Chapter 3

Legal and Policy Framework for Deployment of CCUS in Asia Region, focused on ASEAN

Ian Havercroft, Eric Williams, Nabeela Raji, Matthew Loughrey, Joey Minervini, Errol Pinto, and Alex Zapantis

3.1. Introduction

The ASEAN region presents a dynamic and challenging environment for the deployment of CCS. Countries within the region represent a significant proportion of the world's emissions-intense industry, with many still demonstrating a growing dependence on fossil energy. Set against this, however, are several nations' strengthened emissions reduction targets for 2030 and pledges to achieve net zero emissions in the period between 2050 and 2065. CCS technologies are expected to play a significant role in addressing these twin challenges.

New project-level developments across the region are demonstrative of the emphasis now being placed upon the technology. Recent project announcements, led by the oil and gas sectors, offer significant potential for decarbonising the region's natural gas operations, and are positioned as a key aspect of several countries' transition pathways towards clean energy. Regulators and policymakers across the ASEAN region are now considering how their domestic policy and regulatory settings may be strengthened and improved, to support these ambitions for the technology's deployment.

In many instances, the development of CCS-specific policies, laws and regulations are now a priority, with several early projects announced and in development. Some ASEAN nations are now well-advanced in their legal and regulatory preparedness, with the Indonesian government and the Malaysian state of Sarawak releasing CCS-specific legislation that will regulate CCS operations within their territories. Processes to develop and implement national regulatory frameworks are also underway in Thailand and Malaysia, with both countries currently undertaking preparatory work aimed at supporting the development of law and regulation.

While the pace at which individual jurisdictions are addressing these issues varies greatly, several shared ambitions may be identified amongst the ASEAN nations. Recent reports, workshops, and wider intergovernmental fora have consistently highlighted aspirations to develop and implement domestic CCS-specific legal regimes, as well as the need to collectively address wider intergovernmental issues that will impact transboundary CCS operations in the region. A wide range of practical and technical issues have also been identified as critical to the development of CCS-specific law and regulation, as part of

these discussions.

One important element that has emerged in supporting ASEAN nations' ambitions, is the timely provision of guidance and support, from within the region and internationally. While work is already underway within several nations, regulators, and policymakers from across the ASEAN region have expressed a desire for further information and assistance to support these regulatory processes. The practical experience of other jurisdictions, gained from developing and implementing their own regulatory models, is an invaluable resource for ASEAN governments when designing their domestic CCS-specific regimes. To this end, direct engagement with policymakers and regulators from Australia, the United States, Canada, and Europe, has been sought by several governments in the region.

A further source of information for those seeking to develop their regulatory regimes, are the variety of assessment and guidance frameworks that have been developed over the past decade. Produced by several intergovernmental, research and academic institutions, including the Institute, these materials are aimed at supporting the promotion and development of CCS-specific legislation, or as a means of assessing national frameworks' ability to regulate the CCS process. For regulators and policymakers in the ASEAN region, these resources also offer insight into the key elements and principles that underlie several of the early CCS-specific legal and regulatory frameworks.

The aim of this report is to build upon the work and dialogue underway within the ASEAN region, and the existing array of analytical materials, to provide national regulators and policymakers with regionally focused guidance that may support their activities. As such, these materials offer a targeted, ASEAN-centric review, of the issues identified by stakeholders as critical to the deployment of policy, law and regulation in the region.

3.2. Overview and Methodology

The Institute's guidance builds upon a wider, extended programme of work that has been undertaken in the region over the past 12 months. These activities have included the formal review of national and regional approaches to the design and development of CCS-specific legal and regulatory frameworks, as well as extensive consultation with key stakeholders. An important aspect of this engagement has been the Institute's Southeast Asia CCS Accelerator (SEACA) initiative, which has seen the Institute collaborate with governments, multilateral organisations, and the private sector, to examine the critical issues for supporting CCS deployment in the region. The outputs of this initiative have also been shared with the Economic Research Institute for ASEAN and East Asia (ERIA), which is responsible for coordinating the Asia CCUS Network.

3.2.1. Stakeholder Engagement

In developing the guidance, the Institute has engaged extensively with policymakers and regulators from the ASEAN region and beyond, as well as with key stakeholders with expertise in the development of CCS-specific policy law and regulation. The feedback, and

issues raised in these interviews, have been reflected in the materials addressed throughout the sections of the report.

In addition to the engagement undertaken within the auspices of the SEACA programme, the Institute has conducted multiple interviews with regulators and policymakers in the ASEAN region. These structured, formal interviews sought to gain a more detailed understanding of regional priorities and concerns, as well as the work already underway in several ASEAN nations. Interviews were also conducted with policymakers and regulators outside of the region. In these instances, the interviews afforded an opportunity to discuss the approach adopted to the development and operation of CCS-specific regimes, and to examine broader topics such as transboundary movement and carbon accounting.

Several further interviews were conducted with industry stakeholders, academics, and legal professionals, that have broad experience of the policy, legal and regulatory environment across the ASEAN region. Consultation with these parties offered important insight into the design and implementation of CCS-specific regimes, as well as the issues that will be critical for supporting commercial deployment of the technology. Once again, these stakeholders' views and feedback are reflected in the content of the final guidance.

3.2.2. Review and Analysis

In addition to stakeholder engagement, the Institute conducted a detailed assessment of national approaches to the design and implementation of legislation. The review examined the status of policy, law and regulation in ASEAN nations, the CCS-specific legal and regulatory regimes that have been developed in many jurisdictions around the world, and the examples of assessment and guidance frameworks that have been developed to assist policymakers and regulators.

Examination of current regulatory regimes in the ASEAN nations was undertaken, to determine the extent to which CCS activities may be regulated under existing law and regulation. In addition, the latest policy, legal and regulatory developments and initiatives in these jurisdictions were reviewed, to identify key issues, and wider gaps and barriers that will require legislative intervention.

Several CCS-specific legal and regulatory regimes, developed within the region and internationally, were also reviewed. A particular focus of this analysis were the critical elements of these regimes, and the approaches adopted by policymakers and regulators when designing and implementing the individual frameworks. In addition to the CCS-specific Regulation released by the Indonesian government in early 2023, the review has also drawn upon the legislation enacted in Australia, Europe, the United States and Canada.

A further input into the development of the guidance, was an examination of the core issues identified by various technical assessments and guidance models, that have been created by intergovernmental and academic institutions over the past decade. The result

of detailed, jurisdiction-specific analyses, these materials provide a practical guide to the experiences of policymakers and regulators to-date.

3.2.3. Structure

The final guidance is set out in Parts 3.3-3.6 of this report, with each section focusing upon a discrete set of issues for policymakers and regulators in the ASEAN region. When reviewed as a whole, it is hoped that these sections will provide clearly defined and regionally focused information, to support ASEAN governments in their development and implementation of CCS-specific policy and legislation.

3.3. Policy Architecture for CCS – Overarching Considerations

A country's overarching policy architecture for CCS has proven an important precursor to the removal of barriers to investment in the technology, and often a necessary step for promoting the development of supportive legal and regulatory frameworks.

3.3.1. Integration of CCS within Wider Domestic/International Commitments

The most recent report from the UN Intergovernmental Panel on Climate Change (IPCC) has reaffirmed the vital role of CCS technologies in achieving global climate goals. The greatest need for CCS exists in hard to abate sectors, particularly those with process emissions and in economies that rely upon fossil fuels to support their economic growth. Consequently, it is imperative that CCS advances rapidly in Southeast Asia which hosts a significant proportion of the world's emissions-intense industries and has a growing dependence on fossil energy to meet domestic demand and support economic growth.

Net zero ambitions and potential commercial opportunities for significant emissions reductions through the deployment of CCS has led many governments across the Southeast Asian region to include formal support for the technology within their international and national climate commitments and domestic energy policies. Whilst CCS projects are being developed in this region, gaps in policy, regulation and storage resource development present significant headwinds to reaching FID.

In the corporate world, with ever increasing Environmental, Social and Governance (ESG) pressure on corporations, particularly in regard to climate change ambitions, more companies have established net-zero targets by 2050. Corporations operating in the Southeast Asian region are no exception, and many have taken actions to reduce their operational emissions. Corporate sustainability and climate change targets are a key driver for emissions reductions measures.

Policy incentives to facilitate investment in CCS, in particular CO_2 storage, are mostly lacking in the region, although Indonesia and Malaysia have made significant progress. Future investment in CCS in Southeast Asia will depend on the establishment of legal and

regulatory frameworks and policy incentives, creating the right environment to attract international finance.

3.3.2. Energy Roadmaps/Climate Strategies

As the net zero emissions target by mid-century draws closer, the need for regional and international cooperation is increasing. Several countries in Southeast Asia have pledged or written into policy a net zero target by 2050, including Singapore, Thailand, Viet Nam and PNG. Indonesia is proposing to reach net zero by 2060. Achievement of these targets will rely on national strategies setting out achievable implementation measures, as well as regional cooperation to advance the achievement of global emissions reduction targets.

3.3.2.1. National CCS Roadmaps/strategies

On a national level, several countries in Southeast Asia have stated ambitions to reach net zero by or beyond mid-century and have established (or are in the process of establishing) strategies or roadmaps to guide their energy transition - some of them including CCS/CCUS.

- Singapore

Singapore will also aim to achieve net zero emissions by 2050. A key enabler for achieving net zero emissions by 2050 will be a carbon tax, which formed part of the climate commitments package announced in 2022. (National Climate Change Secretariat, 2022) The carbon tax will be set at \$25/tCO_2e in 2024 and 2025 (up from \$5/tCO_2e in 2023), and \$45/tCO_2e in 2026 and 2027, aiming to reach \$50-\$80/tCO_2e by 2030. Carbon pricing provides a clear price signal to heavy-emitting industries to decarbonise. The strengthened carbon price could pave the way for these industries to start investing in CCS as a tool to reduce emissions.

Under Singapore's Green Plan 2030, Singapore is developing its position as a centre for carbon exchanges to facilitate carbon trading, and as a centre of expertise and service delivery for initiatives associated with CCUS projects. These include the financing of low-carbon development, low emissions, and emissions reduction projects, consultancy, assessment, reporting, and verification within Southeast Asia and the broader international community. (The government of Singapore, 2023)

In the Addendum to Singapore's Long-Term Low-Emissions Development Strategy released in 2022, Singapore states it support for global carbon pricing, as a mechanism to enable countries to internalise negative externalities of carbon emissions, without compromising their international competitiveness. This clearly indicates Singapore's intentions to collaborate bilaterally, regionally and internationally to play its part in reducing global carbon emissions.

The government has also emphasised the role of low-carbon technologies in achieving its emission reduction and net zero targets. In its 2020 Long-Term Low-Emissions Development Strategy, for example, Singapore identifies investment in CCS as one of four key avenues for achieving national emissions reduction goals. Furthermore, the NCCS, together with the country's Economic Development Board, commissioned a study in 2021, to examine the role of CCUS in addressing the emissions of the energy and chemicals sectors in Singapore.

In November 2023, Singapore's Economic Development Board released a statement that Singapore aims to realise at least 2 million tonnes of CO_2 capture potential by 2030, as part of a strategy to make its Jurong Island oil refinery more sustainable. Storage options are being explored across Southeast Asia, and regional cooperation around cross-border transport and storage of CO_2 will be imperative to support plans for carbon capture in Singapore.

- Indonesia

The Ministry of Energy and Mineral Resources' (MEMR) Roadmap to Net Zero Emissions by 2060 in Energy Sector identifies CCUS as a key technology for managing emissions associated with industry, electricity generation and fuel consumption. The Roadmap aims for the capture of 6 metric tonnes of CO2 onwards from 2030, with the ultimate goal of 190 metric tonnes of CO2 annually in 2060. In addition, the Ministry of Energy and Mineral Resources is targeting the establishment of 16 CCS/CCUS projects to be operational by 2030. These developments should be considered within the wider context of the Indonesian government's commitment to phase-out of coal fired power generation, indicating the major role CCS technologies is expected to play in decarbonising the sector.

The National Medium Term Development Plan for 2020-2024 (PR No. 18 of 2020) is a national legal and policy document. It lays out Indonesia's policy direction and strategies and provides sectoral guidance on policy measures for energy, water security, maritime, and food security to name a few. While the document does not list CCS for GHG emissions reduction, it discusses carbon sequestration as a mitigative strategy for the forestry sector through afforestation and reforestation. There could be scope to include CCS under the policy measures for resilience and low-carbon development to support GHG emissions reductions.

In February 2023, an ETS for the power generation sector was launched, and is still under development. Indonesia has also proposed the implementation of a carbon tax – this has been postponed until 2025.

Indonesia is also a party to the Just Energy Transition Partnership (JETP) - a $20 billion fund earmarked for investment in clean energy and designed to funnel money from wealthy economies to some of the high-emitting developing economies of the world. One of the requirements of the JETP is for Indonesia to prepare a roadmap to accomplish its energy transition goals and milestones towards achieving net zero by 2050.

In November 2023, Indonesia released a Comprehensive Investment and Policy Plan (CIPP)(JETP Secretariat, 2023), under the JETP, following the signing of the energy transition funding agreement during the G20 Summit in the same month. CCS has not been included in any specified key areas for investment. Under '*Investment Focus Area 2: Early CFPP Retirement and Managed Phase-out*', Indonesia will retire only two coal-fired power plants totaling 1,700MW and that only in 2037. Further, much of the existing coal-fired power plants will continue to operate but efforts will be made to minimise their output.

According to the CIPP, much of the coal-fired power is used by smelting facilities - approximately 9GW out of the total 13-14GW. It is estimated that a further 20GW could be added by 2030, if all planned captive coal power plants in Indonesia are realised. The CIPP notes that a significant shift in business plans technology choices and regulation will be needed to mitigate the impact of this planned increase in coal-fired power.

The CIPP also rightfully notes that *'Further work is required at more granular levels to better assess coal transition strategies considering Indonesia's decarbonization objectives, system adequacy and flexibility needs, and financial and contractual issues. Coal transition pathways are likely to entail combinations of strategies…'*(*Comprehensive Investment and Policy Plan 2023*, 2023)

In an environment of increasing power needs, CCS could play an important role in balancing reliable energy supply to industry, growing the economy and achieving decarbonisation targets. Combining the large-scale deployment of CCS with the phasing-in of renewable energy will enhance reliability and availability of the power network, whilst reducing emissions from coal-fired power plants in the long term.

- Thailand

At the UN Climate Change Conference of the Parties (COP26) in 2021, Thailand committed to carbon neutrality by 2050. The country's Long-term Low Greenhouse Gas Emission Development strategy sets out several key actions to achieve a low-carbon energy transition, and under its National Energy Policy (NEP2022) CCS has been included as a critical tool to reduce GHG emissions in an environment of increased energy demand. (*Carbon Capture Utilization and Storage (CCUS): A Key Decarbonization Technology for Thailand and the Region*, 2023)

Climate and energy policies have, to some extent, recognised the potential role that CCS may play in achieving the country's mitigation objectives. CCS was originally highlighted in Thailand's Climate Change Master Plan, as part of its strategy focused upon mitigation and low carbon development. The plan proposed that feasibility studies on CCS in the power production sector be conducted, as part of efforts to address mitigation in the wider power generation and energy supply sectors.

Thailand is currently in the process of drafting a National Energy Plan (NEP), which would include principles for the country's Energy Policy, aiming to reach net zero emissions by

2065. The development of such a plan clearly shows commitment from the Thai government to climate mitigation action, as it covers a broad spectrum of areas where action could be taken towards decarbonisation. The NEP will set guidelines for five sub-plans, including:

- Thailand Power Development Plan
- Renewable and Alternative Energy Development Plan
- Energy Efficiency Plan
- Natural Gas Management Plan
- Fuel Management Plan

The Natural Gas Management Plan includes a focus on future procurement to strengthen the energy system and import of LNG to promote Thailand as a regional LNG hub. Going forward, CCS will be important to include in the Natural Gas Management the Fuel Management Plans, as a decarbonisation tool to balance increased fossil fuel imports against decarbonisation targets and the country's committed NDC.

Recent project announcements, and increased emission reduction efforts are likely to result in far-greater levels of activity in the coming years. In this regard, state owned PTT Exploration and Production Public Company Limited (PTTEP) has highlighted its ambitions to undertake transnational CCS activities in the Lang Lebah field in offshore Malaysia in late 2023. The state-owned company is also anticipating it will take a final investment decision for the Arthit CCS pilot project in 2023. (*CCS Development in Thailand*, 2022)

- Malaysia

Malaysia is anticipating economic and population growth of 2% per annum until 2050. This growth is expected to fuel a rise in energy demand over the same period.

Following the update of its NDC in 2021, the 12th Malaysia Plan and the National Energy Policy (NEP 2040) have been developed, setting out key priorities towards achieving the NDC. In addition, several strategic roadmaps are in the process of being developed, to support the implementation of the NEP 2040. Of key importance is the National Energy Transition Roadmap (NETR) which will outline the overarching strategy and key initiatives to expedite energy transition efforts. The NETR outlines six levers and ten catalyst projects, aiming to reduce GHG emissions by at least 10 million tons per annum. One of these levers is CCUS and includes two catalyst projects – the development of a regulatory framework by the Ministry of Economy; and the development of the Kasawari CCS project by Petronas.

In August 2023, the government announced Phase 2 of the NETR, which will focus, amongst others, on biomass, CCS, and hydrogen integration. Phase 2 is said to include 'more actionable items', including getting CCS and hydrogen infrastructure ready. (*Phase Two of NETR to Focus on Biomass, Waste-to-Energy, Carbon Capture*, 2023) The six energy transition levers now include 50 initiatives and five enablers - financing and investment; policy and regulation; human capital and just transition; technology and infrastructure;

and governance and implementation.

NETR also includes the Responsible Transition Pathway 2050, that outlines the energy sector's pathway to reduce GHG emissions from 259MtCO_2e in 2019 to 175 MtCO_2e by 2050. This pathway is based on modelling that suggests natural gas will still account for 56% of the total primary energy supply by 2050, while renewable energy will increase to 22% of the total by then. (Harinderan, 2023) It is clear that the focus on CCS in the second phase of the NETR will be important to achieve climate targets, as natural gas will continue to play a key role in meeting Malaysia's energy demands throughout the transition to a low-carbon economy.

In line with its policy commitments, the Malaysian Government, building upon its foundations and connections into the well-established oil and gas industry, is also positioning itself to be a CCUS leader in Southeast Asia. The state-owned company, Petronas plans to create clusters to share infrastructure and achieve economies of scale, with an eye to becoming a regional sequestration hub. The company's approach could generate new revenues for Malaysia and facilitate the capture of CO2 from smaller sources. It is suggested that 60% of storage capacity will be allocated to Malaysia – for Petronas and partners – while the remaining 40% will be made available to other users. In line with this ambition, the recently released National Energy Transition Roadmap outlines a plan to develop multiple CCUS hubs in Malaysia by 2030 and 2050 to be facilitated by addressing regulatory and policy barriers, including the development of a facilitative regulatory framework, incentive mechanisms, infrastructure, negotiating transboundary CO_2 export and import agreements and promoting local CO_2 utilisation in industry.

While Malaysia has begun developing a CCS-specific regulatory framework, it will likely be based upon the existing oil and gas regulatory regime. The country has been engaged in consultations that the Federal and State levels with input from the corporate sector to align the relevant policy and regulatory frameworks since 2021. Malaysia's net zero and NDC commitments have likely played a role in its intention to set up a domestic ETS. The Ministry of Environment and Water released a report titled 'National Guidance on Voluntary Carbon Market Mechanisms' in 2021. Participation guidance for entities interested in international carbon markets could be forthcoming. In December 2022 Malaysia launched of the Bursa Carbon Exchange, the world's first VCM platform that is also Shariah-compliant. (*Emissions Trading Worldwide: Status Report 2023*, 2023)

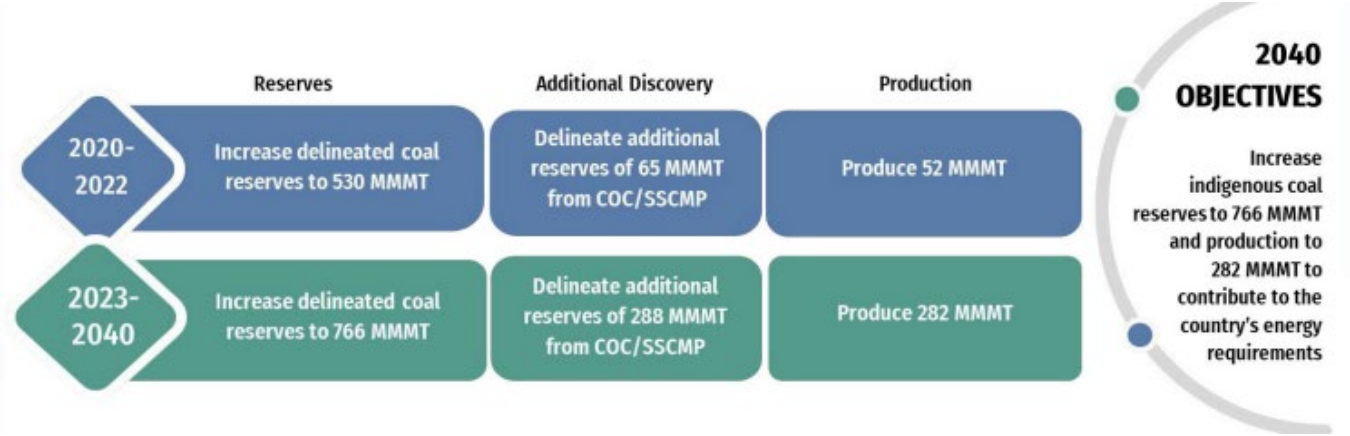
Petronas has announced two CCUS projects, including the Kasawari and Lang Lebah projects. The Kasawari CCS Project reached a positive final investment decision in October 2022 (announced in November 2022). Located offshore from Sarawak and linked to the Kasawari Gas Development, the operation is expected to begin in 2025 to reduce CO_2 emission from high CO_2 gas resources. The project is part of the organisation's broader objective of achieving net-zero by 2050.

- Philippines

In 2019, the government of the Philippines released the National Climate Change Action Plan 2011-2028 (NCCAP), which established seven areas of government focus for adaptation and climate mitigation action. Sustainable energy is one of these areas. Following the release of the NCCAP, the government also released the Philippine Energy Plan 2020 – 2040 (PEP) – a second comprehensive energy blueprint to support the energy transition towards 2050. The PEP is a living document and the latest update was made in 2023. (*Philippine Energy Plan 2020 – 2040, 2023 Update*, 2023)

The PEP contains several plans/roadmaps for various components of the energy mix. Under the Clean Energy Scenario, the PEP provides ambitious plans, policies and targets on renewable energy, natural gas, alternative fuels, and energy efficient technologies. Included in the Plans and Programs for energy, is the Upstream Coal Roadmap, depicted below.

Figure 3.1. Upstream Coal Roadmap – PEP 2023 Update



Source: Philippine Energy Plan 2020 – 2040, 2023 Update.

The plan estimates an increase in industry demand for coal until 2040, with a predicted annual growth rate of 10.1% from 2023 to 2040.

To comply with the Philippine Clean Air Act, the government committed to continue to assist the coal industry mitigate the environmental impact of this growth in coal production, through amongst others, the promotion of clean coal technologies and social acceptability of coal, as well as determining the applicability of technologies such as CCUS.

The predicted growth in demand for fossil fuel in the Philippines until 2040, and the government's stated intention to explore the use of CCUS create a massive opportunity for large-scale deployment of CCS technology.

- Viet Nam

International studies have highlighted the considerable potential for deploying CCS in Viet Nam, in the context of the nation's rapid growth and anticipated increase in energy use and emissions, which will see continued reliance on fossil fuels. Viet Nam also possesses significant storage potential and completed assessments suggest there are considerable storage resources, when compared to their national emissions. In the context of Viet Nam's emissions reduction targets.

Notwithstanding the nation's potential, Viet Nam has yet to develop a formal policy commitment towards deploying the technology. In 2005, in partnership with two Japanese companies, the Viet Namese/Russian joint venture Vietsovpetro, proposed the first CCS/EOR project under the Kyoto Protocol's Clean Development Mechanism (CDM). Although ultimately the project was not approved, the country proved an early mover in the discussion surrounding the inclusion of the technology within the CDM.

More recently, there has been some indication of the nation's desire to deploy the technology. At COP 26, Viet Nam communicated its aim to conduct research on technologies and implement solutions for carbon capture and storage in certain fields.

In August 2023, the Viet Namese government released its National Energy Master Plan (NEMP), laying out foundations for national energy security, reduce carbon emissions to meet the country's commitment to net zero by 2050, and to ensure the energy industry is independent and self-sufficient.

The NEMP estimates an economic growth of 7% per annum until 2030, and between 6.5% and 7.5% per annum from 2031 to 2050. It further estimates the demand for oil in the energy mix will grow by 16-22 million tonnes per year until 2030, and 16-17 million tonnes per year thereafter until 2050. Crude oil production is also predicted to grow steadily until 2050. Natural gas and coal will both continue to play an important role in Viet Nam's energy mix until 2040, with natural gas production set to grow over this period whilst coal mining is predicted to slow down from 2030 onwards.

To reach its climate commitments amid the predicted growth in fossil fuel production and demand, the NEMP states that CCUS will be expanded at industrial production facilities and power plants to achieve a capture capacity of around 1 Mtpa of CO_2 by 2040 with the aim of reaching 3 to 6 Mtpa by 2050. (*Viet Nam Briefing – Viet Nam's National Energy Master Plan: Key Takeaways*, 2023)

- Brunei Darussalam

Oil and gas forms the backbone of Brunei's economy with gas powering 98,95% of its domestic electricity demand. In recent Brunei has repeatedly called for natural gas to play a larger role in the energy transition in Southeast Asia, recognising that Brunei has limited potential for renewable energy due to its size and other geographical constraints.

Although Brunei has made some commitment to transition to cleaner energy, fossil fuels are predicted to continue to form a large part of the energy mix until 2050. Brunei aims to raise its renewable energy contribution to overall power generation to 30% and to achieve a 45% reduction in emissions intensity by 2035.

Flaring of gas, especially at its offshore gas reserves, is currently used to reduce GHG emissions. It will be vital for Brunei to introduce low carbon technologies and decarbonisation measures to achieve its climate targets, however there is currently no legislative or regulatory frameworks in place to support the deployment of CCS. ('Brunei Banks on Technology to Preserve Its Economic Lifeline: ,' 2021)

An MoU was signed between Shell Eastern Petroleum and Brunei Shell Petroleum to explore CO_2 transport and storage options in Brunei and Singapore, however, the government has not announced any further policy commitments or mechanisms to support projects. ('Shell to Explore Carbon Transport and Storage in Brunei and Singapore,' 2022)

3.3.2.2. ASEAN Strategy for Carbon Neutrality

In August 2023, at the 55th ASEAN Economic Ministers' Meeting in Semarang, Central Java, Ministers from member countries endorsed the ASEAN Strategy for Carbon Neutrality (the Strategy), setting an ambitious course for a regional carbon-neutral future. Economic benefits from this strategy are estimated to range between 9%-12% increase in GDP for Cambodia, Lao PDR, Myanmar and Viet Nam; an increase of between 4%-7% for Indonesia, Malaysia, Thailand and the Philippines; and an uplift of 1%-2% for the high-income countries of Singapore and Brunei. (ASEAN, 2023)

The Strategy aims to accelerate an inclusive transition towards a green economy, fostering sustainable growth and complementing national efforts as part of a regional collective effort. The Strategy promotes four key outcomes for the region: (ASEAN, n.d.)

- Developed green industries: To unlock ASEAN manufacturing and export potential and capture the full value of regional green value chains.
- Interoperability within ASEAN: To accelerate the rollout of green technologies at scale, enabling exchange of green electricity, products and feedstocks.
- Globally credible standards: To ensure ASEAN remains a top destination for international capital to increase liquidity in regional markets.
- Green capabilities: To develop green talent and expertise within ASEAN to drive the energy transition.

The Strategy includes eight targeted sub-strategies with sixteen underlying priority initiatives that will give impetus to implementation of the strategy. Following, is a high-level overview of the first of these sub-strategies, '*Accelerate green value chain integration*' with comments on key considerations for CCS-specific policies under the identified activities.

Table 3.1. High-Level Overview of the ASEAN Strategy for Carbon Neutrality on CCS-Specific Policies

	Strategy	Priority Initiatives	Considerations for CCS Policy Architecture
1	Accelerate green value chain integration	- Identify and boost opportunities for greenification of the manufacturing value chains regionally - Enable ASEAN feedstocks pathways for biofuels to capture global markets - **Coordinate development of regional policies and regulations to support CCS/CCUS infrastructure**	Industrial manufacturers (typically high emitters) are increasingly under pressure to decarbonise their operations and reduce GHG emissions. A coordinated regional effort to develop policies and regulations to support the large-scale deployment of CCS/CCUS in the region, could lead to greener manufacturing value chains, especially for hard to abate industries (cement, steel, etc.). Key considerations for regional CCS policies include: Transboundary transport of CO_2 between member countries: - Adoption of the provisions of the London Protocol into national legislation, to allow for export of CO_2 between ASEAN nations and the wider APAC region. - Coordination of bilateral agreements / arrangements required under the London Protocol, which may vary in form and content, depending on whether CO_2 exporting and importing countries are Parties to the Protocol or not.

	Strategy	Priority Initiatives	Considerations for CCS Policy Architecture
			- Coordination of the ratification of the 2009 and 2013 amendments to Article 6 of the London Protocol, following bilateral agreements / arrangements. Development of storage resources in the region: - A collaborative approach to storage resource identification, site characterisation, storage assessment, site planning, and project development. - Coordination of government and private funding for CO_2 storage resource development. - Development of a coordinated set of CCS regulations for the region, covering storage permitting processes, facility operations, and closure and post-closure obligations in terms of monitoring, reporting and verification; and financial liability. Coordination of regulations: - Establishment of a regionally relevant regulatory framework for CCS, consolidating emission reduction efforts

	Strategy	Priority Initiatives	Considerations for CCS Policy Architecture
			in Southeast Asia (see example below) - Development of regionally applicable standards for CCS projects and operations. - Adoption of the regional CCS framework and standards into national legislation. - Coordination of regulatory obligations to avoid conflicts in transboundary CCS operations.
2	Promote regional circular economy supply chains	- Upgrade ATIGA to comprehensively include circular products	N/A
3	Connect green infrastructure and markets	- Enable regional power trading, physical interconnection, and policy cooperation - Enable interoperability of regional transport and logistics infrastructure	Key considerations for regional CCS policies include: Development of regional CCS transport networks: - Establish a regional body to coordinate national efforts to provide financial support and other policy incentives for the development of CO_2 transport infrastructure in the region. - Development of a regional plan for establishment of CO_2 capture hubs/clusters and transport networks, which will leverage economies of scale to

	Strategy	Priority Initiatives	Considerations for CCS Policy Architecture
			reduce risks and costs of regional projects.
4	Enhance interoperable carbon markets	- Harmonise measurement, reporting and verification (MRV) standards and policies to access global liquidity and regional carbon sink potential	Key considerations for regional CCS policies include: Regional MRV policies applicable to CCS: - Development of regional regulations for MRV, including MRV obligations as they relate to transport and storage operations in the region. - to oversee alignment of national MRV regulations with a regional set of regulations. - Establishment of a regional representative body to act on behalf of ASEAN member countries as a whole, to negotiate private finance for regional or cross-boundary projects, and access development funding on behalf of the region for deployment of CCS.
5	Foster credible and common standards	- Promote regional energy efficiency and conservation - Establish globally credible regional GHG inventory to flow from national reports - Standardise globally credible frameworks for corporate climate reporting	Key considerations for regional CCS policies include: Coordination of regional GHG inventory, national targets and regional reporting: - Creation of a regional database, tracking national GHG emissions against targets and NDCs.

	Strategy	Priority Initiatives	Considerations for CCS Policy Architecture
			- Establishment of a regional framework for climate reporting, based on best practice and similar reporting frameworks.
6	Attract and deploy green capital	- Encourage adherence to ASEAN Taxonomy on Sustainable Finance - Promote de-risking through adoption of innovative sustainable finance instruments - Incentivise green fund managers to locate in ASEAN, and local funds to develop	See 4 above
7	Promote green talent development and mobility	- Establish green skills taxonomy and facilitate movement of natural persons	N/A
8	Offer green best practice sharing	- Facilitate best practice sharing to support effective just transition at national level - Conduct capability building for sustainable infrastructure and smart cities	N/A

Source: ASEAN Strategy for Carbon Neutrality.

This Strategy reflects ASEAN's bold ambition for economic integration and positioning the region for a carbon-neutral future. It promotes a coordinated effort between ASEAN nations on several fronts to combat climate change and meet set targets over the next three decades.

This same ambition has been evident in Europe, where a host of regional regulations have been implemented to govern CCS activities and GHG emission reduction strategies in a harmonised manner across the European Union. ASEAN could draw on the experience of the EU and look to frameworks and regulations established to harmonise efforts between

EU Member countries covered under the EU ETS, to give effect to the ASEAN Strategy for Cabron Neutrality. A few pertinent examples of EU Regulations that could provide a good basis for consolidation of climate efforts are provided below.

- Overview of the EU's regulatory framework aiming to **consolidate emission reduction efforts** across the EU.

Effort Sharing Regulation – European Union

An example of a collaborative, regional policy framework which governs cooperation between countries in the same region, and which forms part of the region's climate and energy policies, is the EU's Effort Sharing Regulation. This Regulation establishes binding national GHG emissions targets for 2030, and emission limits for each of the EU Member Staes, and covers several sectors – transport, buildings, agriculture, small industry and waste. The Regulation covers approximately 60% of the EU's total domestic emissions.

Targets set through this Regulation recognise the capacity of each Member State to take action, and therefore more ambitious targets are set for higher income States than for lower income States to allow for a fair and cost-effective effort required from each Member State.

The Regulation allows certain Member States to use a limited amount of ETS allowances to offset emissions in the effort-sharing sectors. In addition, all Member States may use up to 131 million credits from the Land Use sector to offset emissions. Member States may bank surpluses (up to a limit) in years when emissions are lower than allocations, for use in future years; and may borrow (up to a limit) against the following year's allocation where targets are not achieved. These flexibilities are taken into account when targets for subsequent years are set, and where Member States do not achieve their targets (reported annually to the European Commission), they are required to submit an appropriate plan of action.

Source: European Commission, 2021a.

- Overview of the EU's **monitoring, verification and reporting framework** aiming to consolidate data and review compliance of EU Member States at a central point.

Monitoring, Reporting and Verification of EU ETS emissions – European Union

For the EU ETS to operate effectively, the EU adopted a monitoring, reporting and verification system for Member States to report GHG emissions on an annual basis. This annual procedure together with all the associated processes is known as the ETS Compliance Cycle.

All industrial facilities and aircraft operators covered by the EU ETS are required to have an approved MRV plan for monitoring and reporting annual emissions. This plan

also forms part of the permit to operate that is required for industrial facilities. An emissions report is required to be submitted every year, and data in the report must be verified by an accredited verifier by 31 March of the following year. Once verified, operators must surrender the equivalent number of allowances by 30 April of that year.

The MRV system is coordinated by the European Commission, who provides guidance and publish tools to support Member States in understanding requirements and complying with the relevant regulations. The Commission also promotes a harmonised and cost-effective application of the MRV regulations throughout the EU ETS countries.

The rules related to the Compliance Cycle are contained in two regulations – the Monitoring and Reporting Regulation, and the Accreditation and Verification Regulation.

Source: European Commission, 2021b.

3.3.3. Paris Commitments/NDCs and CCS Specific Commitments

The past two years have seen increased focus amongst Southeast Asian nations to set national climate targets, and to contribute to global emission reduction targets. This is evident in the updates to NDCs by countries in the region since 2021 and national strategies and targets released in this period.

This section discusses current global climate contributions from Southeast Asian nations, and specific CCS/CCUS commitments included as part of NDC implementation measures.

3.3.3.1. Singapore

Singapore submitted an updated version of its original NDC, in November 2022, which highlights the nation's intention to reduce emissions to around 60 million tonnes of carbon dioxide equivalent ($MtCO_2e$) in 2030, after peaking its emissions earlier.

The country has focused its mitigation efforts across several key sectors, in particular the reduction of fossil fuel use as part of power generation. In this sector, the government has supported the shift towards the greater use of gas and highlights the percentage of natural gas used in electricity generation has increased from 19% to more than 95%, between the years 2000 and 2022. An increased focus upon reducing the use of fuel oil and the more widespread deployment of solar PV, are also important initiatives. (*Singapore's Update of Its First Nationally Determined Contribution (NDC) and Accompanying Information*, 2022)

3.3.3.2. Indonesia

In September 2022, Indonesia announced a net zero target for 2060. Indonesia also submitted an updated NDC at the same time, with an increased emission reduction target

from 29% to 31.89% unconditionally and from 41% to 43.20% conditionally by 2030. (*Enhanced Nationally Determined Contribution*, 2022)This enhanced NDC is a step towards Indonesia's second NDC, which will be aligned with the Long-Term Strategy on Low Carbon and Climate Resilience 2050, and the trajectory to reach net zero by 2060 or sooner (after emissions peaking in 2030).

It is anticipated that CCS and CCUS will play an important role in the achievement of this target, with storage capacity currently under assessment in the Arun Field, East Kalimantan and Sunda Asri Basin. These storage resources place Indonesia in a firm position to store its own CO_2 emissions, and also provide a storage service to neighbouring countries.

Several of the government's more recent climate change and energy-related policies and announcements have explicitly acknowledged the critical role of the technology in facilitating Indonesia's energy transition. In May 2023, the government of Indonesia reiterated the importance of cross-border CO_2 transportation and storage and is currently drafting a regulation to allow for transboundary transport of CO_2 and storage in Indonesia.

3.3.3.3. Thailand

Under the Paris Agreement, Thailand has made a commitment to reach carbon neutrality by 2050 and net zero emissions by 2065. In November 2022, Thailand submitted a second update to its original NDC, committing to reduce its GHG emissions by 30% from the business-as-usual level, by 2030. The update also includes a conditional increase of up to 40%, subject to adequate and enhanced access to technology development and transfer, financial resources and capacity building support. (*Thailand's 2nd Updated Nationally Determined Contribution*, 2022)

3.3.3.4. Malaysia

Malaysia submitted a revised NDC in 2021, unconditionally committing to cut carbon intensity against GDP by 45% compared to 2005 levels, by 2030. The revision represents a 10% increase from the previously submitted NDC, which clearly indicates Malaysia's commitment to decarbonise its economy and collaborate globally to achieve this target.

Malaysia has been recognised as the best country in Southeast Asia on the Energy Transition Index, by the World Economic Forum, mainly based on its diverse, reliable and accessible energy supply, and the low cost of electricity. This has been achieved largely through production from own oil and gas reserves, which reduced Malaysia's dependence on imports. However, GHG emissions from the energy sector account for 78.5% of Malaysia's total emissions. This poses a challenge, not only in terms of achieving the NDC, but also in terms of competitiveness in global markets. It is estimated that the EU's Carbon Border Adjustment Mechanism (CBAM) will impact 57% of Malaysia's total exports, which will have a knock-on effect on the economy. (Harinderan, 2023)

The NDC does not explicitly refer to CCS, however it will be imperative for Malaysia to implement a comprehensive strategy that balances decarbonisation with the predicted growth in energy demand. As natural gas will remain an important component of the energy mix until 2050, CCS may be the most compelling solution to reduce emissions from the energy sector in particular (but also in other sectors such as cement and steel) and achieve the committed NDC.

3.3.3.5. The Philippines

In April 2021, the Philippines submitted an updated NDC, committing to GHG emissions reduction and avoidance of 75% by 2030, of which 2.71% is unconditional and the remaining 72.29% is conditional. The NDC covers the sectors of agriculture, wastes, industry, transport, and energy. Although CCS is not mentioned in the NDC, the document states implementation and mitigation commitments will be undertaken through bilateral, regional and multilateral cooperation, showing clear intention from the Philippines to collaborate with other Southeast Asian nations to combat climate change. (*Nationally Determined Contribution,* 2021)

3.3.3.6. Viet Nam

Viet Nam submitted an update to its NDC in 2022, increasing its unconditional GHG emissions reduction target to 15.8% against its 2010 business-as-usual scenario, and its conditional contribution to 43.5%, by 2030. (*Nationally Determined Contribution*, 2022) Viet Nam has also committed to achieving net zero emissions by 2050, a target that has been enshrined in legislation since July 2022.

The NDC sets out measures to promote the implementation of the NDC, two of which include specific references to CCS, i.e. '*Science and Technology Development'* and *'Promoting international cooperation in climate change response*'.

Under the '*Science and Technology Development' measure,* CCS is included as an innovation to be promoted domestically; and under the '*Promoting international cooperation in climate change response'* measure, CCS is included in the list of measures having cross-border impact on climate change response activities, and for which international cooperation on research and development will be promoted.

3.3.3.7. Brunei Darussalam

Brunei submitted its first NDC under the Paris Agreement in 2022, committing to achieve a 20% reduction in greenhouse gas emissions by 2030 in comparison to the business-as-usual scenario. Brunei outlines in its NDC that the country aims to adopt a multi-sectoral climate change mitigation strategy to deliver its climate related ambitions. The document refers to the Brunei Darussalam National Climate Change Policy (BNCCP) launched earlier in 2020, which outlines the principles, values and strategies that will underpin the

achievement of the updated NDC. (*Brunei Darussalam Nationally Determined Contribution (NDC)* , 2020)

Although CCS is not specifically mentioned in the NDC submission, there is reference to the introduction of a carbon price by 2025, which would be applicable to all industrial facilities emitting above a specified threshold. This could stimulate interest in CCS as a tool to avoid excess GHG emissions.

3.3.4. Consideration and Position of CCS in Existing or Proposed Incentives and Support Mechanisms

3.3.4.1. Carbon Credits/Tax Credits/Funding/Finance

Below is a summary of fiscal incentives, public finance and market mechanisms in key Southeast Asian countries.

Table 3.2. Fiscal Incentives, Public Finance, and Market Mechanisms

Country	Rating	Gaps	Recommendations
Fiscal incentives			
Indonesia	✘	• Indonesia's carbon tax is under consideration.	• Implement strong fiscal incentive policies. • Supplement carbon taxes with strong fiscal incentive policies such as tax credits. • Current best practice includes tax relief similar to the 45Q programme under the inflation Reduction Act (IRA) in the United States.
Singapore	✓	• Singapore's carbon tax was implemented in 2019.	
Malaysia	✘	• Malaysia has discussed implementing a CCS tax credit. • The other countries do not have a formal fiscal incentive policy in place that supports CCS or action on climate change that could be broadened to support CCS.	
Thailand	✘		
Brunei	✘		
Singapore	✘		
Viet Nam	✘		
Public finance			
Indonesia	✘	• Singapore committed public finance for research and development and demonstration projects on low-carbon energy technology solutions. See section below this table.	• Make available public funding for CCUS Research and Development, Pilot projects and support to commercial CCS facilities. • International cooperation to secure development
Malaysia	✘		
Thailand	✘		
Brunei	✘		
Singapore	✓		

Country	Rating	Gaps	Recommendations
Viet Nam	✗		funding from international development banks and finance institutions.
Market mechanisms			
Indonesia	✓	• Indonesia launched an ETS in 2023. See section below this table.	• Ensure CCS is included in the ETS that Indonesia established in 2023.
Malaysia	✗	• Malaysia announced the implementation of a voluntary carbon market (VCM) in 2022 and is exploring the implementation of a domestic ETS and carbon tax.	• Ensure CCS is included in Malaysia's national ETS that is under consideration.
Thailand	✗	• Thailand launched a voluntary carbon credit exchange (FTIX) in 2022.	• Ensure CCS is included in Thailand's national ETS that is under consideration.
Viet Nam	✗	• Viet Nam plans to establish and operate a national carbon trade exchange as a pilot from 2025, aiming for full operations by 2028.	• Ensure CCS is included in Viet Nam's ETS. Policies were announced in 2022 with other technical considerations to be developed by 2025.
Singapore	✗	• Singapore's Climate Impact X (CIX) launched in 2021 as a global marketplace and exchange for carbon credits.	• Ensure CCS is included in Singapore's global ETS.
Brunei	✗	• Formal market mechanisms do not exist in these countries.	• Formal market mechanisms need to be established in these countries that include CCS.
Institutional strength and Government Support			
Indonesia	✓	• Indonesia has an opportunity to coordinate national CCS policy around the 2023 CCS regulations.	• Continue support for Indonesia's Ministry of Energy and Mineral Resources 2023 CCS

Country	Rating	Gaps	Recommendations
			regulations - MEMR 2/2023 that has synergies with CCS. • Ensure CCS is included in Indonesia's Net Zero by 2060 commitment – in discussion. • The Indonesian Government should continue support for the National Action Plan Addressing Climate Change mentions CCS (2007).
Malaysia	✗	• While institutional support for actions to reduce emissions exists in these countries (Brunei needs to establish support), it is essential that CCS is not excluded.	• Ensure CCS is included in Malaysia's Plan for emissions reduction; however, the commitments are not clear.
Thailand	✓		• Continue support for Thailand's updated NDC that mentions CCS. • Expand support for CCS formally through policy, law, and regulation.
Brunei	✗		• Establish support for CCS through formal institutional support.
Singapore	✗		• Ensure CCS is included in Singapore's Net Zero by 2050 Strategy/Policy.
Viet Nam	✗		• Ensure CCS is included in Viet Nams NDC commitment.
Information sharing and International Collaboration			
Indonesia	✓	• These countries have an opportunity to update their information sharing capabilities and guidance	• Continue support for the following: ○ Member of the Clean Energy Ministerial's CCUS Initiative.

Country	Rating	Gaps	Recommendations
		through regional collaborations.	○ Indonesia is a contributor to the Green Climate Fund. ○ Indonesia has a current state of affairs document with some recommendations for the future. ○ CCS is mentioned only in the abbreviations list in Indonesia's 2012 Technology Needs Assessment.
Malaysia	✓		• Continue support as a participating country on ISO/TC 265 Carbon dioxide capture, transportation, and geological storage.
Thailand		• Thailand has a dated roadmap (2016) that mention CCS.	• Update dated references to CCS with the latest in the industry's learnings.
Brunei	✘	• The country does not currently share information on CCS.	• Brunei has opportunities to collaborate in the Southeast Asian region and to exchange information.
Singapore	✓	• Singapore has an opportunity to update their guidance and collaborative efforts through by extending regional partnerships.	• Continue support for the following: ○ Australia and Singapore signed an MOU in 2020. ○ Collaboration through the Global Clean Energy Action Forum funding for Clean Energy Technology Demonstrations.
Viet Nam	✘	• The country does not currently share information on CCS.	• Viet Nam has opportunities to collaborate in the Southeast Asian region and to exchange information.

Source: GCCSI.

Singapore – Public Finance

The low-carbon transition for industry, the economy and society as whole - promoted through Singapore's Long-Term Low-Emissions Development Strategy (2022) - is proposed to be achieved through four key initiatives, including *'Investing in low-carbon technologies, e.g. carbon capture, utilisation and storage (CCUS), and use of low-carbon fuels'*.

Under the Low-Carbon Energy Research (LCER) Funding Initiative, S$55 million was awarded to support 12 research projects on low-carbon hydrogen and CCUS and S$129 has been reserved for a second phase of the funding programme. In addition, Singapore is exploring potential CCUS deployment pathways, where carbon captured from industrial facilities could be utilised as feedstock for synthetic fuels or building materials (through mineralisation) or stored in sub-surface geological formations. (*12 Projects Awarded $55 Million to Accelerate Decarbonisation in Singapore*, 2021)

Singapore is highly dependent on international cooperation on decarbonisation efforts, and advocates for close bilateral, regional and plurilateral cooperation on decarbonisation. This includes collaboration on carbon markets, green finance, and low-carbon technologies. Singapore has already signed MoUs on carbon credits collaboration with countries including Indonesia, Colombia Viet Nam, Brunei and Marocco – in line with Article 6 of the Paris Agreement.

Indonesia – ETS (*Indonesia Launches Emissions Trading System for Power Generation Sector*, 2023)

In February 2023, Indonesia launched a mandatory, intensity-based emissions trading system (ETS) for the power generation sector. The ETS will cover facilities with a production capacity of more than 100MW, with the aim to also include smaller facilities in the future. 99 coal-fired facilities will be included from the start, covering 81.4% of Indonesia's national power generation capacity. Intensity targets will be set, and it is expected that allowances worth 20 million tCO_2e will be allocated.

The ETS will be implemented in three phases, covering coal-fired plants connected to the grid in the first phase (2023-2024), and including oil and gas-fired plants, and coal-fired plants not connected to the grid in phases two (2025 – 2027) and three (2028 – 2030).

The ETS launch followed a series of government-issued regulations, including 'Regulation No. 46 on Environmental Economic Instruments' in 2017, 'Presidential Regulation No. 98 on the Instrument for the Economic Value of Carbon' in 2021, Regulation 21/2022 'Guidelines for Carbon Economic Value Implementation' in 2021/22, and The MEMR's Regulation 16/2022 'Guidelines for Carbon Economic Value Implementation for the Power Generation Sub-sector' in 2022.

The ETS will operate as a hybrid cap-and-trade system, alongside a carbon tax announced in 2021, as part of 'Law No. 7 on the harmonisation of Tax Regulations'. This carbon tax has however been delayed and is expected to only come into effect in 2025.

Pertamina - JBIC

In November 2022, JOGME (JBIC) signed an MoU with Pertamina to strengthen cooperation between the two organisations, in support of Indonesia's commitment to achieve net zero emissions by 2060 or earlier. The MOU promotes collaboration between Pertamina and Japanese companies in renewable energy, hydrogen, ammonia, and CCS. JBIC will provide financial support to further Indonesia's decarbonisation goals. (*JBIC Signs MOU with National Oil Company of Indonesia, Pertamina*, 2022)

3.3.4.2. Transboundary Bilateral Agreements

- Singapore-Australia

Singapore is progressing options to provide services around CCUS projects, both to address national emissions liability and emissions reduction commitments, and to enhance the nation's role as a hub/cluster for CCUS projects within the Southeast Asian region.

In October 2022 Singapore and Australia signed the Singapore – Australia – Green Economy Agreement. The agreement builds upon earlier commitments, including the recent Low Emissions Solutions MOU, and will target a cooperative approach between the two nations towards supporting the transition to net zero emissions. The arrangement and the text of the agreement contain positive signals for collaboration around CCUS activities. The Agreement references the technology specifically under the '*Principles of Green Economy Cooperation*'.

- Brunei-Singapore

In October 2022, Shell Eastern Petroleum, a unit of Shell Plc, and Brunei Shell Petroleum (BSP) signed a MoU to explore carbon transport and storage options in Brunei and Singapore. The government of Brunei Darussalam and Shell group own 50% in BSP. This initiative has the potential to form part of a CCS hub in Southeast Asia. (*Shell Signs MoU to Explore Carbon Transport, Storage Options in Brunei and Singapore*, 2022)

Under the MoU, the parties will evaluate the technical and commercial feasibility of CO_2 storage in Brunei Darussalam and CO_2 transport solutions from Singapore. The two countries will also cooperate on policy development to support the implementation of the MoU.

Shell has set a corporate target of net zero emissions by 2050 and has expressed ambition to have access to at least 25 Mtpa of storage capacity by 2035. (*Shell to Explore Carbon Transport and Storage in Brunei and Singapore*, 2022)

- Pertamina – ExxonMobil

In May 2022, Pertamina and ExxonMobil signed a Joint Study Agreement (JSA) to assess the potential for large-scale deployment of low-carbon technologies, including CCS. The

agreement builds on the MoU signed between the two companies in 2021, to advance CCS efforts in Indonesia. This collaboration will support Indonesia's ambition to reach net zero emissions by 2060.

This JSA will set the precedent for developed countries cooperating with developing countries to implement global climate solutions. (*Pertamina Cooperates with ExxonMobil to Study CCUS Technology Application in Three Oil and Gas Field Areas*, 2022)

- Petronas – South Korean Companies

In August 2022, Petronas signed MoUs with six South Korean companies to undertake conceptual and feasibility studies, aiming to establish a full CCS value chain. The MoU will include the evaluation of potential CO_2 storage sites in Malaysia, and exploration of other areas across the value chain, including cross-border CO_2 transportation and suitable capture technologies. The MoUs bring Malaysia closer to the establishment of a regional CCS hub in the country. (Petronas, 2022)

3.4. Designing CCS-Specific Law and Regulation

The development of CCS-specific legal and regulatory frameworks has been a key policy response of governments in various jurisdictions worldwide. Several jurisdictions across North America, Europe and in Australia have now successfully developed and implemented regulatory frameworks for the technology. The experience and processes adopted by these jurisdictions in developing and implementing their regulatory models, offer important insights for other governments seeking to design their own domestic CCS-specific regimes.

In the ASEAN region, where legal and regulatory frameworks to facilitate CCS activities are largely absent, regulators and policymakers will inevitably be required to consider several preliminary factors in the design and architecture of their legal and regulatory frameworks. The following sections examine these issues in greater detail.

3.4.1. Approach to Developing CCS-Specific Legislation

Regulators and policymakers, when designing CCS-specific legal and regulatory frameworks to-date, have adopted one of three approaches to regulating the technology. One option has been to enhance existing regulatory frameworks, usually permitting models regulating resources operations, to include CCS-specific provisions, while a further has been to enact stand-alone CCS-specific legal frameworks. The latter has largely resulted in singularly focused framework legislation, while the former has seen CCS activities included within broader, well-established regimes. A further option is the development of project specific legislation to regulate the operation of a sole CCS project; an example of which may be found in the legislation regulating the Gorgon CO_2 injection project.

For regulators and policymakers in the early stages of the legislative process, the decision whether to develop a full, stand-alone CCS regulatory framework, or to amend an existing regulatory pathway, may be influenced by several critical factors. While national specificities will ultimately guide the approach taken, several issues have been highlighted by early regulators in their adoption of a particular model.

3.4.1.1. Supporting Domestic Policy Priorities

A nation's domestic policy regarding the technology's deployment, will play a critical role in determining the regulatory pathway to be adopted by national policymakers and regulators. In some instances, this will require the reconciliation of a variety of critical, and at times potentially competing, factors when finalising the regulatory approach.

While several countries in the ASEAN region have outlined their ambitions for the technology as part of their future climate change mitigation and net zero strategies, many have similarly expressed their vision for CCS as a part of ensuring national energy security and sustaining domestic industry. To this end, policymakers and regulators may consider their domestic policy approach when determining the appropriate legal basis for a future regulatory framework, and, whether this issue is better addressed by a stand-alone or modified existing legal regime.

One example where this may prove significant, is where a nation's policy approach is to recognise other forms of CO_2 injection activities, beyond purely geological storage. In many jurisdictions across the ASEAN region, CO_2 injection is already regulated under existing and well-defined regulatory frameworks governing the resource sector, and consequently, there may be merit in utilising these regimes as the basis for regulating CCS activities. This topic is addressed further, in Section 3.4.2.

The immediacy of domestic policy commitments to emissions reduction, or the deployment of demonstration projects, may similarly impact the weight afforded to selecting a particular legal and regulatory approach. The time taken to incorporate CCS activities within existing regulatory regimes, for example, may ultimately prove more efficient in the near term, than the development of a dedicated CCS-specific framework ab initio. Regulators may choose therefore to use existing regulatory regimes to undertake demonstration projects, and use the regulatory lessons learned from these early activities to inform the later development of a more comprehensive stand-alone regulatory framework.

3.4.2. Role of Existing Regulatory Pathways

The Institute's review of ASEAN nations' legal and regulatory regimes reveals that only two countries have taken steps to introduce CCS-specific legislation. At the time of writing, only Indonesia and the Malaysian state of Sarawak have introduced detailed legal and regulatory frameworks that will regulate future storage operations. The regimes offer the first examples of CCS-specific legislation in the region.

For the wider ASEAN nations, which have yet to develop CCS-specific legal and regulatory frameworks, national policymakers and regulators may be required to rely upon existing regulatory regimes to facilitate early projects. A review of national law and regulations across the ASEAN region, suggests that in many instances these nations already have a body of legislation that would be applicable to CCS operations. Legislation governing the regulation of existing mining, oil, and gas activities, together with broader provisions found in national environmental, property and planning laws, will likely be relevant to aspects of the CCS project lifecycle.

In the context of determining a formal, long-term pathway for regulating commercial-scale deployment of the technology, these existing legal and regulatory regimes must be formally assessed. Several factors will likely prove key to a final decision regarding their utility, however, determining the readiness and adequacy of national legal and regulatory regimes will be central to this assessment.

When undertaking a review of this nature, policymakers and regulators will need to consider the ability of existing legislation to effectively regulate all aspects of the CCS project lifecycle. While existing permitting and licensing regimes, for example, may adequately manage the more familiar elements of the CCS process, it is unlikely that they will address the novel elements required of a CCS-specific regulatory framework.

A further, important consideration will be how, and indeed whether, existing legal and regulatory regimes may be amended or adapted to incorporate CCS activities. In some instances, as has been seen in several jurisdictions around the world, CCS-specific provisions may be readily incorporated within existing regulatory frameworks. Similarly, minor amendments to include or exclude CCS operations from the scope of current legislation, may also afford an efficient means of regulating the technology. The efficacy of this process, when compared with other means of regulating the technology, will be a significant factor in determining a future pathway.

3.4.3. Social License Considerations

The Institute's interviews with regulators, policymakers and industry have revealed that a nation's decision to establish a stand-alone framework or enhance existing legislation, may also be influenced by social license considerations.

The perceived risks of CO_2 storage activities, in comparison to other industries or other emissions reduction technologies, have been highlighted as a key factor shaping public opinion for the technology in several jurisdictions. The public's view of CCS activities will, therefore, hold implications for the approach to be adopted to regulate the technology. Policymakers and regulators interviewed in the ASEAN region, suggested that a lack of knowledge, or indeed a negative perception, as to the role of the technology and its decarbonisation potential are important considerations in their jurisdiction. The issue of stakeholder engagement is considered in greater detail in Section 3.4.5 below.

The establishment of a stand-alone regulatory framework may assist in differentiating CCS activities from other industry sectors and strengthen public perception regarding the climate change mitigation objectives that underpin the technology. An example of this approach can be seen in the case of the newly established regulatory framework to facilitate the offshore wind industry in Australia. In this instance, the approach has brought clarity and highlights the clean energy and emissions reduction objectives that underpin the regulatory framework.

The formal association of CCS activities with emissions intensive industries, through CCS-specific amendments to existing petroleum recovery or mining legislation, may serve to undermine the acceptance or support for the regulatory framework in some jurisdictions. For regulators seeking to develop a CCS-specific regime, in jurisdictions where social licence issues are likely to prove a significant factor, a stand-alone framework may be preferable. Ultimately, however, regulators will need to balance these considerations with the need to expedite the development of a regulatory framework to accelerate deployment in their jurisdictions. The urgency of the challenge may lead to regulators choosing to enhance existing legislation to accommodate CCS.

KEY MESSAGES

- The approach to regulating CCS activities is an important preliminary consideration for governments seeking to develop a CCS-specific legal framework. Regulators and policymakers have historically demonstrated a preference for one of two pathways; a stand-alone regulatory framework or enhancing existing oil and gas legislation to regulate CCS activities.
- While various factors will ultimately shape the approach adopted, in the context of the ASEAN region, domestic policy priorities and social license considerations are two critical factors that may guide policymakers.
- For nations which have established regulatory frameworks governing the resources sector and face the challenge of balancing economic growth with emissions reduction commitments, efficiency and urgency considerations may determine the pathway chosen.

PRIORITY ACTIONS FOR REGULATORS AND POLICYMAKERS

- Evaluate national policy priorities relating to climate change mitigation, energy security and economic development to evaluate the objectives that will underpin CCS-specific legislation and the preferred pathway for regulating the technology.
- Engage the wider public to better understand public sentiment towards CCS, and to gauge the public's level of knowledge and awareness of the technology's role in reducing greenhouse gas emissions.
- Review existing legal and regulatory frameworks relating to resources, energy, environment, property and planning, the adequacy of these regimes in regulating the novel aspects of CCS and the possibility of amending or adapting these frameworks to regulate CCS activities throughout the project lifecycle.

3.4.4. Scope of Frameworks

CCS projects that feature the dedicated geological storage of CO_2 have been the focus of regulators when establishing regulatory frameworks for the technology to-date. CCS technologies, however, constitute a far broader suite of applications and support decarbonisation across a range of sectors, from power generation to industrial activities.

In developing a legislative framework to regulate the CCS process, policymakers and regulators will be also required to consider the inclusion of these applications within the scope of their proposed regulatory models. The approach that will ultimately be adopted, must depend on the objectives underpinning the legislative framework for the technology, in light of the climate change mitigation, energy transition and economic development strategies of each country.

3.4.4.1. Permitting Various Applications

One application of CCS, that has been historically practiced in countries with well-established oil and gas sectors, is CO_2-Enhanced Oil Recovery (CO_2-EOR). The regulation of CO_2-EOR operations has typically been addressed under existing oil and gas legislation, with the activity proving an important feature of oil and gas extraction operations in many jurisdictions around the world.

In the United States the underground injection of fluids, including CO_2 for the purposes of EOR, has been a long-standing practice. Federal regulations for such activities have been in force since the 1980s, under the Class II well category of the US Environmental Protection Agency's Underground Injection Control (UIC) Program (US Environmental Protection Agency, 2023). The Class II categorisation constitutes a separate permitting pathway to those projects involving the dedicated geological storage of CO_2, which are regulated under the UIC Program's Class VI well category.

In Australia a similar approach has been adopted, and CO_2-EOR projects may proceed under existing Commonwealth and state-level provisions relating to petroleum recovery activities. A further permitting pathway has been established for projects involving the dedicated geological storage of CO_2. In other jurisdictions, CO_2-EOR projects have been excluded from the scope of regulatory frameworks entirely. The EU CCS Directive, for example, does not regulate Enhanced Hydrocarbon Recovery activities, save for instances where operators combine these recovery operations with permanent geological storage(Directive 2009/31/EC Of The European Parliament and of the Council, 2009).

In the ASEAN region, Indonesia's MEMR 2/2023 legislation includes both CCS and CCUS activities within its scope, however, these applications have been limited to the upstream oil and gas sector. In this regard, MEMR 2/2023 defines carbon capture utilisation and storage (CCUS) as an effort to reduce emissions and increase oil and gas production through the injection, utilisation and storage of CO_2 emissions (Minister of Energy and Mineral Resources Regulation Number 2 of 2023 Concerning Implementation of Carbon

Capture and Storage, as Well as Carbon Capture, Utilization and Storage in Upstream Oil and Gas Business Activities, 2023).

3.4.4.2. The Inclusion of Carbon Dioxide Removal (CDR) within CCS-Specific Legislative Frameworks

A widespread and growing consensus as to the critical role of carbon dioxide removal (CDR) in achieving net zero emissions by 2050, has brought technologies such as direct air capture and storage (DACCS) and bioenergy with CCS (BECCS) to the forefront of national policy discussions (Smith et al., 2023).

In countries where these technologies are anticipated to play a role in meeting emissions reduction targets, policymakers and regulators will be presented with novel and unique regulatory challenges. Issues relating to, amongst others, construction and infrastructure, land access, property rights and ownership of CO_2 and accounting and reporting have all been highlighted (Hester, 2018). As such, regulators may be required to consider the inclusion of these technologies within the scope of their frameworks and ensure the adaptability of existing frameworks to accommodate technical advancements in CDR technologies.

KEY MESSAGES

- Regulators and policymakers may decide to expand the focus of regulatory frameworks to include the broad suite of applications that constitute CCS technologies across the industrial and power sectors. The inclusion of various applications will depend on the objectives underpinning the legislative framework for the technology, which may relate to the nation's climate change mitigation, energy transition and economic development priorities.
- Permitting approaches may differ for various applications and separate permitting pathways may be established for specific applications. In some countries, certain enhanced hydrocarbon recovery applications, such as Enhanced Oil Recovery (CO_2-EOR), have been excluded entirely from the scope of CCS-specific frameworks.
- The significant role that emerging technologies such as carbon dioxide removal are expected to play in facilitating the net zero transition, will require regulatory frameworks to be adaptable and flexible to accommodate the novel and unique regulatory issues associated with these technologies.

PRIORITY ACTIONS FOR REGULATORS AND POLICYMAKERS

- Identify the specific applications to be covered by the scope of domestic regulatory frameworks.
- Review the extent to which existing regulatory frameworks, relating to resources, environment, property, and planning, may support dedicated geological storage and enhanced hydrocarbon recovery projects.
- Ensure CCS-specific regulatory frameworks remain future focused and are adaptable to reflect the technological advances associated with various applications and emerging technologies.

3.4.5. Detailed Review and Assessment of Domestic Regimes

The processes undertaken by regulators and policymakers, when considering their response to CCS activities, have also proven important factors in determining their ultimate approach to the nature and design of regulatory frameworks. In some of the early-mover nations, policymakers and regulators have completed targeted policy, legal and regulatory studies aimed at examining this very issue. While broader reviews of this nature are not uncommon during the development of legislation, these more targeted, assessment exercises have proven the basis of several of the more comprehensive CCS-specific frameworks enacted to-date.

CCS specific review processes of this nature may also be accompanied by periods of formal and informal consultation. The engagement of a wide variety of critical stakeholders, in addition to those engaged through pre-existing consultation processes, will likely result in the exposure and consideration of far broader range of issues and

potential solutions. Previous examples of these processes have seen the formation of working groups that include industry, academia, and research institutions.

Wider international experience may also prove informative for those developing CCS specific legislation, and policymakers and regulators around the world have at times benefitted from engagement with stakeholders that have experience of addressing these particular issues. While several established fora may offer a platform for dialogue of this nature, national regulators and policymakers may seek to establish wider formal and informal dialogue with a variety of international stakeholders to assist in their assessment and decision-making processes.

KEY MESSAGES

- Regulators and policymakers in several jurisdictions have benefited from targeted studies and assessment exercises. In many instances these activities have afforded important inputs into well-structured and comprehensive regulatory frameworks.
- Inclusive consultation processes involving a diverse group of stakeholders from industry, academia, and research institutions, may contribute to a more comprehensive and holistic understanding of regulatory issues relating to CCS.
- Learning from the experiences of early-mover nations and engaging with international stakeholders provides valuable insights and expertise in the development of regulatory frameworks for CCS. Policymakers and regulators can benefit from established international forums and engagement in formal and informal dialogues to inform their decision-making processes regarding CCS-specific legislation.
- Within the region, the experiences of the governments of Indonesia and Thailand offer tangible examples of the processes involved in developing regulatory frameworks for CCS. Both countries have undertaken collaborative, iterative processes, that have engaged a diverse group of stakeholders across various levels of government.

PRIORITY ACTIONS FOR REGULATORS AND POLICYMAKERS

- Establish dedicated processes, that engage all relevant stakeholders within government, to examine and consider the relevant policy, legal and regulatory issues. Activities may include the conducting studies to obtain an understanding of the nuances required in regulating CCS technologies.
- Engage a diverse range of expert stakeholders from across industry, academia, research institutions and civil society, to gather expert perspectives on the regulation of the technology.
- Leverage international expertise through dialogue with international stakeholders experienced in addressing CCS regulatory challenges. Engage in formal discussions or collaborations through established platforms to benefit from international insights and experiences.

3.4.6. Identifying and Designating a Regulatory Authority

The development, implementation and administration of CCS-specific legal and regulatory frameworks will ultimately involve a range of government stakeholders. The experiences of jurisdictions that have already implemented their CCS-specific regimes and have regulated early CCS projects, suggests that a wide-variety of government departments and regulators will play a role in regulating CCS operations, throughout the project lifecycle. A failure to designate a lead agency, or to provide clarity as to specific regulatory responsibilities, has the potential to cause significant delays to decision-making and ultimately, the deployment of projects.

In addition to clearly designating a lead authority and identifying wider regulatory authorities, the coordination of the various regulatory functions will also be of critical importance, if projects are to progress efficiently through each stage of the project lifecycle. Early-mover nations, which have already developed their legal and regulatory frameworks, clearly identify the lead authority, agencies, and ministers responsible for awarding and administering CCS authorities within the relevant legislation.

Regulatory regimes will also require ongoing interaction between the relevant regulators and agencies, particularly where each may bear very distinct responsibilities under the regulatory framework. To address these potential conflicts, policymakers and regulators may wish to consider how regulatory regimes may be better streamlined or coordinated, to remove any potential obstacles that may cause unnecessary delay within the regulatory process.

Notwithstanding the efforts undertaken to-date, many of the government departments and agencies responsible for administering these regimes have limited CCS-specific experience. This issue is exacerbated further, when responsibility for permitting and administration of a regime extends beyond the lead agency, to include wider government departments and regulatory authorities. A lack of familiarity with CCS and the challenges associated with regulating activities throughout the project lifecycle, may ultimately lead to delay as a regulatory body acquaints itself with both the technology and the authority's consequential roles and responsibilities.

KEY MESSAGES

- CCS-specific frameworks may build upon existing licensing regimes and in some instances rely upon established pathways to regulate discrete aspects of the CCS process. The resulting regulatory frameworks will therefore require the involvement of numerous regulatory authorities and/or agencies, as permits and licenses are sought for capture, transport, and storage activities.
- Many of the government departments and authorities likely to assume roles and responsibilities in the regulation of the technology, throughout the project lifecycle, will be unfamiliar with the technology. There is a risk of delay or a disconnect within the regulatory process, where these stakeholders take time to familiarise themselves with the technology and new regimes.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Government should identify and formally designate a lead government department or regulatory authority, to promote the development and implementation of a CCS-specific regulatory regime.
- The lead authority or department may then act as a coordinator to ensure that all relevant policy and regulatory entities are engaged and familiar with their roles and responsibilities, as part of the regulatory process.
- Governments may wish to consider developing an education and capacity development programme, aimed at familiarizing the relevant policy and regulatory stakeholders with the technology and their roles and responsibilities within the regulatory process.

3.4.7. Stakeholder Engagement in the Development of Legislation

CCS projects are large infrastructure projects that will engage a diverse range of stakeholders, including the government, industry and the wider public. The nature of CCS operations, for example the scale and longevity of the impact of CCS activities upon the physical environment and the climate change mitigation objective that underpins the technology's deployment, have implications for each of these stakeholders. It is critical therefore, that a national legal and regulatory framework for CCS projects is developed with input from all relevant stakeholders. A regime that reflects the interests and distinct impacts of CCS activities, may help provide certainty for investors and operators of projects, assist in reducing administrative inefficiencies leading to permitting delays, and increase public confidence in the regulatory framework governing the technology.

Project operators have frequently cited regulatory uncertainty and lack of clarity in relation to issues such as pore space ownership, liability, and risk management, as significant barriers to developing projects. Plans for regional hubs, shared transport and infrastructure, and transboundary project models, are also increasingly dependent upon

regulatory certainty. Proponents of these type of projects have also highlighted a variety of wider regulatory issues that may arise under these particular project models, including offtake agreements, public-private partnerships, production sharing contracts. These considerations involve coordination and the clarification of regulatory obligations between them (International Energy Agency, 2022).

The regulatory agencies and departments within government, that will be charged with overseeing and regulating projects, will also need to be equipped with the technical and regulatory capacity to ensure the efficient and smooth administration of a CCS-specific regulatory framework. Regulatory frameworks may also be developed at both national and sub-national levels and regulatory functions may be allocated to government agencies across local, state and national levels (Asian Development Bank, 2013). Consultation with the relevant government stakeholders to ensure the closer alignment of regulatory frameworks across various levels of government will be necessary to reduce potential conflict.

Widespread commercial deployment will also be dependent upon the public's perception of the technology. The impact of projects upon the environment, climate change goals, land-use, property rights, and human health and safety have all been highlighted previously as critical concerns. For CCS projects in particular, a lack of understanding of the CCS process, as well as its role in mitigating the impacts of climate change, have been found to be persistent issues and led to misinformation and skepticism(Asian Development Bank, 2013).

An example of a more specific community concern, recognised across various regions, has been the reluctance of private landowners to allow the development of transport pipelines and storage facilities on their land due to 'not-in-my-backyard' sentiments and concerns as to the technology's safety (Braun, 2017; Krause et al., 2014). In the ASEAN context, developing a regulatory framework that addresses these concerns will require consultation and input from the public. While stakeholder engagement may be required as part of a government's strategy to accelerate its deployment within a country, the development of legislation to facilitate CCS will likely require a separate engagement process, as highlighted by several of the regulators and policymakers interviewed by the Institute.

The Institute's interviews revealed that several ASEAN policymakers and regulators have already identified the lack of public awareness of the technology, as a concern in their individual jurisdictions. In these instances, interviewees thought it was critical that misconceptions regarding the environmental and safety implications of the technology were addressed and emphasised the role of private companies in awareness campaigns and educational initiatives.

For many ASEAN nations, a challenge lies in balancing the need to address these stakeholder interests, with the urgency required to develop and implement CCS-specific legislation. A lengthy consultation process that delays the regulatory process, may in turn postpone necessary project investment. Ultimately, national policymakers and regulators must adopt an approach that considers the need to ensure a fair, participative role for relevant stakeholders and caters to the urgency of the task of developing domestic legislation to support the technology's deployment.

KEY MESSAGES

- CCS projects are large, multi-faceted infrastructure projects that will invariably engage a variety of stakeholders from government, industry and the wider public. The development of legislation to regulate these activities will require policymakers and regulators to consider these stakeholders' interests and concerns as part of the process.
- Failure to adequately address the views of these stakeholders when designing and implementing legislation, may ultimately lead to dissatisfaction with the final regulatory framework. This in turn may lead to further inefficiencies or challenges to the deployment of CCS projects.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Government, through the lead regulatory authority, may undertake a formal process of public consultation to ensure interested parties are afforded the opportunity to provide their feedback and that this information is formally captured.
- A formal information programme, delivered by government and/or third-party expert organisations, may be delivered in-tandem with the public consultation effort. A programme of this nature could seek to clarify the role of CCS in addressing domestic climate change commitments or address any misconceptions surrounding the technology.

3.5. Overarching Legal and Regulatory Considerations

The development of CCS-specific legislation will require regulators to consider several wider or overarching legal and regulatory issues that may also impact the regulation of the technology. These issues, which are not confined to the technicalities and phases of a CCS project lifecycle model, are discussed in detail in the following sections.

3.5.1. International Obligations and Considerations

The nature of many contemporary CCS operations requires consideration of their legal position under broader international and regional legal and regulatory frameworks. While

early CCS projects involved sub-surface geological CO_2 storage, within the onshore territory or offshore marine environment of a single jurisdiction, recent years have seen a stronger focus upon the development of projects with a transnational dimension to their operation. In the ASEAN region, several governments and proponents have signalled a greater focus upon storage projects of this nature.

CCS projects under consideration in the region, include a maritime aspect with CO_2 transported across international borders for storage in other jurisdictions. Projects of this nature will require close coordination between governments and companies from different countries, in the implementation of cross-boundary CCS value chains. Early assessments have identified that both conventional and transboundary project models hold implications under various international and regional legal frameworks relating to climate change, the law of the sea, and the prevention of pollution in the marine environment (UNFCCC Subsidiary Body for Scientific and Technological Advice, 2012).

Table 3.3 sets out the international legal frameworks that are potentially applicable to CCS projects. The table identifies the ASEAN nations that are parties to these agreements.

Table 3.3. International Law Frameworks Applicable to CCS Activities

Agreement	Southeast Asian Parties	Description	Application to CCS
The United Nations Convention on the Law of the Sea (UNCLOS) of 1982	Brunei, Indonesia, Malaysia, Philippines, Singapore, Viet Nam, Thailand	The United Nations Convention on the Law of the Sea (UNCLOS) of 1982 establishes an overarching framework agreement which regulates the various uses of the world's oceans and seas and creates specific obligations on states to protect the marine environment.	CCS is not specifically mentioned within the text of UNCLOS, so it may not be said to expressly regulate CCS activities. However, Article 192 of UNCLOS creates an obligation for States to protect and preserve the marine environment in each of their territorial zones of the sea. Similarly, Article 194 obliges States to use necessary measures to 'prevent, reduce and control pollution of the marine environment from any source'. States are further obliged to ensure their activities do not negatively impact the environment of other States and adopt domestic laws and regulations which prevent marine pollution stemming from land-based activities, seabed activities subject to national jurisdiction, dumping, vessels and through the atmosphere. These provisions may have implications for several CCS project activities, from transport of CO_2 via ships or pipelines, and monitoring of CO_2 stored to prevent CO_2 leakage. However, it is unlikely that the position of CCS would be clarified through UNCLOS as it is a framework law which sets the scene for the elaboration of precise obligations in other specific laws such as the London Convention and Protocol

Agreement	Southeast Asian Parties	Description	Application to CCS
			(Havercroft and Purdy, 2007).
The London Protocol of 1996 under the London Convention of 1972	Philippines	The London Convention of 1972 was the first international agreement to provide protection to the marine environment from the deliberate disposal at sea of wastes, however, it was decided in the 1990s that it required modernisation in the form of the 1996 Protocol. The London Protocol of 1996, which entered into force in 2006, supersedes the Convention for those parties to the Convention which have subsequently become parties to the Protocol. The Protocol adopts a stringent, precautionary approach to the disposal of wastes, with Parties required to prohibit the dumping of all wastes at sea, save for those listed in the Protocol's Annex.	The London Protocol's Annex currently includes the category consisting of '*Carbon dioxide streams from carbon dioxide capture processes for sequestration*' which provides a formal basis for the regulation of CO_2 sequestration in sub-seabed geological formations under the Protocol's mechanisms. The Protocol, and in particular its implications for the transboundary movement of CO_2, is considered in greater detail in Section 3.5.2.
International Convention for the Prevention of Pollution from Ships 1973 (MARPOL)	Indonesia, Malaysia, Philippines, Singapore, Thailand, Viet Nam	MARPOL is the primary international agreement for regulating the prevention of pollution by ships. MARPOL seeks to prevent and regulate both pollution and accidental pollution caused by routine shipping operations.	While there is currently no reference to CCS operations within the text of the convention, several amendments have been made to the Annexes to MARPOL, to address the prevention of pollution from shipping. Annex III to MARPOL sets out regulations for the prevention of pollution by harmful substances carried by sea in packaged form. In the context of CCS, the transboundary shipment of CO_2 in gas cylinders or in liquefied form may need to comply with the

Agreement	Southeast Asian Parties	Description	Application to CCS
			requirements set out in Annex III to MARPOL (UNFCCC Subsidiary Body for Scientific and Technological Advice, 2012). Annex VI to MARPOL regulates the prevention of air pollution from ships. A 2018 amendment to Annex VI to MARPOL obliged ships of 5,000 gross tonnage and above to collect consumption data for each type of fuel oil used by the ship, which is to be reported to the flag State after the end of each year.
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal 1989	Brunei, Indonesia, Philippines, Malaysia, Thailand, Singapore	The Basel Convention governs the international trade of hazardous waste with the underlying aim of protecting human health and mitigating risks to the environment. The Convention calls for the reduction of waste production and establishes an international regime for controlling the transboundary movement of waste. A key principle established by the convention is that waste generated by one country should be disposed of within that country. The Convention provides that international trade in hazardous waste is subject to obtaining the prior consent of the receiving country, which is entitled to prohibit this transport. The Basel Convention defines waste as	The provisions of the Basel Convention raise questions as to whether CO_2 is to be treated as a hazardous waste under the Convention. Thus far, CO_2 has not been mentioned in the Convention or included in the Annexes of the convention as a hazardous substance. However, several provisions of the Convention may be extended to CO_2, bringing it under the scope of the Convention. For example, the characteristics of substances listed within Annex III of the Convention, such as corrosiveness and toxicity may be extended to CO_2, particularly where CO_2 from CCS operations is mixed with other substances. Furthermore, Annex IV of the Convention relates to various types of waste disposal operations, including deep injection and release via

Agreement	Southeast Asian Parties	Description	Application to CCS
		'substances or objects which are disposed of … by the provisions of national law'' and the characteristics of hazardous wastes are listed in the Convention's annexes. Contracting Parties are also able to add other categories of waste that are considered hazardous within their national laws and are required to notify the Secretariat of the Convention in such event. International cooperation underpins the Basel Convention, as Parties are required to cooperate by sharing information, monitoring the impact of trading hazardous waste on human health and the environment and developing technical guidelines and codes of practice relating to such disposal. An amendment to the Basel Convention was introduced in 1995 prohibiting the shipment of waste from developed (namely the EU and OECD nations) to developing countries, lacking the legal, technical, and administrative capacity to ensure environmentally safe disposal. Furthermore, the Protocol to the Basel Convention establishes a regime for the allocation of liability for accidents while transporting hazardous waste. However, both	sub-seabed injection into the seas/oceans. If CO_2 is covered by the scope of the Convention, this will hold implications for implementing transboundary CCS projects. Firstly, if CO_2 is treated as a hazardous substance, potential conflicts may arise between states that have chosen to prohibit transport or transit of CO_2 into or over its territory and those states that have allowed these activities. The Convention also only allows hazardous waste to be transported from states that lack the adequate storage and technical capacity to dispose of waste within their own territories. If CO_2 is covered by the Convention, this provision may restrict the export of CO_2 for disposal overseas. To overcome the ambiguities under the Basel Convention relating to CO_2 further clarification is required either in the form of an amendment to the Convention or a determination from the Secretariat to the Basel Convention regarding the treatment of CO_2 under the Convention(UNFCCC Subsidiary Body for Scientific and Technological Advice, 2012).

Agreement	Southeast Asian Parties	Description	Application to CCS
		the 1995 amendment and Basel Protocol are yet to enter into force. A list of substances that constitute waste is defined within the Convention's Annexes.	

Source: GCCSI.

Several of the international agreements highlighted are primarily environmental treaties and as such, were not designed to facilitate large-scale CCS deployment. States will need to consider international environmental law principles such as sustainable development and the precautionary principle in the implementation of their international obligations under these frameworks. The application of these principles may pose a challenge to CCS projects, potentially leading to project permit delays or necessitating the fulfillment of additional environmental impact requirements when conducting injection operations (UNFCCC Subsidiary Body for Scientific and Technological Advice, 2012).

For regulators and policymakers in the ASEAN region, consistency and compliance with international law will be a key consideration when developing legal and regulatory regimes to facilitate CCS project activities. Of particular significance, will be whether a country is a party to an agreement and if they have implemented their obligations under the relevant frameworks within existing national and sub-national legal and regulatory regimes. Clarification of the position of CCS activities under relevant international law frameworks will be imperative for individual states in the region, to ensure there is consistency with national legislation and to maintain commitments under regional institutional frameworks[2].

3.5.2. The Legality of Transboundary Offshore CO_2 Storage Value Chains under the London Protocol

The focus in the ASEAN region upon advancing collaborative project models that involve offshore transboundary CCS activities, will require close consideration of international marine agreements. The 1972 London Convention and its 1996 Protocol, which are aimed at protecting the world's oceans from pollution, have been central to determining the legality of offshore CCS operations.

The 2006 amendment to the London Protocol has proven particularly significant for CCS activities and constituted formal recognition of the storage of CO_2 in sub-seabed geological formations within international law. The amendment inserts the category of '*Carbon dioxide streams from carbon dioxide capture processes for sequestration'* into the Annex of wastes that may be considered for dumping in the marine environment and provides a basis for the regulation of CO_2 sequestration in sub-seabed geological formations under the Protocol's mechanisms.

[2] For example, the ASEAN Joint Declaration on Hazardous Chemicals and Wastes Management, recognises the significance of the Basel Convention in ensuring the management of hazardous wastes and calls for consistency and effectiveness in the implementation of the Convention's provisions across the region.

Transboundary Considerations

Although the 2006 amendment allows the storage of CO_2 in sub-seabed geological formations, Article 6 of the Protocol, which is principally aimed at preventing the export of wastes to non-Parties, has the effect of similarly prohibiting the transboundary transportation of CO_2 for the purposes of geological storage. In October 2009, a formal amendment to Article 6 of the Protocol was adopted by the signatories to the London Protocol to allow for cross-border transport and export of CO_2 for geological storage (Resolution LP-3(4), 2009). However, the amendment required ratification by two thirds of the Protocol's contracting parties to enter into force and thus far, only the governments of Belgium, Denmark, South Korea, Sweden, Norway, United Kingdom, Netherlands, Finland, Estonia, and Iran have ratified this amendment. More recently, the government of Switzerland has also communicated its intention to ratify the amendment. To date, however, the amendment has not entered into force.

At the 2019 meeting of the Contracting Parties to the Protocol, agreement was finally reached to allow the provisional application of the 2009 amendment as an interim solution (IMO Document LC 41/17/Add.1, 2019). The agreement will now allow those countries, who wish to export their CO_2 for storage in another country's territorial waters, to implement the provisions of the 2009 amendment in advance of it entering into force. Adopting the resolution will not set a precedent and will only be binding upon those Parties that choose to be provisionally bound by the amendment. Parties still, however, will be required to meet the standards prescribed by the Protocol.

Figure 3.2 provides an overview of the respective obligations of Contracting Parties and Non-Contracting Parties when undertaking the transboundary export of CO_2 in the context of the 2009 amendment to the London Protocol and the 2019 Resolution accepting the provisional application of the 2009 amendment to the London Protocol (IEA, 2021b).

Figure 3.2. Cross-border maritime CO_2 transport under the 2009 Amendment and 2019 Resolution for Provisional Application of the London Protocol (IEA, 2021)

		LP status of country receiving CO_2 for storage:	
		Contracting party	**Non-contracting party**
LP status of country capturing CO_2 for export:	**Contracting party**	CPs must establish agreements or arrangements, depositing formal declarations to the IMO detailing compliance with environmental conditions related to the composition of CO_2 streams, and CO_2 storage	Exporting CP must ensure that control conditions and permits as applicable to CPs. CP must ensure agreements or arrangements are maintained by the receiving country
	Non-contracting party	Receiving CP must ensure that exporting country demonstrates appropriate consideration of incidental associated substances in CO_2 stream, and treatment if needed. CP must ensure agreements or arrangements are maintained by the exporting country.	Not governed by the LP; may be subject to UNCLOS

Note: LP = London Protocol; CP = Contracting Party.
Sources: IEAGHG (2021); IMO (2013).

Compliance with the London Protocol: Considerations for ASEAN Nations

In Southeast Asia, only the Philippines is a Contracting Party to the London Protocol and no country has ratified the 2009 amendment to Article 6 of the London Protocol, or deposited declarations to allow the provisional application of this amendment. To date, only the governments of Norway, the Netherlands, Denmark, Korea, the United Kingdom, Sweden and Belgium have deposited declarations announcing the provisional application of the 2009 amendment to the London Protocol within their jurisdictions.

To undertake projects that feature a transboundary component hosted by a Contracting Party to the Protocol, it will be essential for national governments in the region to ensure they comply with the provisional application requirements agreed by the Parties in 2019. National regulators and policymakers who are Contracting Parties to the Protocol will be required to support these projects, put into place the necessary agreements, and subsequently notify the IMO of their arrangements.

In the context of plans to initiate transboundary CCS projects, it is a key near-term priority for Southeast Asian nations to take steps to ratify the London Protocol and adopt the 2009 amendment to Article 6 of the Protocol to avail themselves of the provisional application requirements of this amendment.

KEY MESSAGES

- A wide variety of international agreements are to be considered when determining the legality of domestic or regional CCS operations.
- Activities involving the transport of CO_2 across international maritime zones and marine areas have implications under a broad range of international agreements, including those relating to the pollution of the marine environment, the safety of maritime transport, the transport of dangerous goods and the carriage of compressed gases.
- The London Protocol removed barriers to the technology's deployment and provided a basis under the Protocol's mechanisms for the regulation of CO_2 sequestration in sub-seabed geological formations. Recent amendments to this agreement offer an important pathway for facilitating the transboundary transportation of CO_2 for geological storage.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Undertake a detailed review of national commitments under wider international law, to determine their impact upon CCS operations.
- Investigate the implications of exporting/importing CO_2 from those countries which are Parties or non-Parties to the London Protocol.
- Develop secondary guidance to support project developers when advancing projects that feature the transboundary movement of CO_2.

3.5.3. Interactions with Wider Domestic Legal Frameworks

Irrespective of the pathway chosen to regulate CCS activities, a more extensive body of national laws and regulations will also be applicable to the capture, transport and storage operations of a CCS project. CCS projects have similar features to major oil and gas operations and industrial activities and as such, it is likely that legislation governing operational liabilities, pollution prevention and control, health and safety, planning and environmental impact assessment, will apply to the various aspects of the CCS process.

The scale and nature of CCS operations will require regulators and policymakers in the ASEAN region to consider the potential interactions and obligations triggered under wider domestic legislation, when developing their CCS-specific legal and regulatory frameworks. CCS-specific regimes may directly outline compliance requirements within broader legislation or include a general overarching provision requiring project operators to ensure compliance with existing laws and regulations relevant to activities within the CCS project lifecycle.

An example of this approach may be found in Indonesia's new legal regime for CCS and CCUS projects, established by MEMR 2/2023. In this instance, the legislation requires projects to draft plans on the mitigation and management of environmental, social and

public impacts, in accordance with existing laws and regulations. The requirement will likely bring CCS and CCUS projects under the scope of Indonesia's existing AMDAL process. The process is Indonesia's system for conducting environmental impact assessments, and involves several elements, consisting of a Terms of Reference, an Environmental Impact Analysis Report, an Environmental Management Plan and an Environmental Monitoring Plan. At present, Indonesia's CCS regime does not clarify the exact obligations of project operators in relation to the AMDAL process. [3]

Many countries within the ASEAN region are seeking to conduct offshore CO_2 storage activities, develop storage sites in specific geographical regions of their territories, and undertake CO_2 export and import activities via ship. In these circumstances, it is likely that CCS activities will trigger domestic legislation relating to the environment, maritime shipping, natural resources, construction, planning health and safety.

In Malaysia, for example, it is likely that CCS project construction and development will be required to comply with additional obligations under the country's federal and state planning and construction laws. The Department of Environment, at the federal level will determine as part of its Environmental Impact Assessment review whether the project is consistent with local zoning requirements. However, the ultimate decision will be made by state and local authorities. There is currently no clarity as to how these various federal and state legal frameworks interact and apply in the context of CCS projects.

Clearly defining the obligations of project operators within wider national laws and regulatory regimes, through consequential amendments for example, will provide certainty and afford greater depth to national CCS-specific regulatory frameworks.

[3] Indonesia's Gundih CCS project, a small-scale CCUS pilot project at the onshore Gundih gas field, was the subject of an AMDAL during the early stages of the project (Asian Development Bank, 2019b).

KEY MESSAGES

- A substantial body of domestic legislation will ultimately apply to the entirety of a CCS project. For many nations within the ASEAN region, existing oil and gas operations will provide a good analogue for the various regimes that may also apply to CCS activities.
- Legislation relating to planning, land use, energy, health and safety, and environment protection matters will likely be applicable to CCS operations.
- In some jurisdictions, sub-national legislation (e.g. state level legislation) may also be applicable to CCS operations.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Undertake a detailed review of national legislation to determine key legal instruments applicable to CCS operations.
- As part of this review, policymakers and regulators should identify the wider approvals pathways for CCS projects, to reflect all necessary national and sub-national legislation. The review should also seek to clarify obligations for project proponents and determine responsibilities between various national and sub-national regulatory authorities.
- Identify overlapping permitting responsibilities between national and sub-national regulatory authorities and identify any potential challenges.
- The development of secondary guidance may assist project proponents in navigating the requirements of wider legal and regulatory regimes.

3.5.4. Enabling Emerging Project Models

Historically, many CCS projects were proposed as a single integrated system, incorporating a sole CO_2 capture plant with its own CO_2 transport and storage facilities. The CCS process associated with this project model, particularly the transport and storage elements of the project lifecycle, also share similar characteristics to traditional oil and gas activities. These characteristics have enabled existing oil and gas legislation to provide a useful starting point for the regulation of activities across the CCS value chain.

More recently, however, there has been a strong focus upon the development of networked projects, using shared transport and storage infrastructure to which multiple industrial point sources of CO_2 are connected. Some CCS developments, such as shipping projects, pipelines, or new storage facilities, do not involve CO_2 capture at all and handle CO_2 captured by third parties. An example of this type of project can be seen in the province of Alberta, Canada, where a growing number of multi-user storage-only facilities are being deployed to facilitate industrial decarbonisation (Government of Alberta, 2023).

In the ASEAN region, high domestic emissions, limited domestic storage potential and close geographic proximity to suitable storage sites in the territorial waters of neighboring countries, have also strengthened the case for the export and import of CO_2. Several countries and operators in the region are seeking to adopt a more collaborative approach towards exploring project models that involve the transboundary export and

import of CO_2 for storage.

The need for a legal and regulatory framework that encompasses the new issues and risks that these project models entail, is a further consideration for regulators and policymakers seeking to regulate CCS. Shared transport and storage infrastructure linked to industrial clusters, for example, will involve multiple stakeholders and raise a variety of potential issues. In this instance, legislation will be required to consider the coordination of CO_2 storage licenses, the allocation of liabilities for leakage, clarity as to pore space ownership, technical requirements for receiving and storing CO_2, fair and equitable access to shared infrastructure and adequate dispute resolution mechanisms in the event of any conflict (International Energy Agency, 2022).

With proponents in several ASEAN nations considering transboundary CCS projects that involve storage hubs and shared transport elements, the development of legislation that addresses novel issues and ensures cooperation and clarity for the various stakeholders involved, will be essential for ensuring their deployment.

KEY MESSAGES

- Modern CCS projects, including those proposed and in-development in some ASEAN nations, increasingly feature networked elements, utilising shared transport and storage infrastructure.
- Projects of this nature will likely require policymakers and regulators to adopt new regulatory approaches for their management.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Timely engagement with project proponents to understand project proposals in development.
- Ensure that the development of any subsequent CCS-specific legislation adequately manages these new and emerging project models.

3.5.5. Eligibility under Carbon Crediting Mechanisms

In many jurisdictions, legislation plays an important role in supporting wider policy mechanisms employed by governments to incentivise CCS deployment. Governments frequently require compliance with CCS-specific legal and regulatory frameworks to qualify for incentive schemes that may promote or support the deployment of CCS, such as emissions trading or carbon crediting schemes.

There are several emissions trading mechanisms in operation worldwide, which provide operators or owners of CCUS projects the ability to acquire emissions credits and allowances for conducting emissions reduction activities. Examples include the EU Emissions Trading System (EU ETS), California's cap and trade programme and Alberta's Technology Innovation and Emissions Reduction (TIER) Regulation. The regulatory

frameworks governing the operation of CCS projects are central to the generation of credits under these schemes. In the EU, for example, operators that successfully capture, transport and store CO_2 emissions in accordance with the provisions of the EU CCS Directive, are not required to surrender allowances for these emissions under the EU ETS.

Indonesia's new regime enables contractors to benefit from the carbon economic value created by CCS activities. The carbon economic value relates to the carbon credits generated from the emissions reductions achieved by CCS activities. Carbon credits may be delivered under the carbon trading scheme established in Indonesia under Presidential Regulation No. 98/2021 on Economic Value on Carbon, which currently recognises CCS and CCUS as an emissions reduction activity.

The interaction between the regulatory framework and any incentive schemes is critical to the commercial considerations that underpin many CCS projects. Clarifying the nature of this interaction, within the design and development of a CCS-specific regulatory framework, will be critical for eliminating inadvertent barriers to investment.

KEY MESSAGES

- Compliance with CCS-specific legal and regulatory regimes is an important feature of many carbon crediting schemes that offer support for CCS activities.
- Several examples of this interaction exist in jurisdictions around the world and enable project proponents to gain formal recognition of their geological storage operations, including the generation carbon credits.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Undertake a formal review of the inclusion of CCS activities within any existing or proposed domestic carbon crediting scheme or mechanism.
- Examine the legal and regulatory implications of formally recognising the geological storage of CO_2 within any existing or proposed scheme or mechanism.

3.5.6. Interaction with Reporting and Accounting Mechanisms

Regulatory frameworks play an important role in defining robust reporting and verification requirements and ensuring that emissions reductions associated with CCS activities can be accurately verified. As discussed in the preceding section, compliance with these regulatory requirements also enables project operators to realise their verified emissions reductions under established carbon crediting mechanisms or schemes.

National accounting schemes and regulatory programmes play a key role in this regard. For example, in Australia, the National Greenhouse and Energy Reporting (NGER) scheme is central to Australia's national greenhouse gas (GHG) accounting model and is the principal data source for preparing the national GHG inventory (Clean Energy Regulator, 2022). Under the NGER scheme, registered corporations that meet the prescribed

thresholds under the scheme, are required to report annually on all greenhouse gas emissions, energy production and energy consumption from facilities under the operational control of the registered corporation or members of its group.

The NGER scheme has now been amended to explicitly recognise the role of CCS. The 2008 Regulations, that underpin the scheme, now include specific provisions regarding the treatment of emissions and CCS operations. Further guidance is also set out in the 2008 Measurement Determination and the accompanying Clean Energy Regulator (CER) guideline, which offer more detailed methodological and measurement provisions to enable reporters to appropriately report emissions from those facilities employing CCS during a reporting year. Emissions reductions reported and accounted for, pursuant to the NGER scheme, enable projects to qualify for carbon credits under mechanisms such as the Emissions Reduction Fund (ERF) in Australia.

Other notable examples of schemes which explicitly address CCS projects, include the EU Emissions Trading Scheme (EU ETS), the California LP(LCFS) and the US federal Greenhouse Gas Reporting Program.

3.5.6.1. Accounting and Reporting Obligations in the Context of Transboundary CCS Value Chains

In the context of transboundary CCS operations, national accounting schemes and regulatory programmes will need to consider a variety of factors. The involvement of multiple stakeholders from the countries involved in a transboundary CCS project, the allocation of responsibilities for the reporting of CO_2 captured at source and stored in the reservoir, as well as any necessary accounting of CO_2 leakage in the transport chain and storage reservoir, must all be addressed. An example of how reporting responsibilities can be allocated is to be found in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, which includes guidance on accounting for greenhouse gas emissions and removals that result from the CCS value chain(Intergovernmental Panel on Climate Change, 2006a).

The guidelines provide that where CO_2 captured in one country (Country A) is to be transported for storage in another country (Country B), Country A is required to report the amount of CO_2 captured, any emissions from transport or temporary storage that takes place within the territory of Country A, and the amount of CO_2 exported to Country B. Country B in turn is required to report the volume of CO_2 imported, any emissions from transport and temporary storage (within the territory of Country B) and any emissions from injection and geological storage sites (Intergovernmental Panel on Climate Change, 2006b).

Under this allocation of responsibilities, where CO_2 is received for storage from another country, a country will be required to report the volume of CO_2 received (imported) and any emissions associated arising from the transport, temporary storage, injection and storage of the imported CO_2.

For regulators and policymakers in the ASEAN region seeking to establish CCS-specific legal and regulatory frameworks, the clarification of reporting obligations of projects will be a key consideration. Regulatory frameworks relevant to CCS operations must also require adequate safeguards are in place to ensure that any injected CO_2 remains permanently stored. Such safeguards will be essential for demonstrating the integrity of emissions reductions associated with CCS projects.

KEY MESSAGES

- The detailed reporting and accounting of stored CO_2, as part of geological storage operations, is an important aspect of ensuring compliance with CCS-specific legislation and for ensuring the wider integrity of CCS operations.
- Several national greenhouse gas reporting frameworks have been amended to formally recognise the geological storage of CO_2 and provide formal methodologies for operators when reporting their storage operations.
- The 2006 IPCC Guidelines offer an important indication as to how national accounting schemes may manage the reporting of transboundary CCS operations.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Review current emissions reporting and accounting frameworks to determine the extent to which CCS operations may be addressed.
- Ensure clarity within domestic emissions accounting frameworks of the treatment of CO_2 subject to transboundary movement.

3.5.7. Developing National Protocols and Regulatory Guidelines

A further consideration for regulators and policymakers is the development of national protocols and regulatory guidelines to accompany CCS-specific legal and regulatory frameworks. National protocols that establish standardised requirements for various aspects of the CCS project lifecycle, such as site selection, assessment and approvals, and CO_2 transport, ensure uniformity in administering compliance procedures to regulators. Guidelines issued by regulators often provide the necessary context and specificity to project operators when navigating the complexity of CCS-specific legal and regulatory frameworks.

In 2010 the European Commission released four Guidance Documents to aid the European Member States in their implementation of the Directive on the geological storage of CO_2 (CCS Directive)(European Commission, 2023). The four documents, which were aimed at promoting consistency in application of the Directive's provisions, covered the following topics:

1. CO_2 Storage Life Cycle Risk Management Framework
2. Characterisation of the Storage Complex, CO_2 Stream Composition, Monitoring and Corrective Measures
3. Criteria for Transfer of Responsibility to the Competent Authority
4. Financial Security and Financial Mechanism.

Following an extensive period of consultation with experts from the Member States and other key stakeholders (including industry, academic and research communities and NGOs), final versions of the guidance documents were published by the Commission in late March 2011. Although these guidance documents are not legally binding, they have proven an important source of information for many parties in interpreting the key principles of the original Directive. These documents are currently under review and will be updated by the Commission to reflect experience to-date.

Guidance Documents for CO_2 Storage Activities: Examples from Australia

In Australia, two key regulatory authorities are responsible for administering the approvals process for CCS projects under Australia's Commonwealth Offshore Petroleum and Greenhouse Gas Storage Act of 2006, the National Offshore Petroleum Titles Administrator (NOPTA) and the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). Both NOPTA and NOPSEMA issue guidance to industry on applying for various greenhouse gas storage authorities and complying with obligations relating to such authorities.

For example, to be granted an injection license to commence injection operations, the Offshore Petroleum and Greenhouse Gas Storage Act 2006 mandates that a project operator is required to obtain a declaration of the suitability of an identified GHG storage formation. NOPTA has issued guidance that notes that applicants will be required to define the 'fundamental suitability determinants' for the eligible storage formation, which will include the following:

- the amount of GHG substance that may be stored, noting that it must be at least 100,000 tonnes
- the particular GHG substance for which the storage formation is suitable to store
- the proposed injection point or points
- the proposed injection period
- any proposed engineering enhancements (if any) required
- the effective sealing feature, attribute or mechanism of the storage formation that enables permanent storage.

Project operators are also required to submit an environment plan prior to undertaking a GHG activity. The content of the Environment Plan is described in detail by NOPSEMA in the 'Environment plan content requirement' guidance note. For example, the Guidance note requires that project operators provide information on aspects such as:

- The activity and the environment
- Regulatory and other requirements and acceptable levels for impacts and risks
- Detailed analysis of impacts and risks
- Evaluation of impacts and control measures
- Environmental performance outcomes, standards and measurement criteria
- Public comments and adjustments
- Consultation process and ongoing consultation measures
- Implementation strategy and environmental management system

Source: Offshore Petroleum and Greenhouse Gas Storage Act 2006, Australia.

In the ASEAN region, Indonesia remains the only country that has established comprehensive CCS-specific legislation. Articles 53-55 of the MEMR 2 of 2023, however, mandates the authority administering the framework to provide guidance and supervision regarding the implementation of CCS and/or CCUS activities (Minister of Energy and Mineral Resources Regulation Number 2 of

2023 Concerning Implementation of Carbon Capture and Storage, as Well as Carbon Capture, Utilization and Storage in Upstream Oil and Gas Business Activities, 2023).

These examples demonstrate how national protocols and guidance may provide further detail to a CCS-specific legal and regulatory framework, and consequently afford greater certainty to project operators. Developing guidelines and protocols, which incorporate best practice and remain adaptive to project realities, also ensures the smooth and efficient implementation of regulatory frameworks.

KEY MESSAGES

- Supplementary guidance, in the form of national protocols or regulatory guidelines, offers important assistance to all project proponents when interpreting and utlising legal and regulatory frameworks.
- While the development of this type of guidance is not uncommon, policymakers and regulators in several jurisdictions have developed materials that will assist parties in their interpretation of the requirements of early CCS-specific frameworks.
- Policymakers and regulators may adopt an iterative approach to the development of these guidance materials, enabling them to be updated to reflect recent developments and best practice models.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Review existing national protocols and guidance that may support the development and interpretation of future CCS-specific legislation.
- Where legislation is being proposed or implemented, policymakers and regulators may consider the development secondary guidance to support project developers in complying with the new legislative requirements.

3.6. A CCS-Specific Legal and Regulatory Framework

The Institute's analysis, together with the outcomes of the accompanying interviews and workshops, reveals the principal concern of governments throughout the ASEAN region, remains the formal design of CCS-specific regimes. Notwithstanding the critical policy, legal and regulatory choices that will determine and underpin the architecture of future regimes - examined in the preceding sections of this report - policymakers and regulators in the region are also keen to identify and understand the issues and elements that comprise a CCS-specific regulatory framework.

The Institute's review similarly confirms that ASEAN governments and industry stakeholders throughout the region, recognise the need for national frameworks to be comprehensive and facilitative of the technology's deployment. While many regional governments remain in the early stages of designing their regimes, and yet to fully determine how they will regulate the technology, several have consistently noted the need to develop legislation which reflects the lifecycle of a CCS project. As such, these key stakeholders are seeking guidance as to how existing international best-practice may

support these ambitions when developing regional approaches and national legislation.

The following section sets out the key issues and considerations to be addressed by ASEAN governments, as they navigate the design and implementation of domestic CCS-specific legislation. The content builds upon the earlier sections, which focused upon conceptual and related legal issues, to provide a regionally focused overview of a CCS-specific legal and regulatory framework.

3.6.1. Identifying the Key Elements of a Legal and Regulatory Framework

During a period of concerted action by some policymakers and regulators in the two decades since 2003, proponents of the technology have seen the removal of both national and international legal barriers to the technology, as well as the emergence of several comprehensive, jurisdiction-specific regimes. These legal and regulatory regimes have made significant contributions towards addressing the issues identified as obstacles or barriers to deployment. In many instances, the development of this legislation has led to the promotion of novel approaches to regulating the technology, within the bounds of domestic regulatory regimes.

The CCS-specific models, adopted across several jurisdictions in Europe, North America, Asia and Australia, have largely followed a similar approach and regulate the entirety or aspects of the CCS process. As highlighted in the preceding section of this report, in all but one instance, policymakers and regulators have also adopted one of two pathways to regulating the technology, deciding to either enhance existing regulatory frameworks with CCS-specific provisions or to enact stand-alone CCS-specific legal frameworks. While these regimes vary in their complexity, and contain nuances that reflect national requirements, they also share many commonalities in the way they address the novel challenges of the CCS process.

3.6.1.1. Assessment and Guidance Frameworks

A further, important tool for nations' seeking to develop their legal and regulatory regime for the technology, are the variety of assessment and guidance frameworks that are now available to regulators and policymakers. The past decade has seen the development of several of these frameworks, which have been developed with the aim of supporting the promotion and development of CCS-specific legislation, or as a means of assessing national frameworks' ability to regulate the CCS process. Developed by leading intergovernmental, research and academic institutions, these frameworks provide a useful insight into the key elements and principles that underlie may of the current CCS-specific legal and regulatory frameworks.

Several of these assessment and guidance frameworks were considered in the completion of this document:

- *CCS Legal and Regulatory Indicator (CCS-LRI),* Global CCS Institute, Melbourne, 2023.

The Institute's Legal and Regulatory Indicator provides a detailed examination and assessment of national legal and regulatory frameworks in 55 countries. Now in its fourth edition, the Indicator employs a legal and regulatory assessment model that considers a range of issues that have been determined to be essential for regulating a CCS project throughout its lifecycle. The resulting assessment provides an indicative guide as to the complexity of a nation's current regulatory model.

- *Legal and Regulatory Frameworks for CCUS: An IEA CCUS Handbook*, International Energy Agency, Paris, OECD/IEA 2022.

Developed by the International Energy Agency (IEA) in 2022, the handbook builds upon and updates the earlier *Carbon Capture and Storage: Model Regulatory Framework* that was developed in 2010. The handbook is a non-prescriptive resource and is intended as a guide for those seeking to develop legislation. The model highlights 25 essential issues that policymakers and regulators may consider when designing and implementing a CCS-specific regulatory regime. While ultimately high-level, the model draws upon existing frameworks and the experiences of several jurisdictions around the world.

- *Prospects for carbon capture and storage in Southeast Asia,* Asian Development Bank, Mandaluyong City, Philippines: Asian Development Bank, 2013.

The 2013 study, completed by the Asian Development Bank, included a detailed assessment of the legal and regulatory regimes of Indonesia, the Philippines, Thailand, and Viet Nam. Although the four nations do not currently have dedicated CCS-specific legislation, the report recognised that national regulators need not start from scratch and may develop their regimes based upon existing legal and regulatory pathways. To this end, the report proposed several issues that would need to be addressed to support the commercial development of CCS in these nations.

- *CCS Guidelines: Guidelines for Carbon Dioxide Capture, Transport, and Storage,* World Resources Institute (WRI). Washington, DC: WRI, 2008.

The WRI Guidelines were developed to support project proponents, financiers, policymakers and regulators, in the design and operation of CCS projects. Although intended for a wide audience, the Guidelines highlight key considerations across the capture, transport and storage aspects of the CCS project lifecycle.

- *Permitting Issues Related to Carbon Capture and Storage for Coal-Based Power Plant Projects in Developing APEC Economies,* APEC Energy Working Group, APEC Secretariat, September 2012.

The APEC study examined the CCS legal and regulatory regimes for nine developing economies, including: People's Republic of China, Indonesia, Republic of Korea, Malaysia, Mexico, the Philippines, Chinese Taipei, Thailand and Viet Nam. Noting the absence of CCS-

specific legislation in these nations, the study reviewed existing laws and regulations that may be amended to address various aspects of the CCS project lifecycle. Included within the study is an assessment of each nation, by reference to nine key CCS-specific issues.

A review of these materials highlights a potentially wide number of issues that may be critical to the development of CCS-specific legal and regulatory frameworks. There are, however, several issues that have been consistently emphasised across the various frameworks, as significant when designing and implementing a CCS-specific regime. The following inexhaustive list, is indicative of some of the issues that were frequently identified in these resources:

- Rights associated with accessing the pore space.
- Authorisation/permitting of storage activities.
- Protection of the environment and human health
- Environmental impact assessment
- Transportation of CO_2
- Classification of CO_2
- Site selection and characterisation
- Monitoring, reporting and verification
- Liability throughout the project lifecycle
- Closure of a storage site
- Competition with other users and preferential rights issues.

For policymakers and regulators in the preliminary stages of considering or developing national legislation, these assessments offer an important insight as to the potential scope and level of detail that may be incorporated within a CCS-specific regime.

3.6.2. ASEAN Nations' Perspectives

As noted in earlier sections of this report, the Institute's research and interviews have revealed that in many ASEAN nations, policymakers and regulators will currently be required to rely upon a myriad of existing regulatory regimes to regulate a pilot or demonstration project. In many instances, the permitting or licensing frameworks governing existing mining, oil and gas activities would likely provide a starting point for regulation of CCS operations. It is highly unlikely, however, that these regimes in their present form would be able to support the commercial-scale deployment of the technology.

In addition to these resource or petroleum licensing models, a broad array of existing domestic environmental, planning and health and safety laws and regulations will also potentially apply to both pilot and early commercial operations in these nations. In many instances, these regimes would require further amendment or review, to readily accommodate CCS operations at a commercial scale project. In some instances, it was

suggested that specific amendments may be required to either include or exclude CCS operations from the scope of these preexisting models.

Notwithstanding the incomplete nature of the current legal regimes and the absence of stand-alone, dedicated regulatory frameworks for the technology, the Institute's analysis and interviews revealed a range of issues identified as critical for ASEAN policymakers and regulators, including:

- Design and structure of a dedicated CCS regulatory framework
- Types of permits required to regulate CCS operations
- Pore space ownership
- Classification of CO_2 – a waste or pollutant
- Health and safety considerations for CO_2 transport and storage
- Assessment of environmental impacts and public consultation
- Monitoring and verification requirements
- Treatment of stored CO_2 and associated liabilities upon closure of a storage site.

The reconciliation of these issues and topics within domestic frameworks will be critical, as policymakers and regulators navigate the design of their CCS-specific regimes.

Indonesia's recently released legal and regulatory framework to facilitate CCS activities, provides an important and timely example of how a regional government has addressed many of these key issues within a domestic regime.

Design and Structure of Indonesia's New CCS-Specific Regime

Regulation No. 2 of 2023 on the Organization of Carbon Capture and Storage (CCS) and Carbon Capture, Utilization and Storage (CCUS) for Upstream Oil-and-Gas Business Activities (MEMR 2/2023) is part of a suite of regulations introduced by the government to facilitate the country's energy transition and fulfill its climate change mitigation targets.

The new regulatory framework under MEMR 2/2023 builds on the existing legislative regime applicable to oil and gas exploration and production operations and provides a comprehensive framework for CCS and CCUS projects, including project operator and regulator roles and responsibilities, approval requirements, and monitoring and reporting obligations. In its current format, the Regulation addresses various aspects that relate to the implementation of CCS and CCUS in relation to oil-and-gas business activities.

The scope of MEMR Reg No. 2 of 2023 comprises the following matters:

- Organisation of CCS and CCUS
- Monitoring and Measurement, Reporting and Verification (Monitoring and MRV)
- Economic aspects and assets
- Emergency response systems
- Guidance and supervision
- Administrative sanctions.
- Post-closure transfer of liability

Source: Regulation No. 2 of 2023 on the Organization of Carbon Capture and Storage (CCS) and Carbon Capture, Utilization and Storage (CCUS) for Upstream Oil-and-Gas Business Activities (MEMR 2/2023)

Source: GCCSI.

3.6.3. Developing a Permitting Model for CCS Activities

A permitting approach which reflects the CCS project lifecycle, and that allocates responsibilities across the entire duration of a CCS operation, is an important feature of the CCS-specific regimes that have been enacted to-date. While this type of permitting model may form the basis of a stand-alone regulatory framework, it may equally be included within an existing domestic licensing regime, of the nature of those regulating oil and gas activities.

A permitting model of this nature includes clearly defined processes and obligations, for both an operator and regulator, from an initial planning and exploration or pre-injection phase, throughout the operational lifetime of a project and beyond into a closure and post-closure period. Under this phased approach, an operator seeking to undertake CCS-specific activities will be required to obtain a series of authorisations, at key points in the project lifecycle, which enable the project to transition from the pre-injection phase, through the operational stage of a project and ultimately into the eventual closure and

post-closure phase.

The various licences, permits and leases that may be awarded under a lifecycle permitting model of this nature, authorise and require operators to undertake specified activities, as determined by the relevant regulator. As illustrated in Figure 3.3, separate permits or licenses may be required for activities such as assessment or exploration activities to identify potential CO_2 storage sites and for the subsequent injection and storage activities within suitable CO_2 storage sites. In more comprehensive regimes, licenses may also be required for the construction and operation of CCS-related infrastructure and to operate CO_2 pipelines. Often however, these permits may already pre-exist in relation to oil and gas recovery projects and regulators may adapt these permits to enable CCS projects.

In some examples, such as the regime established under the Australian Commonwealth government's offshore Act or the model established under the EU CCS Directive, failure to obtain the required authorisation will be an offence under the statute. The rights conferred by each permit varies. The applications for these authorisations also include a variety of information requirements, and in many instances require the submission of detailed plans aimed at addressing an operator's approach to the management of the storage site. The relevant permits are typically revocable by the granting authority if the terms and conditions attached have not been complied with.

The CCS Permitting Model in Australia

Under the Australian Offshore Petroleum and Greenhouse Gas Storage Act of 2006 (OPPGSA), an operator seeking to undertake exploration for a potential storage site in Commonwealth waters, will be required to obtain a 'GHG assessment permit'. The permit enables the holder to conduct exploration activities for potential GHG storage formations and potential GHG injection sites, within the designated permit area.

An assessment permit may be transitioned to a 'GHG holding lease', where a declaration of an identified GHG storage formation is made and an operator wishes to delay injection and storage activities. In other instances, following the declaration of an identified GHG storage formation, injection and permanent storage activities are subsequently authorised under a 'GHG injection lease'.

The award of an injection licence entitles the holder to inject a GHG substance into an identified GHG storage formation within the licence area, provided that the injection well is situated within the licence area. The licence authorises the permanent storage of the injected GHG, as well as the equivalent rights to exploration and appraisal activities, which are afforded under either an assessment permit or a holding lease. Similar to all other forms of title under the Act, it is an offence to undertake these activities without authorisation.

Source: GCCSI.

It should be noted that as transboundary CCS project models are increasingly pursued, permitting models will span multiple jurisdictions and operators may need to consider compliance with more than one national regimes. Permitting issues for this type of projects may need to be clarified within domestic regulatory frameworks.

In the ASEAN region, where several state-owned enterprises are proposing to host CCS projects in partnership with private companies, permitting arrangements may again differ. The current situation in Indonesia offers a tangible example of how this may operate.

The Indonesian regime is distinct from other permitting regimes around the world, as CCS activities can only be conducted by a Contractor, appointed by the Ministry of Energy and Mineral Resources to carry out exploration and exploitation in a designated working area. This arrangement stems from the current model governing oil and gas resource exploration and production activities. Indonesia's oil and gas legislation, mandates that the state is responsible for these activities, and the country has established a system where private domestic oil companies earn the right to explore and produce oil and gas resources from the government by entering into cooperation contracts. The contracts represent a form of production-sharing agreement involving both state and private parties and that is beneficial to the Indonesian government.

Similarly, in the context of CCS projects, a Contractor, who is defined as a business entity, or permanent establishment, is authorised to conduct exploration and exploitation activities pursuant to a Cooperation Contract, which must be obtained from the Ministry of Energy and Mineral Resources. The state parties that are involved in a Cooperation Contract are SKK Migas and BPMA. A Contractor is also able to enter into a cooperation agreement with a third party to carry out CCS activities within a designated Working Area, subject to approval from SKK Migas and BPMA (Ashurst, 2023).

Under a Cooperation Contract, Contractors must propose a plan detailing how CCS and CCUS activities will be carried out within the designated working area (covered by a field development plan). The plan should include an assessment of the technical, economic, operational, safety and environmental and closure aspects of the proposed CCS or CCUS project.

As an approved proposal will lead to an amendment to the Cooperation Contract, Contractors through SKK Migas and BPMA may submit a proposal on the amendment to the Cooperation Contract for approval to the Ministry of Energy and Mineral Resources. If approved, the Cooperation Contract or field development plan covering the designated working area for the CCS or CCUS project will be amended.

Indonesia's permitting framework applicable to CCS projects is an example of a further layer within the permitting process and coordination with a variety of stakeholders, both public and private. This model, established in accordance with Indonesia's domestic oil and gas regime, centres around state ownership of oil and gas resources and the involvement of state-owned enterprises in CCS projects.

In other countries in the region where state-owned enterprises will be involved in advancing the technology, such as Malaysia and Thailand, permitting models may also need to be adapted to reflect the government's involvement.

3.6.4. Core Legal and Regulatory Issues Across the CCS Project Lifecycle – the Institute's Model

The Institute's interviews and research have been used in the development of the regulatory model, which is set out in Figure 3.3. The structure of the model and the issues that it addresses, reflect the feedback and experiences of multiple stakeholders from across the ASEAN region. It should be noted, however, that the requirements of national regulators and wider policy objectives may ultimately see this model modified to reflect individual jurisdiction's circumstances and preferences.

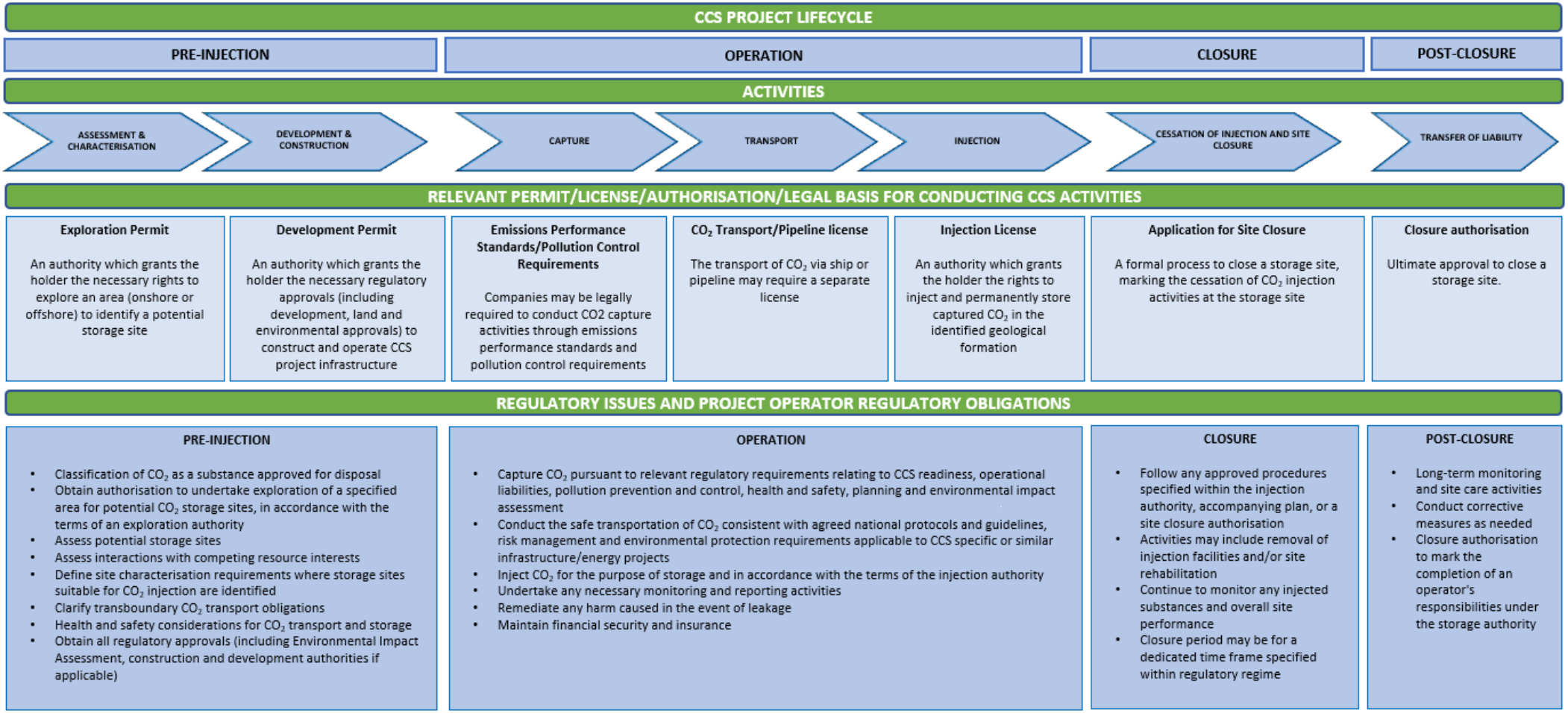
The subsequent sections of this report will examine at a high-level, the core legal and regulatory issues to be addressed in a CCS-specific legal and regulatory framework under the following four phases of a CCS project lifecycle, as depicted in Figure 3.3:

1. Pre-injection (assessment and development)
2. Operation
3. Closure
4. Post Closure

The discussion of regulatory issues under each phase provides an overview of the issue under consideration, together with examples of how it has been addressed within legal and regulatory regimes developed to date.

Where relevant, and for the purpose of illustration, approaches to the regulation of the issue in the ASEAN region are also provided. Significant gaps in national or regional legislation are also highlighted for the purpose of examination and review by national authorities. Key messages and priority actions for regulators in the region for the development of national regulatory frameworks addressing the aspects discussed under each phase.

Figure 3.3. The Regulation of the CCS Project Lifecycle



Source: GCCSI.

3.6.5. Pre-Injection

The pre-injection phase of a CCS project comprises the stage prior to the commencement of CCS operations. During this phase, proponents will likely undertake assessment activities aimed at determining the capacity and suitability of potential storage sites, as well as the planning and construction of necessary project infrastructure.

The following sections will explore these individual issues in greater detail.

3.6.5.1. Classification and Purity of CO_2 Streams

The classification of CO_2 within existing legislation is an important initial consideration for determining whether there are any specific legal obligations applicable to CCS projects. In instances where captured CO_2 is to be treated as a waste or a hazardous material, obligations applicable to waste management projects and environmental protection are likely to be triggered. A failure to adequately address this issue may subsequently obstruct or delay the authorisation and operation of CO_2 storage activities. To provide clarity, several jurisdictions, including the United Kingdom and United States, have formally excluded CO_2, captured for the purpose of geological storage, from their wider definitions of wastes or pollutants.

The composition of CO_2 streams for storage, is a further important consideration, particularly where these streams may contain or collect impurities during the capture, transport or injection phase of a CCS project. Several CCS-specific legal and regulatory frameworks address this issue by providing a qualitative definition for the CO_2 that will subsequently be injected into a CO_2 storage site.

In Australia, the Commonwealth's offshore Act defines the composition of greenhouse gas substances as '*carbon dioxide or a prescribed greenhouse gas in a gaseous or liquid state, or a mixture of carbon dioxide, any prescribed greenhouse gas substances and incidental greenhouse gas related substances*', so long as the mixture consists '*overwhelmingly*' of either or both carbon dioxide and the greenhouse gas substance prescribed in the legislation. A further definition of the term overwhelmingly has not been provided.

Under the EU CCS Directive, there are no technical specifications for the purity of the CO_2 stream. The legislation provides that '*a CO_2 stream shall consist overwhelmingly of carbon dioxide*'. A CO_2 stream may, however, contain incidental associated substances from the source, capture or injection process, or that have been added to assist in monitoring and verifying CO_2 migration. The concentrations of these incidental or added substances must remain at levels that ensure the integrity of storage operations and prevent risks to the environment and human health.

In the US, there is no uniform definition of CO_2 at either the federal or State levels, however there is generally some attempt to define the term. The Final Rules for Class VI

Wells promulgated under the federal Underground Injection Control (UIC) Program[4] define 'carbon dioxide stream' as '*carbon dioxide that has been captured from an emission source, plus incidental associated substances derived from the source materials and the capture process, and any substances added to the stream to enable or improve the injection process*'. The stream may also contain trace substances that have been added to assist in monitoring and verifying the CO_2 migration post-injection.

Amongst the ASEAN nations, Indonesia is currently the only nation that has developed a definition for CO_2 in the context of CCS operations. Within the new regulatory framework, CO_2 is covered under the definition of a greenhouse gas and is referred to as CO_2 captured from upstream oil and gas business activities and other industries. In contrast, in Viet Nam, CO_2 is regarded as a dangerous substance and there are currently strict requirements regarding its transportation via inland waterways and roads.

3.6.5.2. Ownership of the Pore Space within CO_2 Storage Sites

In many jurisdictions interests in the subsurface (including the pore space) are formally owned by the State, however, in several others the ownership and access rights are far more complex. As a result, it has proven critical for operators to determine property interests at a storage site, to acquire the necessary surface and subsurface rights for injecting and storing CO_2 in a particular geological formation. Regulators and policymakers in several jurisdictions have now introduced provisions within their CCS-specific frameworks, aimed at addressing this issue.

At the federal level in the United States, the Underground Injection Control programme does not cover pore space ownership. The federal Environmental Protection Authority (EPA) has clarified that property and land ownership rights are beyond the scope of its jurisdiction, and the Class VI UIC Program Regulations clearly state that a permit issued under the regulations do not operate to convey property rights. Consequently, property rights relating to CCS operations have typically been a matter addressed by the individual US states. Subsurface ownership of property rights varies from state to state, with different parties owning the pore space and mineral estates. In Montana, Wyoming and North Dakota, for example, legislation provides that ownership of the pore space is vested in the owner of the surface estate. As a result, provision is made for the leasing or transfer of pore space as a separate property interest from the surface(Jacobs & Craig, 2017).

In contrast to the complex system of ownership in the United States, policymakers and regulators in some jurisdictions have resolved the issue by declaring that ownership of

[4] The UIC Program regulates 6 types of underground injection wells, with Class II and Class VI wells being the most relevant in the context of CO_2 injection. Class II wells are used to inject fluids associated with oil and natural gas production and include wells used for enhanced recovery of oil and natural gas. Class VI wells are those used to inject CO_2 into underground geological formations for the purpose of long-term storage.

the pore space is formally vested in the state. This approach had been adopted in the Canadian Province of Alberta and the Australian state of Victoria.

In the ASEAN region, countries have yet to formulate a clear legal and regulatory position regarding pore space ownership in the context of CCS projects. Several nations, however, implicitly grant ownership of the geology of the subsurface to the State. In Indonesia, for example, there is no uniform provision clarifying ownership status, however, the constitution vests ownership of the land, water, and natural resources of Indonesia with the state. The use of subsurface areas also requires authorisation from the relevant statutory authority. Furthermore, the State is the ultimate owner of minerals and coal, and land titles do not give holders of the land any rights to minerals or coal located on or under the land.

A similar position may be found in Malaysia, where ownership of resources or land is allocated to the state or state entities under various legislative provisions. For example, Malaysia's Petroleum Development Act 1974 grants Petronas the exclusive rights to explore, exploit and obtain petroleum, whether onshore or offshore in Malaysia. Under this broad grant, Petronas' Production Management Unit exercises ownership of property rights associated with oil and gas exploration and production fields, by granting exploration and production rights through production sharing contracts. Similarly, under the Continental Shelf Act 1966, all rights to the exploration of the continental shelf and the exploitation of its natural resources are vested in Malaysia and exercised by the federal government.

Formally addressing these issues will be critical for the regulation of CCS activities, and in particular storage resource assessment, site development and CO_2 injection operations. In some instances, it is necessary for operators to formally acquire the surface and subsurface rights to undertake their proposed activities. In Australia, for example, where there is state ownership of the pore space, the Commonwealth's offshore legislation includes a formal application process to release offshore areas to potential operators. Under this 'acreage release' model, proponents are granted an opportunity to apply for a permit that will enable them to explore an area for permanent offshore storage locations.

Clarifying these rights also enables operators to evaluate impacts on other resource interests and take appropriate risk mitigation steps, in the event that injected CO_2 migrates within the subsurface. Liability for CO_2 during the operational phase of a project will normally remain with the operator of a site, who must have a right to store in the subsurface formation into which the CO_2 is being injected.

3.6.5.3. Ownership or Title to Stored CO_2

The movement of CO_2 across the CCS value chain also raises the issue of ownership or title to the CO_2, particularly where there are distinct entities involved in the capture, transport, and storage aspects of a project. Determining the nature of this ownership

will be significant, for it will impact wider issues such as monitoring, reporting and verification obligations, and long-term liability (International Energy Agency, 2022).

In many instances, it is likely that ownership of CO_2 will be determined through commercial contracts between the operator of a storage or transport facility and the capture facility; however, regulatory frameworks may also play a role in determining this ownership. Where CO_2 injection activities are authorised under a CCS-specific permitting model, the permit conditions may clarify ownership obligations for the stored CO_2 during the operational phase of a project. In many instances, it is the operator of a storage facility, or the holder of an injection permit that is responsible for any CO_2 that has been injected and subsequently stored. Some jurisdictions also allow for the transfer of ownership of the CO_2 to the state, upon the closure of a project.

The issue of ownership or title to the CO_2 remains unaddressed in the ASEAN region, including in Indonesia which has established a CCS-specific regulatory framework.

3.6.5.4. Authorisation to Conduct Assessment for Potential CO_2 Storage Sites

Under a CCS-specific regulatory permitting model, an operator seeking to undertake exploration activities to identify a potential CO_2 storage site, will typically be required to obtain an exploration authorisation. In many instances, this step will be similar to the processes used for the permitting of oil and gas exploration activities and which may be found in many petroleum licensing regimes. Like these regimes, the application process for obtaining a CCS-specific authorisation may require operators to demonstrate their technical and financial capabilities, as well as provide detailed plans regarding their proposed activities.

The grant of an exploration authorisation may be made subject to particular conditions or a specified timeframe. It is likely that the authorisation will specify a designated area for operations. In some instances, parties seeking to undertake storage operations may be required to possess an exploration permit, prior to applying for an injection or storage authorisation.

The Australian federal government's offshore regime requires an operator, seeking to undertake exploration for a potential storage site in Commonwealth waters, to obtain a 'GHG assessment permit'. The permit enables the holder to conduct exploration activities for potential GHG storage formations and potential GHG injection sites, within the designated permit area. Similar provisions are to be found in the European Commission's CCS Directive, which has created an exploration permit to regulate the investigative activities necessary for selecting a potential storage site.

ASEAN nations may follow the same model in terms of establishing separate permits for the exploration phase of a CCS project. However, in the absence of CCS-specific legal and regulatory frameworks in many nations, it is likely that approvals for the exploration phase would be similar to the oil and gas sector. For example, in Malaysia, the Petroleum Development Act requires operators to obtain a license from Petronas for any oil and

gas exploration and production activities.

In Indonesia, a Cooperation Contract, a form of production-sharing agreement involving both state and private parties, must be obtained from the Ministry of Energy and Mineral Resources to conduct exploration and exploitation activities for CCS and CCUS projects.

3.6.5.5. Site Characterisation Requirements

Site characterisation has been identified as a critical aspect of the CCS process and early legal and regulatory frameworks afford considerable weight to this activity. Where a potential CO_2 storage site has been identified pursuant to an exploration authority, project operators are typically required to undertake detailed technical assessments of the site to determine its suitability for injection and the permanent storage of CO_2. The completion of a detailed site characterisation process is a pre-requisite in an application for a subsequent storage authority under many permitting or licensing regimes.

Several examples of these processes have been developed and the assessment of CO_2 storage resources will ultimately involve a variety of discrete technical activities[5] including but not limited to:

- Geophysical data acquisition, encompassing 2D and 3D seismic surveys, gravimetric surveys, and Controlled Source Electro-Magnetic (CSEM) Surveys
- Drilling appraisal wells and injectivity tests
- Comprehensive core analysis programme, including porosity and permeability measurements, MICP, XRD, rock mechanics, SCAL, and RCAL analysis
- Well log analysis
- Fluid data analysis
- Subsurface modeling

Where a suitable storage site has been identified pursuant to a GHG Assessment Permit, awarded under the Australian government's offshore regime, a project operator may apply to the Minister for a declaration of an identified GHG storage formation. For this declaration to be granted, applicants will be required to demonstrate that the formation meets the requirements of an 'eligible storage formation'. The criteria for determining whether a storage site is an eligible storage formation are set out in the Act as 'Fundamental suitability determinants', and they cover a range of data points relating to the geological characteristics of the storage formation.

The EU CCS Directive also specifies criteria that are to be used for selecting suitable storage sites, and for ensuring that the sites selected for CCS activities do not pose any

[5] The site characterisation workflow is defined based on project technical and regulatory needs. In Australia, the high-level site characterisation workflows for existing CCS projects, such as Bayu Undan and Petrel CCS projects (Titles G-11-AP and G-7-AP), can be found on the National Offshore Petroleum Titles Administrator website.

risk of leakage or damage to the environment and human health. Annex I to the Directive sets out the criteria to be used for the characterisation and assessment of the potential storage complex and surrounding area. The Commission Guidance Document (GD2), released by the Commission in 2010 to aid Member States in their implementation of the Directive, offers a more detailed perspective of the proposed approach to characterising the storage complex and the requirements and criteria set out in Annex I of the Directive (Publications Office of the European Union, 2012) .

In the ASEAN region, Indonesia's MEMR 2/2023 establishes a host of geological and technical requirements relating to the locating of CO_2 storage sites, within the areas designated as 'Injection Target Zones'[6]. In addition, when applying for a Cooperation Contract to conduct CCS activities, contractors are required to submit an assessment of the geology, geophysics, and reservoirs, in addition to the engineering, safety, environment, evaluation and risk mitigation aspects of transport, storage and injection operations.

In other parts of the region, the absence of CCS-specific frameworks means that there are no CO_2 storage specific site characterisation requirements. However, it should be noted that as many of these countries have established oil and gas industries, subsurface information is already required under permitting regimes applicable to oil and gas exploration and exploitation activities. Assessments of CO_2 storage sites are largely similar to oil and gas resource assessments, and subject to amendment, the requirements within existing oil and gas legislation may be adapted to permit CO_2 storage site exploration activities.

Imposing detailed site characterisation and selection requirements is a key risk management strategy employed by regulators to minimise risks associated with the technology. A comprehensive regulatory framework will require the collection of key details relating to the geological characteristics of the storage site to inform not only storage site selection, but also the construction and operation of infrastructure and facilities associated with the project. International guidance and best practice relating to CO_2 storage, such as relevant ISO standards may provide a reference point for establishing detailed site characterisation requirements.

3.6.5.6. Construction and Development Requirements

The construction and development phase of CCS projects may require separate permits and approvals, depending upon the nature and location of the proposed facility. These approvals may be in addition, or complementary, to the existing environmental, planning, construction, and zoning requirements found in federal, state and local government regulations.

[6] Injection Target Zones include both hydrocarbon reservoirs and saline aquifers.

In Australia, the Commonwealth's offshore Act includes detailed provisions governing the construction and operation of pipelines and infrastructure in Commonwealth waters. A pipeline license will specify the design, construction, size and capacity of the pipeline, its route, and position in relation to the seabed. A further license issued under the Act, authorises the construction and operation of infrastructure facilities associated with greenhouse gas storage activities. The Act and secondary legislation, set out detailed application procedures for both licenses.

Examples of well construction requirements may also be found in the United States. The EPA's Underground Injection Control (UIC) Program's requirements for Class VI wells include requirements for injection wells to be cased and cemented, to prevent the movement of fluids into or between underground sources of drinking water. The casing and cement, used in the construction of each newly drilled well, is required to be designed for the life expectancy of the well. Wells must meet specific tolerance standards and use materials that will be compatible with fluids (in this case, the CO_2 stream) with which the materials may be expected to come into contact.

Current legal and regulatory frameworks in ASEAN nations do not address the design and construction phases of a CCS project. In the absence of specific provisions, wider national legislation relating to the environment, health and safety may be deemed applicable, which in turn may require projects to be designed and constructed in a specific manner. In Indonesia, for example, there are currently no specific requirements relating to design and construction of CCS projects. Regulation MEMR 2/2023, however, imposes various health and safety obligations on project operators, such as safety checks and monitoring requirements with the aim of preventing harm to the environment and human health. By implication, this requires the construction of projects in a manner that assures these objectives.

3.6.5.7. Environmental Impact Assessments

A regulatory framework governing CCS projects may require project operators to conduct dedicated environmental impact assessments (EIA), as a means of systematically evaluating and mitigating risks stemming from the potential effects of proposed CCS activities. These may reflect or be in addition to environmental impact assessment requirements under wider national environmental legislative and regulatory frameworks imposed on similar large infrastructure projects. Typically, EIA requirements mandate the identification of local and regional environmental impacts, as well as the approaches or measures necessary to minimise these impacts.

Examples of how EIA requirements may be applied to CCS operations, can be found in Europe and in the United States. In Europe, the CCS Directive amended the existing legal regime governing EIA, to integrate CCS activities within its scope. As a result, formal EIA assessments will be required as part of the planning process for CCS operations. In line with the provisions of EU law, this obligation has been transposed into the domestic laws of the EU Member States.

In the US, where there is no federal framework for environmental impact assessments for CCS projects, the White House Council on Environmental Quality released new guidance to promote the responsible development and permitting of CCUS projects. Elements included within this guidance include a focus upon facilitating federal decision making on CCUS projects and CO_2 pipelines, public engagement, understanding of environmental impacts, and carbon dioxide removal (The White House, 2022; US Federal Register, 2022).

In the ASEAN region, Indonesia's MEMR 2/2023 provides the only example of environmental impact assessment requirements applicable to CCS projects. The new regulatory regime for CCS and CCUS projects, requires projects '*to draft mitigation and management of environmental, social and public involvement impacts in accordance with the existing laws and regulations*', which will likely bring CCS and CCUS projects under the scope of Indonesia's AMDAL process. The AMDAL process is Indonesia's own system for conducting environmental impact assessments, and involves several elements, consisting of a Terms of Reference, an Environmental Impact Analysis Report, an Environmental Management Plan and an Environmental Monitoring Plan.

The Minister of Environment decides which business or activity requires an AMDAL, based on the scope of work involved, the proximity of the development to protected zones and their potential impact on the environment. The types of businesses and activities that are required to obtain an AMDAL are set out under regulations established by the Ministry for Environment. While not explicitly mentioned within these regulations, the scope of these regulations may be extended to cover CCS and CCUs projects.

In Malaysia, the Environment Quality Act 1974 requires an EIA to be prepared in consultation with the Department of Environment, for major projects with the potential to significantly impact the environment. The DOE's guidance on EIAs emphasises the need for EIAs to prioritise the issue of site suitability and ensure that sites are developed and managed in an environmentally safe manner. Although not explicitly applicable to CCS projects, these existing environmental requirements may still apply by extension, noting the likely scale of proposed CCS operations.

The examples highlighted demonstrate that several jurisdictions already have comprehensive environmental impact assessment frameworks that may be triggered where a CCS project is to be deployed. However, the application of these requirements is not immediately clear. Clarification as to the application of these requirements to CCS projects signals a commitment to risk mitigation, supports the streamlining of CCS-specific approval processes, and provides greater certainty for project operators with regard to their compliance obligations. The inclusion of the EIA process within the broader CCS-specific regulatory framework, also demonstrates a formal policy commitment to considering the environmental, social and economic impacts of a proposed project or development.

3.6.5.8. Public Engagement Requirements

Formal pathways for engaging and consulting the public, as part of the decision-making processes associated with major infrastructure projects, are an established aspect of many jurisdictions' planning and environmental legislation. Under these regimes, operators will likely be obliged to consult the wider public on their proposed operations, in a manner and format specified by the legislation. In some instances, national or supra-national legislation governing access to environmental information, may also afford the public rights to formal engagement and consultation procedures (APEC Energy Working Group, 2012; International Energy Agency, 2022; World Resources Institute, 2008).

CCS projects, by virtue of their size and nature, are likely to meet the thresholds set out in these existing regimes and will likely be subject to the regulatory requirements governing public engagement and consultation. Several of the early CCS-specific regimes have formally recognised this approach through consequential amendments to existing legislation, and by including formal engagement and consultation requirements in their permitting pathways.

Australia, the United Kingdom, and the USA already have established public consultation and notice requirements for CCS projects. In Australia, for example, the commonwealth's Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 require greenhouse gas titleholders (CCS-specific permits or licenses) to undertake consultation with relevant stakeholders whose interests may be impacted by their activities. A report that includes a summary of all the consultations undertaken, including the merits of any objection or claim, must be submitted along with the Environmental Plan to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) during the application process for a CCS-specific permit or license.

The United States has also recently released guidance by the White House Council on Environmental Quality outlining public notice requirements for CCS projects. This guidance seeks to promote responsible development and permitting of CCS projects. The guidance from the Council on Environmental Quality (CEQ) builds upon their 2021 report on Carbon Capture, Utilization, and Storage (CCUS) and aims to streamline environmental reviews for CCUS projects. It emphasises the importance of transparent evaluations and encourages agencies to conduct life cycle analyses for these projects, making the findings publicly available. Additionally, the guidance stresses the early integration of environmental justice and equity considerations into CCUS project planning to safeguard communities from potential adverse effects. Tribal consultation and stakeholder engagement plans are highlighted as crucial components, with a call for continuous and meaningful engagement throughout project development. Specific actions recommended include evaluating impacts on host communities, providing comprehensive information before consultations, and avoiding additional burdens on vulnerable communities. Ultimately, the guidance aims to foster the development of CCS projects in alignment with community perspectives and that ensures climate, public

health, and economic objectives (The White House, 2022; US Federal Register, 2022).

Formal public consultation and engagement requirements for CCS operations are currently absent in the ASEAN region. Like other jurisdictions, however, these requirements may be extended to CCS activities under countries' wider legislative frameworks. In Malaysia, for example, formal participatory pathways are built into existing environmental and planning legislation. While there are currently no CCS-project-specific requirements, planning legislation requires state authorities to ensure that adequate opportunities are provided to the public to make representations regarding the structural plans of projects. The country's environmental legislation also requires public participation during environmental impact assessment of projects, with requirements to hold local hearings with the public when preparing detailed EIAs.

In Indonesia, as highlighted previously, there are currently no public consultation requirements for CCS and CCUS projects. However, activities and businesses that undertake the AMDAL process are required to engage the public, which is defined to include a broad range of stakeholders that may be impacted by the proposed activities.

3.6.5.9. Clarification of Obligations where There are Interactions with Existing Resource Interests

The CCS value chain involves infrastructure facilities and operations that span large geographical areas, both onshore and offshore. Inevitably, these operations will interact with a variety of pre-existing interests on the surface and subsurface, including other resource and industry interests. CCS-specific legal regimes may be required to resolve potential conflicts of interest and provide for the co-existence of CO_2 storage activities with these pre-existing interests. In the ASEAN region, CCS activities are anticipated to take place in areas currently utilised by the oil and gas industry and will likely involve the re-use of infrastructure and facilities for CCS operations. CCS operations will likely give rise to a plethora of interests that will require regulatory frameworks to provide coordination and conflict resolution (Global CCS Institute, 2019; International Energy Agency, 2022).

The Australian Commonwealth's offshore regime is illustrative of how these potential conflicts can be managed. Statutory titles to conduct CO_2 storage and petroleum activities, may be granted over areas where there are CO_2 titles or petroleum titles already in force. The management of these interests is carefully managed within the regime, and the impact on petroleum exploration and production activities is considered. The legislation distinguishes between two types of petroleum titles: pre-commencement petroleum titles and post-commencement petroleum titles. Pre-commencement titles are titles that were in existence before the CCS-specific amendments to the commonwealth Act came into effect in November 2008, while all other subsequent titles are post-commencement titles.

Where a potential conflict arises between a proposed CO_2 title and a pre-commencement

petroleum exploration title, the Minister assesses whether the grant of the CO_2 title will have a 'significant risk of a significant adverse impact (SRSAI)' on the pre-commencement title. Where a risk is likely, the CO_2 title will not be approved. Alternatively, the Minister will also consider if there is a commercial agreement between the two titleholders before granting approval.

In the case of a later conflict, at the stage of granting a CO_2 injection license or a post-commencement title, the Minister will decide which activity should proceed based upon the public interest. However, once post-commencement titles have been granted, the Minister will apply the SRSAI test to determine whether a CO_2 title should be granted in respect of the conflicting area.

3.6.5.10. Transboundary CO_2 Storage Considerations

With government and industry across the ASEAN region increasingly pursuing opportunities to collaborate on regional CO_2 transport and storage projects, the resolution of legal and regulatory issues governing the operation of these activities will be critical. It will be important to ensure that issues of international and national law are addressed in a timely manner and that project proponents, policymakers and regulators have confidence in the regimes developed. Section 5 of this report provides a detailed examination of issues associated with transboundary operations.

With the conclusion of formal agreements between nations, and the development of national regimes to regulate storage activities, many issues will eventually be managed as part of the CCS permitting regime. At present, however, and in the absence of clear legal and regulatory frameworks for these operations, there are several elements and preliminary issues that are currently to be considered in the pre-injection phase. Examples of these issues include but are not limited to, bilateral agreements between nations, the allocation of liabilities for accidents and leakages, the reporting and accounting of transferred CO_2, transboundary environmental impacts and dispute resolution mechanisms.

KEY MESSAGES

- The pre-injection phase of a CCS project refers to the period prior to the commencement of CCS operations and will require regulatory approvals for conducting a variety of preparatory activities.
- Project proponents will typically be required to secure the relevant authorisations for exploration, construction, and development activities.
- Operators and regulators will be required to consider property issues relating to ownership of/access to pore space in the subsurface, as well as the classification of CO_2 and title to the CO_2 stored.
- CCS-specific regimes also include provisions governing site selection and characterization, and environmental impact assessments, with the aim of assuring the safety and permanence of CO_2 storage operations.
- The interaction between CO_2 storage operations and current or future petroleum activities, must be carefully considered.
- Legal and regulatory issues will arise in the context of transboundary project models, which will trigger obligations under international, regional, and national regimes. The absence of clear legal and regulatory frameworks for these operations, within international and national law, suggests this issue is addressed in the pre-injection phase and prior to operation.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Determine how captured CO_2 is to be treated within domestic legal frameworks. Consider the necessity of excluding it from the scope of current waste management legislation.
- Establish guidelines or standards regarding the purity and composition of CO_2 streams.
- Clarify and define ownership rights over subsurface geological formations and the pore space, potentially through legislation or regulatory amendments.
- Develop site selection and characterisation requirements to ensure that CO_2 storage sites are suitable for the safe and permanent containment of CO_2. Consider the need for secondary guidance to assist project developers in their interpretation of these requirements.
- Engage with regulators and policymakers in the region to support the development of a consistent approach to the transboundary movement of CO_2.
- Ensure that these activities and requirements are adequately captured within a domestic permitting framework.

3.6.6. Operation

The operation phase of a project refers to the period during which a CCS project is fully operational, and capture, transport and injection activities are being undertaken. Under a phased approach to permitting, similar to the one proposed in this report, an operator seeking to undertake storage activities will be required to obtain a specific storage authorisation when they transition from the pre-injection phase, through to this

operational stage.

During this phase, CCS-specific regulatory frameworks, as well as broader legislation, will impose a wide variety of obligations upon an operator, relating to the capture, transport, and storage elements of the CCS value chain. Operators will be required to undertake specific tasks including, for example, monitoring, reporting and verification activities and the remediation of any damage caused by their operations.

3.6.6.1. CO_2 Capture

When developing early CCS-specific legal and regulatory regimes, regulators and policymakers have in many instances chosen to focus exclusively upon regulating the storage aspect of the CCS process. The decision to focus upon this element has been a deliberate policy choice, and indicative of the view that existing legislative instruments will adequately manage the capture element of the process. To this end, operators will need to comply with a range of regulatory obligations found within existing domestic laws and regulations governing industrial activities.

An example of this approach may be found within the European Union, where the CCS Directive made consequential amendments to existing EU environmental legislation, to address the risks associated with the capture process. A consequential amendment to the EU's Industrial Emissions Directive (IED) now enables national authorities to regulate CO_2 capture activities, in accordance with this Directive. Capture plant operators will be required to obtain and operate in accordance with a permit, to achieve the aims of the Directive. Public consultation requirements are also included within the Directive, and operators are required to use best available technology for capture activities (Odeh & Haydock, 2009).

The CCS Directive also made amendments to the Environmental Impact Assessment (EIA) Directive, to require that an EIA be undertaken for the capture aspect of the CCS process. Operators are obliged to undertake environmental impact assessments, as a part of the capture permitting process.

Within the ASEAN region, policymakers, regulators, and project proponents will likely be familiar with the application and operation of similar regimes, which are well-established in the context of other major industrial and infrastructure activities. Regulators may consider issuing guidance on the application of these frameworks to the capture phase of projects.

3.6.6.2. CO_2 Transport

Similar to the approach adopted to the capture aspect of the CCS process, many policymakers and regulators have chosen to regulate the transportation element under existing domestic regulatory frameworks. To this end, few of the CCS-specific regulatory models developed to-date, include detailed provisions governing the transport aspect of the CCS process.

The compression and transport of CO_2, as part of a CCS project, are likely to be governed by a variety of wider pipeline, health and safety, planning and environmental legislation. This legislation will aim to ensure the safe transportation of CO_2, in a manner consistent with both national protocols and guidelines for CCS-specific operations, and for similar infrastructure and energy projects. Regulatory frameworks also establish risk management systems for CO_2 transport activities.

For CO_2 transportation by pipeline, broader domestic legislation typically specifies requirements for the permitting, design, construction, testing, operation, maintenance and repair of pipelines. The Australian commonwealth's offshore regime, for example, includes detailed provisions applicable to infrastructure development and pipeline construction and operation in Commonwealth waters. The Act establishes an offence for conducting activities without the correct authorisation(s) and sets out procedures for obtaining infrastructure and pipeline licences. Operators of CO_2 pipeline operations, operating within territories covered by this Act, will be required to comply with these provisions.

In the case of transportation of CO_2 by ship, environmental and maritime health and safety legislation governing the transportation of substances, together with existing requirements for maritime operations, will all likely apply.

3.6.6.3. Authorisation of Storage Activities

CCS-specific legal and regulatory models, which establish a lifecycle permitting regime for conducting CCS activities, typically require a project operator to be granted a storage authorisation (e.g. a licence or permit) to begin CO_2 injection operations. Under many of these legal and regulatory frameworks, a storage authorisation may only be granted where the operator has identified and successfully characterised a suitable storage site, in accordance with the technical screening criteria established within legislation.

Under the Australian commonwealth's offshore Act, the operational phase of a CCS project is managed through the grant of a greenhouse gas (GHG) injection licence. The award of an injection licence entitles the holder to inject a GHG substance (in this instance a CO_2 stream), into an identified GHG storage formation within the licence area. Similar to all other forms of title under the Act, it is an offence to undertake injection and storage activities without first being granted the licence.

Similarly, under the EU CCS Directive, where a suitable storage site has been identified and successfully characterised, a potential operator may apply for a storage permit. A storage permit authorises the injection of CO_2 into geological formations for the purpose of permanent storage.

Currently, in the ASEAN region, separate pathways for permitting CO_2 storage activities have only been established in Indonesia and in the state of Sarawak in Malaysia. As discussed previously, in Indonesia, CO_2 storage is permitted under a Cooperation Contract, obtained from the Ministry of Energy and Mineral Resources. In Sarawak, in

Malaysia, CCS projects will be required to obtain a 'carbon storage license' to develop and operate a project. A carbon storage license may be obtained by any petroleum operator, any person undertaking any industrial activity or any storage user who desires to use the storage site, regardless of whether the CO_2 to be injected by the person is obtained within or outside Sarawak.

3.6.6.4. Development of Plans

When applying for a storage authorisation, applicants are required to prepare and submit a range of plans and information that details how they will manage their operations. These plans may address a range of issues relevant to the operation of a project, including monitoring arrangements, and details of the proposed corrective measures to be taken where there are risks posed to human health or the environment. Often, the plans submitted by applicants will be required to satisfy specified criteria, set-out in the relevant legislation. Regulatory frameworks will also require the relevant regulatory authority to approve the content of these plans, prior to the formal grant of a storage authorisation.

The preparation of a series of plans, which set out how an operator will manage the operation and eventual closure of a storage site, is an important element of the CCS Directive's permitting model. These plans will describe monitoring arrangements, as well as details of the proposed corrective measures to be taken in the event of a leakage, and the proposed course of action for the period following the closure of the storage site.

The Directive requires an iterative approach to regulation and operators will be required to review and update their plans and processes frequently, throughout the lifetime of a project. Operators will need to reflect relevant changes to the assessed risks to the environment and human health, new scientific knowledge, and improvements in best available technology in these plans.

Information Requirements in the Preparation of Plans: Regional Examples

A distinct feature of the Indonesian regime is the requirement that CCS activities can only be conducted pursuant to a Cooperation Contract. To obtain a Cooperation Contract, Contractors appointed by the Ministry of Energy and Mineral Resources must prepare a proposal and implementation plan in accordance with the requirements set out within MEMR No. 2 of 2023, which includes details relating to the implementation of:

- environmental and social impact assessments,
- engineering, procurement and construction processes,
- commissioning of CCS and CCUS operations,
- operation safety management,
- environmental management,
- emergency response activities,
- repair and maintenance,
- monitoring and verification and
- closure of a project.

In the Malaysian state of Sarawak, which has established the Sarawak CCS Rules, a storage user permit enables a storage user (an entity who is not the holder of a carbon storage license) to use the site.

The application for a storage user permit has detailed requirements, including a requirement to submit a storage development plan that includes various details about the stakeholders and nature of the project.

Source: Regulation No. 2 of 2023 on the Organization of Carbon Capture and Storage (CCS) and Carbon Capture, Utilization and Storage (CCUS) for Upstream Oil-and-Gas Business Activities (MEMR 2/2023), Indonesia and Land (Carbon Storage) Rules 2022, Sarawak Government Gazette.

Source: GCCSI.

3.6.6.5. Monitoring, Reporting and Verification Requirements

Monitoring of the CO_2 storage site is a further important aspect of the operational phase of a CCS project. Regulatory requirements for conducting monitoring activities are aimed at ensuring that the behaviour of the CO_2 plume is in-line with predicted models and there is permanent containment of the injected CO_2, with minimal risk of leakage. An effective monitoring regime is also imperative for ensuring the climate change mitigation benefits of the CCS process are realised.

Many of the CCS-specific regulatory frameworks also require project operators to report the results of their monitoring activities. Reporting requirements are a means of managing the risks of geological storage, with operators obliged to report any incidents or imminent threats, of leakage or environmental harm. Some jurisdictions, however, have also established reporting requirements as a means of tracking and verifying

greenhouse gas reductions that have been delivered through CO_2 storage activities.

An example of comprehensive monitoring and reporting requirements can be found within the US federal Underground Injection Control Program's requirements for Class VI Injection wells. The requirements include minimum technical criteria applicable to the monitoring of the CO_2 storage site. The purpose of these monitoring criteria is to ensure that CO_2 injection activities are operating as permitted and are not endangering underground sources of drinking water (USDWs). Project operators of Class VI wells are also required to comply with certain reporting requirements annually, when conducting CO_2 injection and sequestration activities under the federal Environmental Protection Agency's Greenhouse Gas Reporting Program (GHGRP).

The Storage Directive requires operators to undertake monitoring of their injection facilities, the storage complex, and where appropriate the surrounding environment. Monitoring is to be commenced on the basis of the operator's monitoring plan and is to be undertaken with a view to ascertaining:

- A comparison between actual and modelled behaviour of the CO_2
- 'Significant irregularities'
- Migration of the CO_2
- Leakage of CO_2
- Significant adverse effects upon the surrounding environment
- Effectiveness of any corrective measures undertaken
- Updating the assessment of the safety and integrity of the storage complex.

An operator will be required to submit to the national authority, on at least an annual basis, the results of its monitoring activities. As part of this reporting obligation, the operator will also provide details on the 'quantities and properties' of the injected CO_2 streams.

Within the ASEAN region, monitoring and verification requirements may be found in Indonesia's CCS-specific regulatory regime. Operators are required to prepare a monitoring, verification, and reporting plan at the pre-implementation phase of the project, covering all stages of the project, from planning through to post-closure. There are also requirements in relation to measuring, reporting, and verifying the emissions reduction contributions of projects and utilisation of the economic value of the carbon.

3.6.6.6. Corrective Measures and Remediation Measures

Scientific models of the CCS project risk profile, suggest that risk rises throughout a project's injection phase, before reducing considerably as pressure in the storage site reaches its maximum when injection stops. Consequently, the CCS-specific regimes developed to-date have incorporated a variety of measures aimed at managing and reducing risks throughout the project lifecycle.

The US federal UIC Class VI Injection Well Rule, includes provisions requiring owners or operators of Class VI wells to perform corrective action on all wells in the 'area of review'[7] that are determined to require corrective action. An owner or operator of a well is to submit a corrective action plan, which details how these activities will be conducted and the actions that will be undertaken prior to injection. Operators must also submit an emergency and remedial response plan describing actions that will be taken to address movement of the injection or formation fluids that may cause an endangerment to underground sources of drinking water (USDWs) during the construction, operation, and post-injection site care periods. In the event that CO_2 injection poses any threat of endangerment to USDWs, the rule requires operators to implement their response plan and notify the UIC Program Director within 24 hours.

The United Kingdom's regime, which implements the requirements of the EU CCS Directive, also requires an operator to take any necessary corrective measures, as well as those necessary for the protection of human health. These measures are to be undertaken in instances where a significant irregularity or leakage has been detected. The measures must include at least those set out in the corrective measures plan, which is to be submitted as part of the application for a storage permit.

In the ASEAN region, only Indonesia has introduced provisions aimed at addressing this issue. The nation's new Regulations require operators to consider mitigation and risk management responsibilities as part of their application process for a Cooperation Contract to conduct CCS activities. Once a Cooperation Contract has been awarded, a contractor is required to undertake a risk assessment to identify the risks that may arise from the failure of the injection and storage activities and determine how these risks will be mitigated.

In the absence of CCS-specific provisions, regulatory requirements applicable to oil and gas operations and environmental protection may be applicable to CCS projects. In many jurisdictions, operators of industrial operations may be required to take all reasonable measures to prevent pollution or damage to the environment, in the event of an incident.

3.6.6.7. Liability During the Project Period

Liabilities arising during the injection phase of a project are referred to as operational liabilities. During this phase, where storage activities are undertaken in accordance with a CCS-specific permit or license, operators will bear a liability in the form of compliance obligations that are imposed under these authorisations. In addition, and distinct from the enforcement powers to be exercised by an authority in instances of a breach of a permit or licence, administrative liabilities will be borne under a jurisdiction's wider environmental legislation. Where operating in a common law jurisdiction, operators will

[7] The region surrounding the geologic sequestration project where underground sources of drinking water may be endangered by the injection activity.

also be liable for any damages to the interests of third parties, that are the result of their operations.

The Australian commonwealth's offshore licensing regime imposes statutory liabilities upon an operator, where a GHG injection permit or licence is granted under the Act. Under these authorisations, an operator will be required to ensure that environmental protection and public health standards are maintained throughout the lifetime of a project. Operators will also be obligated to take action to prevent or remedy a serious situation.

Similar provisions are found in the United Kingdom's regulatory regime, where several duties are imposed upon a storage operator, when in possession of a valid storage licence. Once awarded, an operator will bear a number of obligations in relation to the injection of CO_2, including, monitoring, the reporting of leakages and significant irregularities and undertaking corrective measures where necessary.

In the ASEAN region, Indonesia's permitting process establishes clearly defined responsibilities for the project operator at each stage of the CCS project lifecycle. Proponents are required to prepare a proposal and implementation plan in accordance with the requirements set out in the regulations, which includes implementation of operation safety management, environmental management, emergency response activities, repair and maintenance and monitoring and verification. The operator is required to obtain approval on the management of these considerations from the Ministry of Energy and Mineral Resources. Once approved, these considerations are incorporated within the Cooperation Contract[8] that authorises CCS activities. Project operators are responsible for ensuring compliance with these requirements once they are part of the Cooperation Contract.

[8] As explained in Section 3.6.3, in the Indonesian regime, CCS activities can only be conducted pursuant to a Cooperation Contract that is to be obtained from the Ministry of Energy and Mineral Resources.

KEY MESSAGES

- The operational phase of a CCS project should be underpinned by a regulatory regime that governs CO_2 capture, transport, and storage activities.
- Examples from current regulatory frameworks demonstrate that countries have chosen to adapt or enhance a variety of existing regulatory regimes to regulate these activities. Legislation governing oil and gas and resources operations, environmental protection, property, planning, health and safety, and pollution control, may all have an impact upon CCS operations.
- Key issues to be prioritised during this phase of a CCS project, include the authorisation of injection activities, risk management measures such as the preparation of plans relating to monitoring and reporting, corrective action, and the allocation of liability during the operational phase.
- Existing regulatory frameworks, predominantly those facilitating other industrial activities, may serve as the basis for CCS regulation in the ASEAN region. Further amendment of these frameworks will be necessary to fully address the regulatory issues posed by CCS activities.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Develop a regulatory regime aimed at facilitating the operational phase of a CCS project, including technical requirements that ensure the safe operation of capture, transport and storage activities.
- Review existing regulatory frameworks and the extent to which they accommodate the regulatory issues associated with the technology and ensure that CCS activities are sufficiently integrated within wider legal frameworks that may also be applicable.
- Develop adequate risk mitigation measures that incorporate strategies and contingency plans to address potential CO_2 leakage during the operational phase and after the closure of a project.
- Clarify project operators' responsibilities during operation and ensure clarity as to the allocation of liabilities during this phase in instances of non-compliance with regulatory obligations or in the event of any accident or leakage.
- Establish adequate monitoring and reporting procedures to ensure robust accounting verification of the stored CO_2.
- Ensure there are adequate, formal opportunities for regulators to monitor activities and ensure compliance with the regulatory framework.

3.6.7. Closure

The cessation of injection operations and the closure a CO_2 storage site, triggers various obligations for the project operator. CCS-specific regulatory frameworks typically establish procedures for undertaking the closure a CO_2 storage site, as well as clarifying the responsibilities of both operators and regulators in the period immediately following its closure.

3.6.7.1. Authorisation for Storage Site Closure

Upon the completion of injection operations, regulatory frameworks typically require project operators to obtain a formal approval to close a CO_2 storage site. An approval for site closure will usually be conditional upon the operator fulfilling various obligations, including decommissioning activities, the removal of all injection well infrastructure, and land rehabilitation. Many of these activities will be undertaken in accordance with a site closure plan, that was approved by the regulator at the time of granting a storage authorisation (APEC Energy Working Group, 2012; International Energy Agency, 2022).

Under the provisions of the Australian commonwealth's offshore Act, an operator is required to apply to the Minister for a site closure certificate where injection operations under an injection license have been completed. Once an application has been made for a site closure certificate, the Minister may direct the holder of an injection license to carry out site closure activities, including the removal of all property from the relevant area, plugging, or closing off all wells, and the conservation and protection of the natural resources in the surrender area.

The EU's CCS Directive sets out the closure and post-closure obligations of an operator and competent authority, including the process and requirements for closing the site. A storage site will be closed once an operator has completed their obligations under a storage permit, including the storage of the total quantity of CO_2 authorised under the permit. The Directive requires that an operator fulfil their closure requirements based upon a final version of the post-closure plan, which is to be prepared by the operator and approved prior to the site's closure. As part of their closure obligations, an operator is required to seal the storage site and remove the injection facilities. Significantly, an operator shall continue to remain liable for monitoring, reporting and corrective measures, pursuant to the requirements of the Directive, and for all obligations under the EU Emissions Trading Scheme (EU ETS) and Environmental Liability Directive (ELD), once the site is closed.

Indonesia's MEMR 2/2023 provides a region-specific example of a comprehensive closure regime for CCS and CCUS projects. The regulations set out several conditions that will precipitate the closure of a project, these include, where the storage reservoir has reached its capacity, sources of captured CO_2 are no longer available, and the Cooperation Contact has expired. Contractors under a Cooperation Contract are required to submit a closure plan for approval to SKK Migas and the Director managing oil and gas activities. Closure plans must include strategies to prevent damage to the environment, human health, resources and the assets of the state(Ashurst, 2023).

3.6.7.2. Well Plugging and Decommissioning Requirements

Well plugging requirements for CO_2 storage wells vary from jurisdiction to jurisdiction; however, many of these regulatory requirements have evolved from legislation governing well abandonment in the hydrocarbon and petroleum extraction industries.

A 2011 report by the IEA Greenhouse Gas R&D Programme, which reviewed 11 different regulatory regimes in Europe, Australasia and North America, concluded:

'*Generally, the regulations in place provide guidance on abandonment methods for existing wells, and although the review shows that there is always a need for a cement plug, the length of cement plug varies greatly, from a minimum of 15m in Canada, to up to 100m in some European scenarios. Other areas where variation is apparent include verification of abandoned wells, provisions made for CO_2 storage, and data availability.*(IEA Greenhouse Gas R&D Programme, 2009)'

In the Canadian province of Alberta, the Alberta Energy Regulator regulates CO_2 storage activities through the issuance of directives. Well plugging requirements for CO_2 storage wells are set out in Directive 020, which distinguishes between routine and non-routine abandonments, and prescribes requirements for both instances.

Many of the ASEAN nations have not established CCS project-specific decommissioning requirements, however, existing oil and gas legislation will likely apply.

KEY MESSAGES

- During the closure phase of a CCS project, regulatory frameworks typically establish procedures for closing a CO_2 storage site. Regulation may also clarify obligations and allocate responsibilities between various stakeholders for overseeing the site after closure.
- The responsible and safe closure of a CO_2 storage site are the focus of regulatory requirements during the closure phase. Legislation will require project operators to seek authorisation to close a CO_2 storage site upon the fulfilment of prescribed criteria and may include well decommissioning and plugging requirements.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Develop a procedure within the regulatory framework to formally authorise site closure.
- Review existing legislation relating to oil and gas exploration and production for the purpose of enhancing or adapting provisions relating to well abandonment and site closure.

3.6.8. Post-Closure

Following the formal closure of a CO_2 storage site, project operators will still be required to comply with regulatory obligations that aim to ensure the long-term safety and security of any stored CO_2. In several jurisdictions operators will retain continuing legal responsibilities for the closed storage site and will be required to undertake post-injection site care and long-term monitoring for an extended period of time. In many instances, operators will also retain a variety of liabilities under wider legal regimes.

An important feature of several CCS-specific legal and regulatory frameworks, however, is the ability of operators to transfer their responsibility for the storage site to the state, where certain conditions are met (APEC Energy Working Group, 2012; Global CCS Institute, 2019; Global CCS Institute et al., 2014; International Energy Agency, 2022).

3.6.8.1. Post Closure Site Care and Monitoring Requirements

Prior to the closure of a site, project operators are typically required to submit a post-closure monitoring plan to be approved by the relevant regulatory authority. Regulatory frameworks also require that project operators continue to monitor the CO_2 storage site following its closure, pursuant to the post-closure monitoring plan and for a specified period of time.

In Indonesia, for example, MEMR 2/2023 requires that after the closure of the storage site the operator remains liable for any leakage at the site while also being responsible for conducting post-closure monitoring and reporting activities.

The Malaysian State of Sarawak's CCS Rules require project operators to comply with a range of post-closure obligations. Amongst these, a storage user is required to monitor the storage site post-closure, in accordance with a monitoring plan and comply with reporting and notification requirements and ensure corrective measures in the face of any risks, up until the storage permit applicable to the CO_2 storage site is cancelled.

3.6.8.2. Transfer of Liability and Stewardship

The novel risks and unique aspects associated with a CCS project gives rise to many different forms of liability that a project operator may incur during and after the completion of operations. These liabilities may be allocated through the design and implementation of new CCS-specific mechanisms, however in many instances far broader obligations are likely to be borne by operators through the implicit application of a wider body of legislation and case law.

However, the significant timeframes necessitated by the permanent geological storage of CO_2 have been raised as a concern for project operators. Liability for CO_2 storage operations extending into perpetuity, potentially beyond the lifetime of a traditional corporate entity, has been raised as particularly challenging. Regulators and the public, on the other hand, have sought to ensure that the process is comprehensively regulated and that solutions afforded high levels of protection to the environment and human health(Global CCS Institute, 2019).

One approach adopted by regulators has been to adopt regulatory provisions enabling the transfer of liability for a storage site or stored CO_2, from an operator to a state's competent authority. Examples of this approach have been implemented in frameworks in Canada, Australia, and under the European Union's CCS Directive. The operation of these transfer provisions varies between jurisdictions, but all require the satisfaction of

specific performance criteria before a transfer may be affected. In many instances, the completion of a post-closure time limit will also be necessary, prior to a proposed transfer.

An example may be found in the EU CCS Directive, which provides the opportunity for operators to transfer their liabilities to the state following cessation of activities. Members States have subsequently transposed its provisions into national frameworks, resulting in a largely harmonised European approach to liability. In some Member States, notably those with strong commitments to deploying the technology, regulators have implemented models which go beyond the requirements of the Directive. The UK's transposition of the Directive is one example of this approach, with regulators adopting extensive transfer provisions that would encompass any sort of potential civil claim or administrative liability arising from a leakage, whether the leakage occurred before or after the transfer.

A critical issue in the development of any transfer regime, is determining precisely which liabilities and responsibilities are to be transferred. As highlighted in the preceding sections, an operator will bear a variety of different types of liability during the project lifecycle, and legislation will need to be clear as to which of these will be the subject of the transfer. In many instances, even following the transfer, an operator will remain liable for their operations in some form of liability.

The conditions necessary for enabling a transfer are a further significant consideration for policymakers and regulators. Many of the early regimes sets out a series of pre-conditions that have to be fulfilled by an operator and are intended to confirm the stability and integrity of the storage site. These conditions are ultimately designed to give the authorities confidence that the storage complex, including the sub-surface plume and related processes, will continue to behave in a predictable and safe manner.

Post-Closure Transfer of Liability: The Indonesian Model

Under Indonesia's MEMR No. 2 of 2023, following the satisfaction of responsibilities during the operational phase, there are certain conditions that, when satisfied, may lead to a Contractor's rights and responsibilities under a Cooperation Contract for CCS or CCUS project activities being transferred to the state. These conditions include that:

- the contractor has received a stipulation of verification results from the Director General of Oil and Gas for the completion of CCS closure activities,
- the monitoring results show no leakage,
- ground water contamination or other risks caused by CO_2 injection activities and
- the Cooperation Contract period has ended.

Following approval from the Ministry of Energy and Mineral Resources, provided in consultation with SKK Migas and BPMA, the contractor's rights and obligations for CCS or CCUS implementation in the Working Area will cease. Upon this cessation, responsibilities over the CO_2 storage site in relation to site care and supervision will transfer to the state.

Source: Regulation No. 2 of 2023 on the Organization of Carbon Capture and Storage (CCS) and Carbon Capture, Utilization and Storage (CCUS) for Upstream Oil-and-Gas Business Activities (MEMR 2/2023), Indonesia

Source: GCCSI.

3.6.8.3. Financial Security

In addition to transfer provisions, several CCS-specific regimes also include the requirement for operators to provide some form of financial security, aimed at addressing the various liabilities and anticipated costs that an operator may incur over the life of a project – including the post-closure period.

An example of an approach adopted to financial security can be found in Article 19 of the EU CCS Directive, which requires an applicant for a storage permit to provide proof by way of '*financial security or any other equivalent on the basis of arrangements to be decided by Member States*', to ensure that any obligations under the permit including closure and post-closure obligations can be met. The financial security is to be provided in advance of the grant of a permit and is to remain in place up until the point that responsibility for the storage site is transferred to the State in accordance with the Directive.

The European Commission's accompanying Guidance sets out the obligations that must be covered by the Article 19 financial security requirements. Clear from the Guidance is that the scope of financial security includes the costs of CO_2 leakage under the EU ETS, which would require an operator to provide an up-front payment for an ostensibly uncapped liability. The Guidance proposes that Member States should use current prices or estimates for near-term allowance prices over a 3-5 year period, making amendments to financial security periodically.

In the United States, in the State of North Dakota, the North Dakota Industrial Commission regulates/oversees CCS activities. The requirements for financial responsibility in North Dakota for permitting Class VI wells (CO_2 injection wells) are set out below:

- The storage operator is required to demonstrate and maintain financial responsibility as determined by the commission. The commission specifies the types of financial responsibility instruments that can be used and the CCS project activities that require coverage by the financial responsibility instrument. Activities covered include corrective action, injection well plugging, post-injection site care and emergency and remedial response measures. The provisions provide further detail as to the protective conditions of coverage that must be included in the financial responsibility instrument.
- The provisions establish a Carbon Dioxide Facility Administrative Fund and Carbon Dioxide Storage Facility Trust Fund to which operators are required to pay a fee for each ton of CO_2 injected for storage.

Regulators should also consider imposing requirements for project operators to obtain additional third-party financial assurance measures to ensure that projects are able to meet comply with regulatory obligations throughout the life of the project.

While the approach adopted to financial security varies between jurisdictions, the underlying rationale for the imposition of financial security requirements remains similar: a policy goal of reducing the exposure of the taxpayer and general government funds (Global CCS Institute, 2019).

KEY MESSAGES

- Regulatory obligations during the post-closure phase will include long-term monitoring and responsible site care, to ensure the safety and security of CO_2 storage sites. Regulatory frameworks may oblige project operators to provide post-closure monitoring plans to address potential risks, including leakage and site integrity concerns.
- Liability for stored CO_2 is a key issue that regulators and policymakers have attempted to address within early CCS-specific legal and regulatory frameworks.
- Regulatory provisions enabling the transfer of liability for a storage site or stored CO_2, from an operator to a state's competent authority, following the closure of the storage site is a key mechanism adopted across various regulatory frameworks.
- Regulatory frameworks also mandate financial security provisions to address the long-term liabilities associated with the closed CO_2 storage site, by requiring financial guarantees to cover closure, post-closure, and potential CO_2 leakage liabilities, to reduce the burden on public funds.

PRIORITY ACTIONS FOR POLICYMAKERS AND REGULATORS

- Develop regulatory provisions addressing long-term monitoring after site closure and require approval of these plans to ensure adherence to safety and reporting