2.1)**
6 Finalisation of CCUS financial model **(ST2.2)**
7 Implementation of pilot CCUS projects within Oil and Gas, Power and Manufacturing **(ST1.1)**
8 Development of CCUS hub and cluster in east coast, Peninsular Malaysia **(ST1.2)**
9 Formation of industrial CCUS clusters and hubs **(ST1.3)**
10 Deployment of regulatory sandbox **(ST3.3)**
11 Projection of CCUS workforce demand **(E3.1)**
12 Promotion of national awareness on CCUS targeting key stakeholders **(E4.1)**

Phase 2
Execution
2028 - 2040

1 Implementation of regulations under CCUS Act 2025 (licensing, liability structure, cross-chain coordination) **(E1.5)**
2 Achievement of first CO_2 injection as early as 2030 for non-petroleum operations **(ST1.2)**
3 Deployment of first CCUS hub in east coast, Peninsular Malaysia with total storage capacity of 10 Mtpa by 2030 **(ST1.2)**
4 Establishment of infrastructure to support the scaling up of CCUS projects **(ST2.2)**
5 Development of local CCUS technologies for commercialisation and large-scale deployment **(ST3.1)**
6 Deployment of CO_2 utilisation and development of new and adjacent industries **(ST3.4) (ST4.3)**
7 Development of local CCUS talents and experts **(ST3.2) (ST3.4)**

Phase 3
Scaling Up
2035 - 2050

1 Commercialisation and scaling up of CCUS projects **(ST2.3)**
2 Development of up to 6 CCUS hubs **(ST1.3)**
3 Transformation of industrial parks to be CCUS-ready, equipped with CCUS facilities, access to renewable energy, and financial incentives to support low carbon economy transition **(ST1.4) (E2.1) (E2.2)**
4 Preparation for closure, decommissioning and MRV of CCS sites **(E1.5)**

Figure 4.10: Malaysia CCUS Roadmap Execution Plan

Note: Strategic Thrust (ST) and Enabler (E) refer to the initiatives outlined in the CCUS Strategic Framework

Critical Success Factors

The successful development and deployment of CCUS activities require a coordinated ecosystem across government, industry players, financial institutions, academia and technology providers. This coordination extends beyond domestic boundaries, where strong regional collaboration, cross-border partnerships and G2G cooperation enable the development of integrated CCUS hubs and regional value chains. This must be underpinned by clear and harmonised regulatory and carbon accounting frameworks, robust MRV systems, technically aligned standards and streamlined approval processes to enhance investor confidence and operational integrity. In addition, sustainable financing mechanisms, targeted incentives and carbon market development are required to support infrastructure development and the commercial viability of CCUS projects. Finally, building skilled talent, fostering innovation, as well as maintaining stakeholder alignment and public trust are critical to delivering a scalable CCUS ecosystem that supports Malaysia's decarbonisation and regional leadership ambitions.



CCUS **Flagship Projects**

Key Messages:

- *The flagship projects demonstrate tangible implementation pathways across the CCUS value chain, featuring technical feasibility, commercial readiness and scalability of CCUS projects in Malaysia.*
- *Early flagship projects will catalyse infrastructure development, strengthen investment confidence and accelerate ecosystem readiness.*

Overview

The Malaysia CCUS Roadmap features four flagship projects to demonstrate the practical implementation of its strategies. The projects span across industrial, energy and bio-based sectors, showcasing feasibility, driving early deployment and building momentum to scale up the industry. Collectively, these projects exemplify Malaysia's whole-of-nation approach in developing the CCUS industry, aligning policy, regulatory frameworks and multi-stakeholder coordination.

The four flagship projects are illustrated in Figure 5.1 below.

The flagship projects translate the strategic thrust identified under the Malaysia CCUS Roadmap to advance pilot CCUS projects in the oil and gas, power and manufacturing sectors into tangible action. The selection of the flagship projects is based on the following criteria:

- High-impact results that contribute to the true north and key indicator targets
- Committed budget and investment
- Structured timeline and milestones in place
- Technology readiness level of four and above
- Potential for scaling up

Flagship Project 1	Flagship Project 2	Flagship Project 3	Flagship Project 4
National Carbon Capture (NCC) Project *Owner: MITI* • Pilot to demonstrate the feasibility and scalability of carbon capture in Malaysia's industrial sector • Capturing carbon emissions at source of a carbon-intensive industrial plant in the east coast, Peninsular Malaysia. • Expected to commence the EPCC by 2028. **Capture**	**East Coast, Peninsular Malaysia Offshore CCS Project** *Owner: PETRONAS* • Development of a liquefied CO_2 receiving terminal in Kuantan. • 245 km of offshore pipeline and storage site at Duyong (depleted field). • Targeted establish 5 Mtpa of storage capacity as early as 2031. **Transportation & Storage**	**Project Dragon** *Owner: TNB* • Integrating CCU with Thermal Power Plant towards decarbonisation and sustainable power generation. • CO_2 Utilisation: 5,000 kg/year from Jimah East Power via pilot CCU system. • CCU system completion is targeted for Q3 2026, with techno-economic assessment by Q1 2027. **Capture & Utilisation**	**Project Chlorobloom** *Owner: TNB* • Direct capture/utilisation of CO_2 into algae photobioreactor systems (Bio-CCU). • Demonstrates biological CO_2 utilisation via algae, producing high-value biomass and showcasing carbon pricing and circular economy at a coal-fired plant. • Technical and economic analysis expected to be completed by Q4 2026. **Capture & Utilisation**

Facilitation Required to Scale Up

- Blended Financing, Incentives & Grants
- Finalise G2G Agreements, GHG Accounting Framework for CCUS Projects & CCUS Regulations
- Talent Development & Capacity Building throughout CCUS Value Chain
- Develop infrastructure and technology required for CCUS

Figure 5.1: Flagship Projects, Description and Required Facilitation

FLAGSHIP PROJECT 1

National Carbon Capture Project

Project Details

The National Carbon Capture (NCC) Project is a pilot project to demonstrate the feasibility and scalability of carbon capture in Malaysia's hard-to-abate industrial sectors, with an initial focus on iron and steel. It involves capturing carbon emissions at the source of a carbon-intensive industrial plant on the east coast of Peninsular Malaysia using membrane-based contactor technology. The project is led by MITI, with PETRONAS and SIRIM as key stakeholders.

Key Impact

- Supports the establishment of refined technical validation and cost estimates for broader CCUS deployment
- Builds early foundational learnings to inform future CCUS policy and investment, particularly for hard-to-abate industries
- Enables decarbonisation pathways for CBAM-exposed sectors
- Supports the development of the MRV framework and data systems needed for CCUS deployment within the metal industry

Next Steps

- Replicate the CO_2 capture techno-economic model for broader hard-to-abate industries
- Front-End Loading (FEL) 2 and FEL 3 targeted by 2027
- Engineering, Procurement, Construction and Commissioning (EPCC) targeted for 2027–2030, subject to FEL 3 findings and decision-making

FLAGSHIP PROJECT 2

East Coast Offshore CCS Project

Project Details

The East Coast Offshore CCS Project is a large-scale initiative, located along the east coast of Peninsular Malaysia, aimed at providing CO_2 storage solutions to domestic and international emitters. It involves the development of a liquefied CO_2 receiving terminal in Kuantan, a 245-kilometre offshore pipeline and a CO_2 storage site at the depleted Duyong field. The project is led by PETRONAS, with Mitsui & Co., Ltd. and TotalEnergies as key partners in providing transportation and storage services, as shown in Figure 5.2.

Key Impact

- Enables provision of 5 Mtpa of storage capacity as early as 2031
- Attracts investments through partnership models
- Stimulates infrastructure development in the East Coast region
- Enables spillover impact on adjacent economic activities
- Creates new job opportunities
- Enables the oil and gas services and equipment (OGSE) sector to apply its existing capabilities to new opportunities in CCS

Next Steps

- Replicate the model to set up future CCS hubs
- Final investment decision to be made by Q3 2028
- In line with emitter readiness, first injection is targeted as early as Q4 2031

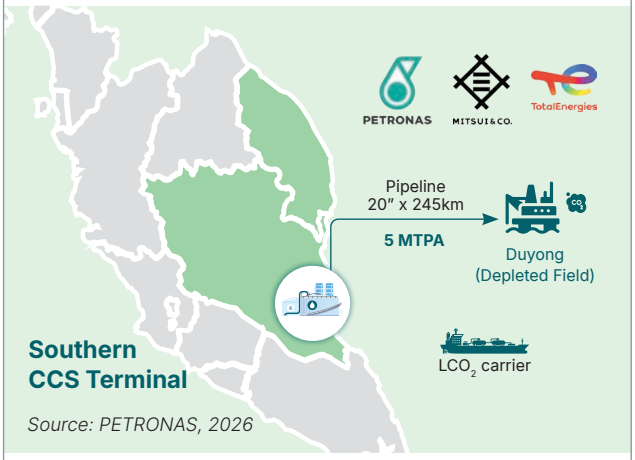


Figure 5.2: East Coast Offshore CCS Project

FLAGSHIP PROJECT 3

Project Dragon

Project Details

Project Dragon is an integrated CCU pilot project championed by TNB that aims to utilise CO_2 from the Tunku Muhriz Power Station, Jimah. The project demonstrates the feasibility of CCU integration using actual flue gas and establishes the unit production cost of CCU technology in the energy industry. As illustrated in Figure 5.3, the project will leverage key technologies such as post-combustion capture technology, Algae Bio-CCU, Greenhouse Bio-CCU and E-Fuel Production Systems, with an estimated investment of RM14.16 million.

Key Impact

- Enables the utilisation of approximately 5,000 kg per year of CO_2
- Showcases the commercial potential of captured CO_2

Next Steps

- Establishes the unit production cost for CCU technology for power plants
- Completion of overall CCU system by Q3 2026
- Completion of the techno-economic analysis of the overall CCU system by Q1 2027

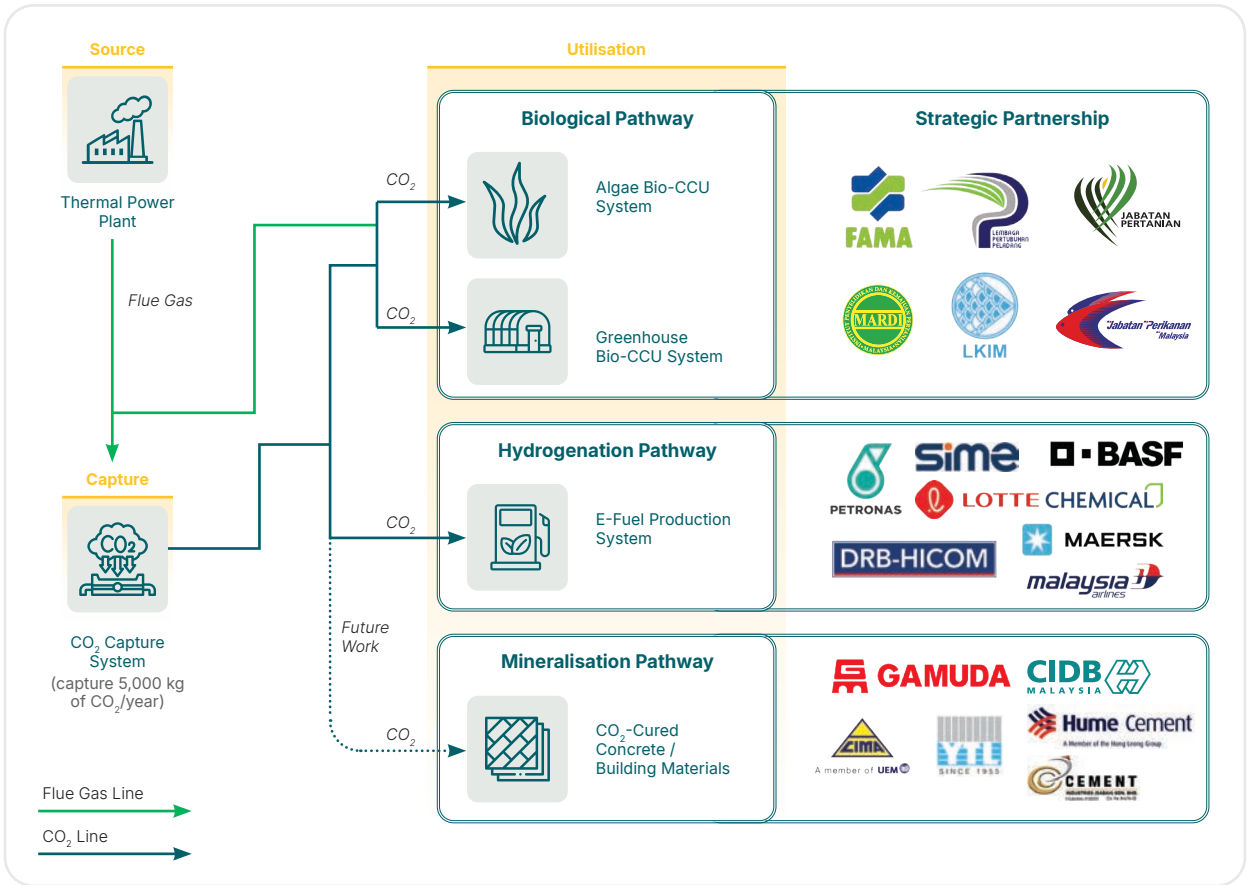


Figure 5.3: Project Dragon

Source: TNB, 2026

FLAGSHIP PROJECT 4

Project Chlorobloom

Project Details

Project Chlorobloom is another CCU project led by TNB that aims to utilise CO_2 from the Sultan Azlan Shah Power Station, Manjung, to produce high-value algae-based biomass products. The project demonstrates CO_2 utilisation while integrating circular economy principles at a coal-fired power plant, as illustrated in Figure 5.4. The project will leverage key technologies such as native microalgae and air-lift photobioreactor systems, with an estimated investment of RM6.4 million.

Key Impact

- Enables the utilisation of approximately 6,000 kg per year of CO_2
- Demonstrates the CO_2 utilisation technology via a biological pathway
- Showcases the commercial potential of algae biomass products
- Features circular economy principles at a coal-fired power plant

Next Steps

- Completion of Bloom III (24 m^2 capacity) by Q3 2026
- Kick-start power plant decarbonisation with actual flue gas by Q3 2026
- Technical and techno-economic data gathering & analysis to be conducted in Q3 2026

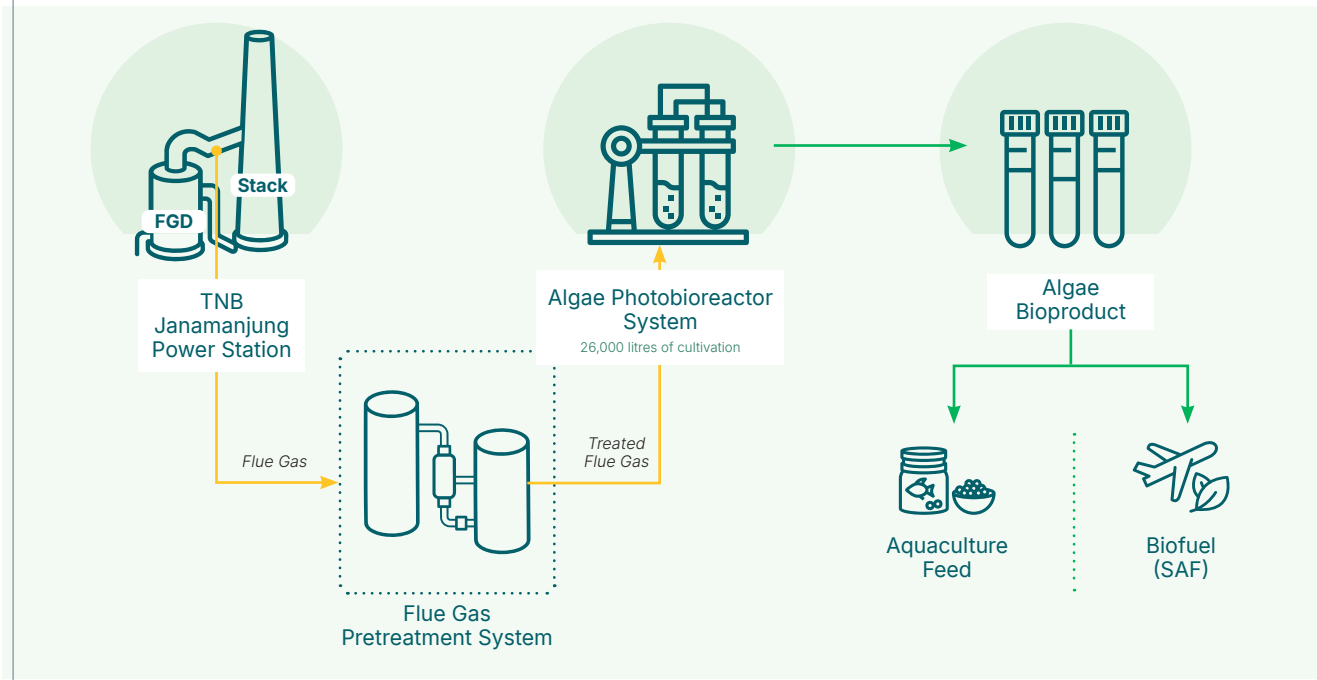


Figure 5.4: Project Chlorobloom

Source: TNB, 2026

Way **Forward**

The Malaysia CCUS Roadmap 2050: Towards Green Economy translates national ambition into a coordinated and actionable framework. The Roadmap offers a pragmatic and forward-looking approach to advancing national sustainability goals while positioning the nation as a regional leader in CCUS.

The Roadmap provides the initial strategic framework to guide the development of detailed action plans aimed at operationalising and accelerating the development of CCUS. The action plans serve as a basis for coordinated action across ministries, agencies, academia, financiers and industry players, while helping to prioritise early initiatives, enable project development and build long-term ecosystem readiness. Success will depend on sustained stakeholder coordination, as well as the ability to address challenges related to financing, technology maturity, talent development and public awareness.

These foundational efforts support the planned initiation of Malaysia's CO_2 injection as early as 2030, establishing a baseline for gradual scale-up and long-term regional competitiveness. The CCUS initiative also benefits the rakyat by creating high-value employment, safeguarding local livelihoods through a fair workforce transition and unlocking economic opportunities.



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Terminology

No.	Term	Definition
1	Hard-to-abate industries	In general, it covers industries associated with high-emission activities which are hard to reduce. Hard-to-abate definitions vary across jurisdictions[12]. This includes industries such as: • Oil and gas (WEF, IRENA) • Power (Aus. NDC) • Cement • Iron and steel
2	Carbon capture and utilisation (CCU)	Process of capturing carbon dioxide (CO_2) emissions from industrial sources or the atmosphere and converting them into useful products such as fuels, chemicals, building materials or other value-added outputs.
3	Carbon capture and storage (CCS)	Process of capturing CO_2 emissions from industrial sources or power generation and transporting them to be permanently stored in geological formations, such as depleted oil and gas reservoirs or deep saline aquifers, to prevent their release into the atmosphere.
4	Carbon capture, utilisation and storage (CCUS)	Refers to an integrated approach that involves capturing carbon dioxide (CO_2) emissions from industrial sources or the atmosphere, and either utilising the captured CO_2 to produce value-added products (CCU) or transporting and permanently storing it in geological formations (CCS), thereby reducing overall emissions while enabling potential economic value creation.
5	CCUS hub	A centralised, shared infrastructure system that aggregates CO_2 from multiple emission sources, enabling its transport, utilisation and/or permanent storage at scale through common facilities such as pipelines, terminals and storage sites.
6	CCUS cluster	Refers to a geographically concentrated network of industrial emitters and shared infrastructure where multiple sources of carbon dioxide (CO_2) are connected to common transport and storage or utilisation systems. This cluster-based approach enables economies of scale, reduces costs and risks and facilitates coordinated deployment of CCUS across industries within a specific region.

[12] (Dufour-Décieux et al., 2025)

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