Accelerating Cross-border CCS in Asia Pacific

IEAGHG 8th International Workshop on Offshore Geological CO2 Storage

21 April 2026

Asia Natural Gas & Energy Association

ANGEA's Mission and Values

Mission

To promote natural gas as an affordable, scalable, reliable, and lower-carbon energy source to meet Asia’s climate and sustainable development goals.

Values

The Asia Natural Gas & Energy Association is the only regionally based industry association with a focus on delivering, in partnership with Governments and societies across the region, reliable and secure energy solutions that achieve economic, energy security, social and environmental objectives.

Our membership

The Asia Natural Gas & Energy Association is unique in Asia Pacific – it covers the full natural gas value chain of energy producers, energy buyers, shippers, suppliers and infrastructure companies operating in the region.

Examples of CCS Activities by ANGEA Members in APAC

Australian storage projects

- **Moomba CCS** — Santos — Operational
- **Gorgon CCS** — Chevron — Operational
- **Angel CCS** — Woodside Energy — Pre-FEED stage

Indonesia, Malaysia & Timor Leste

- **Tangguh CCUS** (under construction) — bp, GE VERNOVA
- **Offshore Sarawak** (supported by JOGMEC) — JGC
- **Japan-MY value chain** (with Petronas) — jera
- **Bayu Undan CCS** (with SK E&S) — Santos

Singapore S-Hub

Consortium evaluating and developing Singapore's first cross-border CCS project.

ExxonMobil

Appointed as lead developer with Shell

Japan role model projects

Five domestic and four overseas projects selected to advance commercialisation.

MITSUBISHI HEAVY INDUSTRIES

Leading capture technology provider

LCO2 carrier JV

MOL Mitsui O.S.K. Lines

with Petronas and MISC

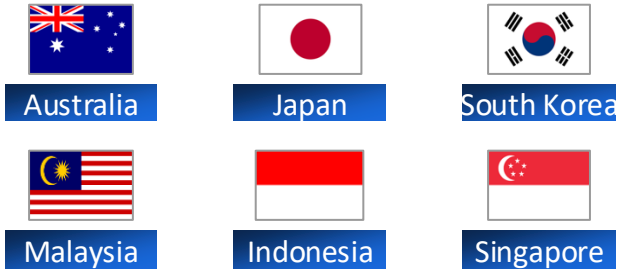
Cross-border CCS is an important pathway for APAC to decarbonize hard-to-abate sectors

- Cross-border CCS is critical for countries in Asia to achieve their emission reduction goals at the lowest cost
- Cross-border CCS also entails several socio-economic benefits, e.g. infrastructure development, job creation, technology and skills transfer, and financial incentives
- A regional approach by storage countries with a fully integrated CCS hub model would create access to intra-regional economic opportunities
- International climate finance and foreign aid may provide the financial resources to support capacity development, early-stage pilot and demonstration projects
- To enable cross-border CCS, governments and private sector stakeholders need to agree on what to include in bilateral and commercial agreements

ANGEA study answers key questions to facilitate cross-border CCS agreements

Opportunity

- CCS is critical for decarbonization efforts in Asia Pacific.
- The region is pioneering cross-border CCS opportunities to advance towards its climate targets.
- The study focuses on initial 6 countries in the region.



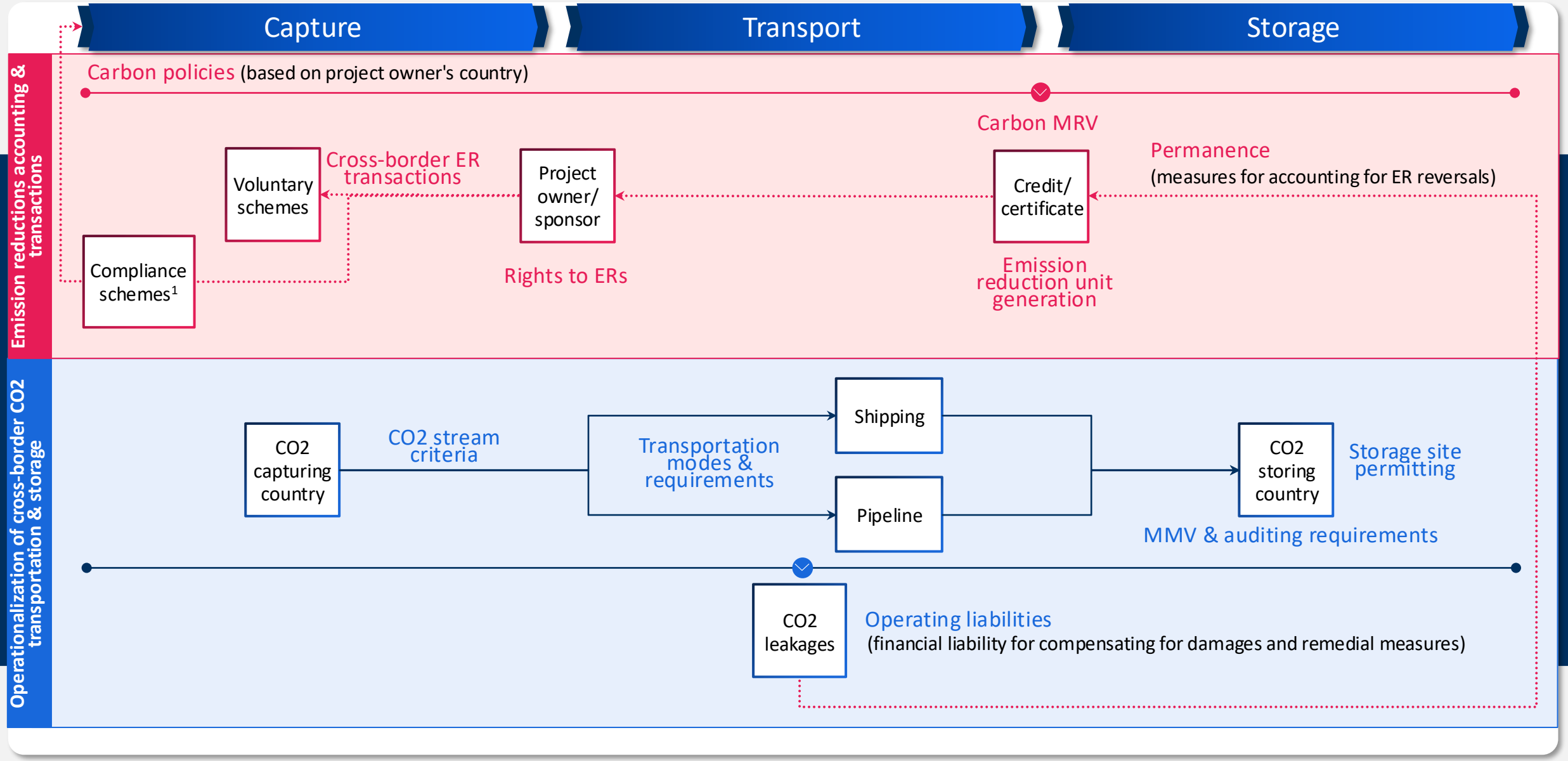
Challenges

- Cross-border CCS is complicated by an array of international guidelines and the differing regulatory frameworks across countries in the APAC region
- For cross-border CCS projects to be commercially viable, G2G agreements are important in providing clarity and flexibility for commercial agreements to proceed on key issues including:
  - What types of certifications can be used?
  - How to ensure no double counting?
  - Clarify long-term liabilities in the event of leakages

Objectives of ANGEA's Study

- Examine existing international guidelines, domestic regulations, and carbon accreditation mechanisms for certifying emission reductions from cross border CCS
- Review potential business models, based on the intended uses of reduction units, to identify gaps and challenges that need to be addressed in the G2G agreements.
- **Provide recommendations on what should be considered in the G2G agreements** (vs. what to be included in the commercial agreements).

Scope of cross border CCS study



1. This is simplified to reflect that where the project owner/sponsor uses the CCS emission reductions to fulfil its compliance obligations (e.g. via an ETS or to reduce its taxable emissions); other ways of where emission reductions can be counted towards capture/storage/other countries' NDCs is covered in more detail in Chapter 2.

Overview | Cross-border CCS study structured along 4 chapters

Accelerating Cross-border Carbon Capture and Storage in Asia Pacific

Guidance for accelerating cross-border CCS projects in APAC

1 Introduction

Aims and objectives of the study

2 Emission reductions accounting & accreditation

- (i) Emission reduction unit generation
- (ii) Rights to emission reductions
- (iii) Cross-border emission reduction transactions
- (iv) Carbon MRV
- (v) Permanence

3 Operationalization of cross-border CO2 transportation & storage

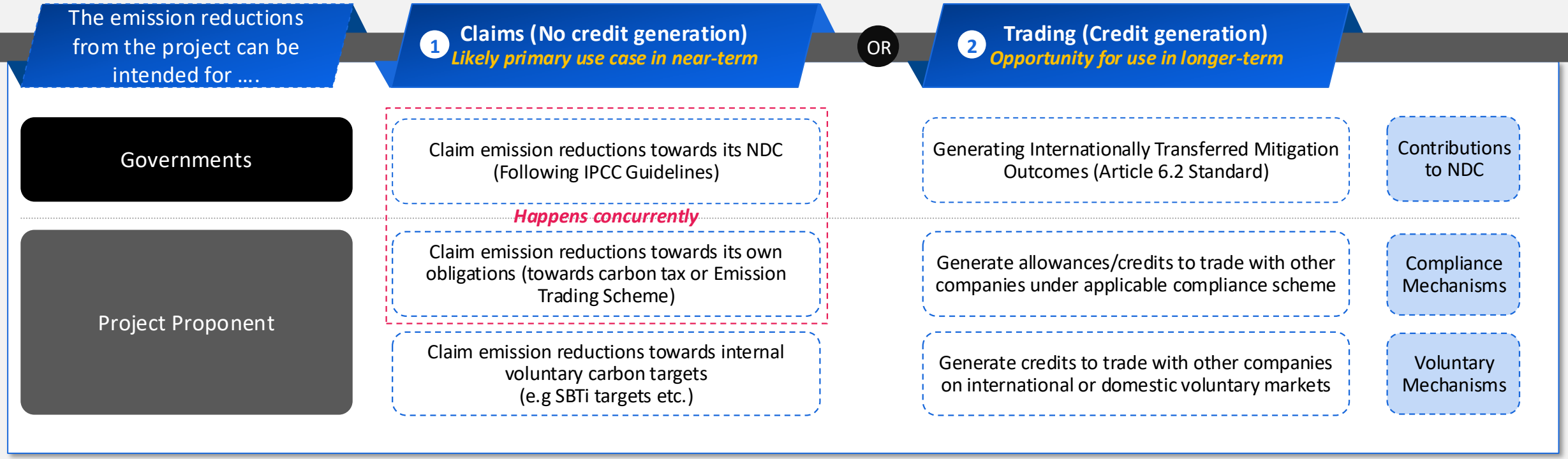
- (i) CO2 stream criteria
- (ii) Transportation modes and requirements
- (iii) Storage site permitting
- (iv) MMV & auditing requirements
- (v) Site closure procedures
- (vi) Operating liabilities

4 Application

Defining Bilateral vs commercial agreements

☆ To discuss in more details

Emission reductions from cross-border CCS can be used for own claims or generating credits for trading



5 potential accreditation standard types (3 global and 2 local) can be used to generate emission reduction certificates/credits from CCS projects… (1/2)

Potential global accreditation standard types to consider

	1 Article 6.2 standard: Partner with government to register emission reductions under standard applicable for ITMOs	2 Article 6.4 standard: Register emission reductions under standard applicable for generating A6.4ERs	3 International standard: Register emission reductions under international standard applicable for VCM
Options			
Benefits and Constraints/ Challenges	+ Clear rules in place, with existing ITMO transactions + Enables public funding support – Guidance on reporting and rules on authorization of ITMOs still unclear – Limited standards approved and no methodology for (cross-border) CCS currently	+ CCS methodologies are being developed by Art 6.4 Supervisory Body & CCS+ initiative[2], potentially with cross-border considerations – Not operational yet, as rules have not been agreed – Lacks guidance on environmental integrity around carbon removals	+ Internationally recognized and accepted + CCS methodologies are being developed, potentially with cross-border considerations – Lack of price transparency for internal carbon pricing – Integrity of credits could be implicated by wider VCM skepticism
Examples (non-exhaustive)	**Japan's Joint Crediting Mechanism (JCM) is used by Japan for Article 6.2 transactions under the Paris Agreement[1]** ▪ Government of Japan entrusts private sector entities to implement projects that can generate JCM credits, which was previously used for the preceding Kyoto Protocol ▪ JCM is looking to use the International Organisation for Standardisation (ISO) as a reference methodology, to include CCS projects in its scope	**Article 6.4 is developing a CCS methodology as a transition from the Clean Development Mechanism (CDM) under the Kyoto Protocol** ▪ Guidelines proposed to have removal activities under Article 6.4, which will include CCS **Under transition and development**	**Several VCM standards have CCS methodologies, but all do not have guidance for cross-border cases** ▪ Gold Standard has a CO_2 removal draft methodology, but only accepts transport via pipeline ▪ Puro.earth has a Geologically Stored Carbon methodology, but only for storage through DAC or biogenic capture, and geological storages under Europe or American laws ▪ Verra's CCS+ draft methodology under the Verified Carbon Standard (VCS) is developing guidance on cross-border cases

1. Japan is currently using the JCM, which was used for the preceding Kyoto Protocol, for Article 6.2 transactions. 2. The CCS+ initiative has mentioned that their developed methodology may be used for Article 6.4.
Note: ITMOs = Internationally Traded Mitigation Outcomes; NDCs = Nationally Determined Contributions; IPCC = International Panel for Climate Change; VCM = Voluntary Carbon Market; DAC = Direct Air Capture

…although guidance on cross-border cases is currently limited and developing (2/2)

Potential local accreditation standard types to consider

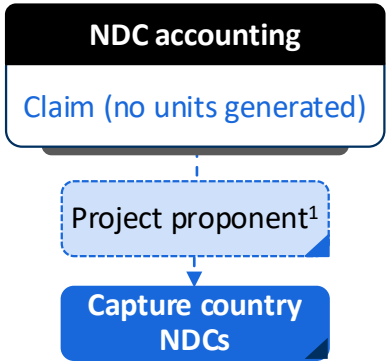
	4 Domestic standard: Register emission reductions under domestic standard, applicable for VCM and/or domestic compliance scheme	5 Emission Trading Schemes (ETS) or cap-and-trade: Claim/register emission reductions under domestic ETS[1] or cap-and-trade scheme
Options		
Benefits and Constraints/ Challenges	⊕ Greater autonomy for govt to set criteria & rules, ensuring clear accounting ⊕ Clearer price transparency, enabling internal carbon pricing ⊖ Depends on eligibility of cross-border CCS under domestic standard, which most might be silent on currently ⊖ Requires institutional capacity to develop/ review and approve CCS methodology	⊕ May not require CCS-specific accounting methodology[2] ⊕ Incentive for CCS projects driven by ETS allowance prices, enabling internal carbon pricing ⊖ Depends on eligibility of cross-border CCS under domestic ETS, which most might be silent on currently ⊖ Requires institutional capacity to develop regulations for CCS under ETS
Examples (non-exhaustive)	**Countries with domestic standards that have/are developing methodologies for CCS** ▪ For these schemes, governments typically approve, register and verify projects and methodologies ▪ China's Greenhouse Gas Voluntary Emission Reductions Program (CCER) developing a CCUS methodology ▪ Australia's ERF has a CCS methodology to generate Australia Carbon Credit Units (ACCUs), which can be used for domestic compliance as well as the VCM ▪ American Carbon Registry has a CCS methodology, which can be used for domestic compliance as well as the VCM [**Note:** None of these programs address nor provide guidelines for the project proponent storing CO_2 in another country thus far]	**Some ETS accept CCS projects, but mostly outside of APAC** ▪ Both the European Union (EU) and United Kingdom (UK) ETS allows emitters to use CCS projects to reduce their obligations (allowances not generated); where the UK government has tailored policy approaches and CCS incentives for different CCS business models ▪ Japan's Green Transformation (GX) – ETS allows JCM credits to be exchanged for allowances, which accept CCS projects ▪ California's Low Carbon Fuel Standard (LCFS) has a CCS Protocol to allow CCS projects to generate credits for domestic cap-and-trade scheme

1. Depending on the ETS, a CCS project may be used as a method to reduce emissions under ETS obligations, or to generate allowances that can be sold in a cap-and-trade market. For generating allowances, some countries may use a domestic standard that is fungible with the VCM or other domestic compliance schemes as in Option 4. 2. If CCS is used as a method to reduce emissions under ETS obligations, the emitter may only be required to apply the guidance for emissions accounting in general.
Note: VCM = Voluntary Carbon Market; ERF = Emission Reductions Fund; NDCs = Nationally Determined Contributions; GX-ETS = Green Transformation ETS

Three options for emission reduction ownership rights

Option 1: Single ownership

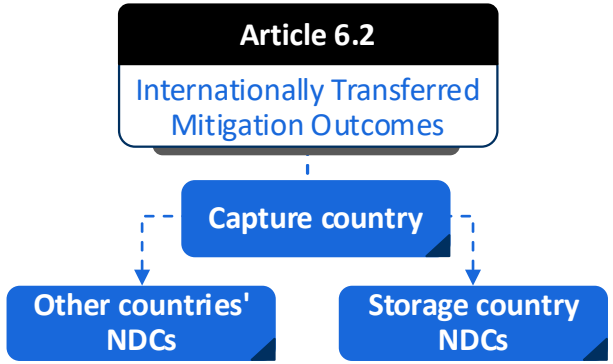
Capture country retains rights to the emission reductions to claim towards their NDCs; no emission reduction benefit for storage country



- ⊕ Based on principle that ownership should go to where emissions would have taken place
- ⊕ Provides clear case for capture country to incentivize cross-border CCS projects
- ⊖ Storage countries have no emission reduction benefit

Option 2: Single ownership, with trading/selling

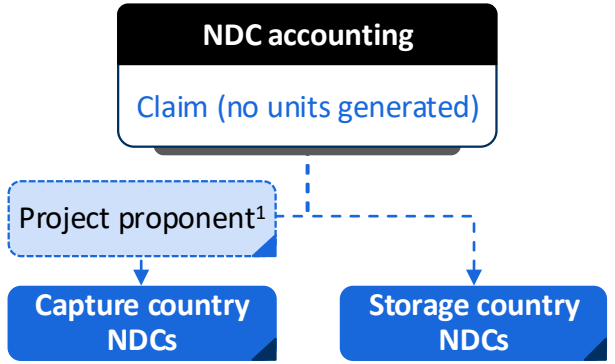
Capture country retains rights to the emission reductions to generate Article 6.2 ITMOs, may share proportion of ITMOs with storage country



- ⊕ Ensures clear credit ownership rights, using already established mechanism
- ⊕ Storage countries have opportunity to benefit beyond storage fees
- ⊖ Dependent on capture country/ project proponent's intended use – they may not agree to generate ITMOs
- ⊖ Capture country cannot claim for emission reductions

Option 3: Joint ownership

Capture country and storage country has joint ownership of the emission reductions, and can both agree on a split to claim towards their NDCs



- ⊕ Storage countries have opportunity to benefit beyond storage fees
- ⊖ Not clear if this will be accepted by IPCC/UNFCCC in practice
- ⊖ Risk of double counting will need to be managed carefully

⊕ Pros ⊖ Cons

1. If project proponent is claiming for emission reductions towards a compliance scheme (i.e. an ETS or carbon tax), this will be accounted towards the capture country's national GHG inventory and hence NDCs.

Our perspective | Option 1 is the most likely scenario and will ensure critical integrity criteria of avoiding double counting

The **capture country holds the rights to the emission reductions** as the location of the emitter.

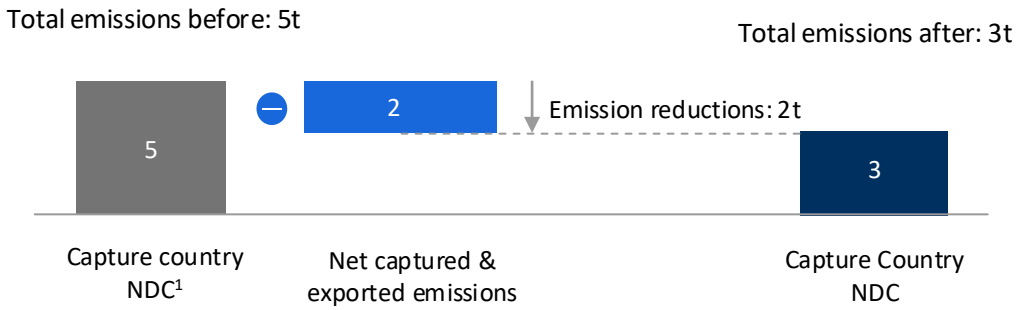
2006 IPCC Guidelines:

Capture country to report to the IPCC:
- Amount of CO_2 captured
- Emissions from transport/storage that takes place within borders
- Amount of CO_2 exported to storage country

Storage country to report to the IPCC:
- Amount of CO_2 imported;
- Emissions from transport/storage that takes place within borders
- Emissions from storage sites

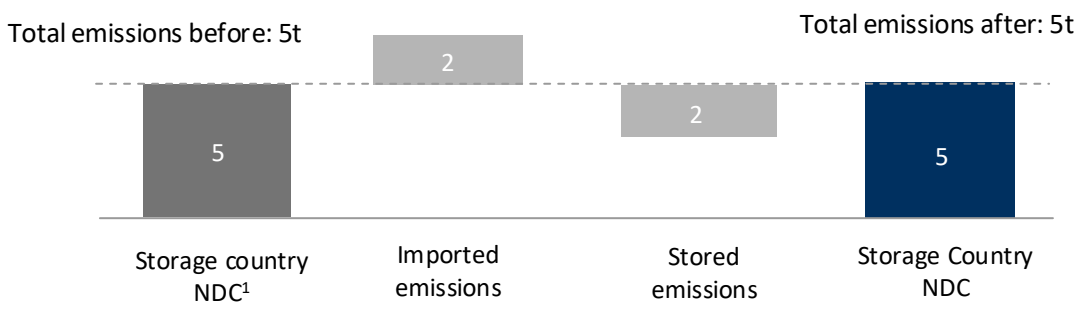
Recommended approach to claiming for emission reductions from cross-border CCS projects:

Capture country claims for ERs



Capture Country

NDC for storage country stays the same



Storage Country

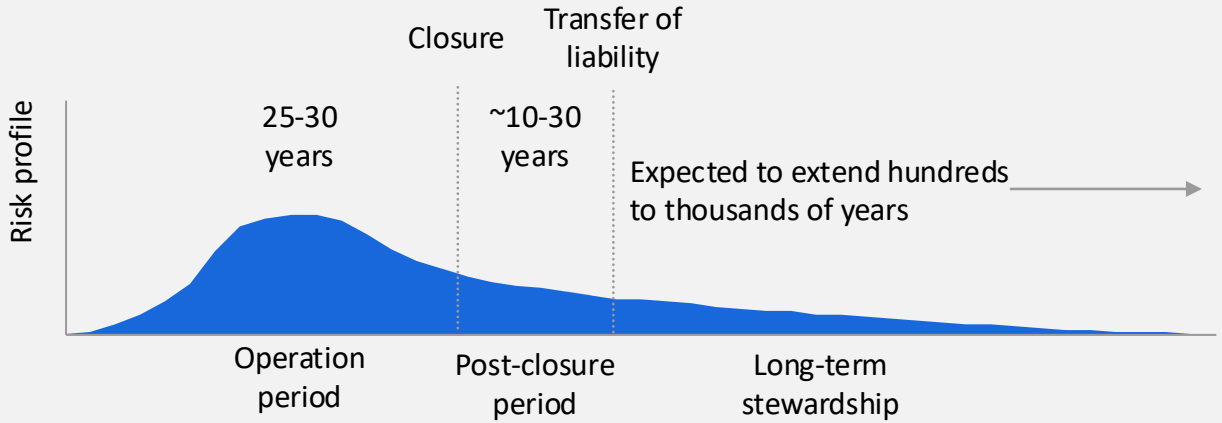
Note: For projects that are orchestrated by private entities for use of the project's emission reductions by private sector, the study assigns the emission reduction rights to the project proponent (who is the party or parties sponsoring the project, which in many cases would be the emitter). 1. Assume that capture and storage country have the same national emissions before the CCS project.
Sources: IPCC; Gold Standard; Puro Earth; Project team analysis

Managing risk of CO_2 leakages is addressed in two ways

Illustrative

CCS leakage risks overtime

Frequency of leakage is expected to average <1% over a 1,000 year period (and longer, decreasing over time), with low probability for appropriately selected sites



Our study covers risks of CO_2 leakages across the CCS value chain (capture, transport, storage) **which significantly decreases upon site closure**

Liabilities

Clearly laying out operating liability for CO_2 leakage will help ensure that responsibilities for site remediation and corrective measures are assigned

In some cases, part of liabilities include responsibility for managing non-permanence risk, or part of the compensation for damages include compensating for reversals of emission reduction units

Permanence

As the initially stored CO_2 is released, the leaked emissions have to be accounted for given that emission reductions are reversed

Note: Content for sections will be tested and refined during stakeholder engagements
Source: Wilson et. al., 2007; IPCC Special Report on CCS (2005); Alcade et al (2018) "Estimating geological CO2 storage security to deliver on climate mitigation"; U.S. Department of Energy (2016)

3-tiered liability system can help manage risks and liabilities during CO_2 storage

Two types of financial instruments recommended for operators to cover short to medium-term and long-term liability

Liability on private sector | Liability on regulators | Illustrative

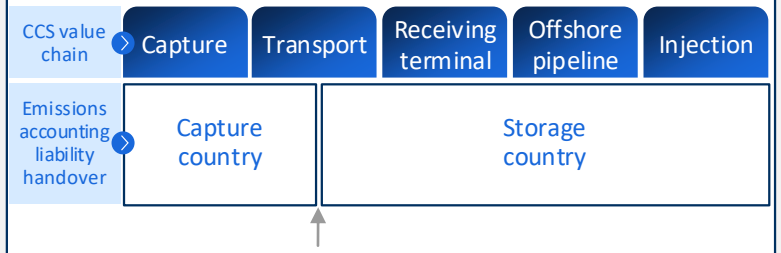
	Storage operations	Site Closure & Post-closure period	Transfer of responsibility and long-term stewardship
Tier 1: Liability on private sector	**Storage operator** covers monitoring and remediation in case of CO_2 leakage through short to medium-term financial security instruments during operating and post-closure period	Storage operator covers liability for the operating and post-closure period, utilizing financial guarantees as they define and as per regulatory requirements	
Tier 2: Shared liability	**Escrow fund (or similar mechanism)** used to cover long-term monitoring and remediation; contributed through percentage of storage fees		*When operating liability has been transferred to regulators* → In case of CO_2 leakage, escrow fund (or similar mechanism) managed by the regulator and financed through percentage of storage fees (contributed by storage operators during the operating period) can be used to take remedial action related to CO_2 leakages
Tier 3: Liability on regulator	**National regulators in storage country** offer a final layer of financial security through indemnification agreements, ensuring comprehensive coverage for any residual risks		*If damages exceed escrow fund* → Regulators provide indemnification to cover liabilities

Note: Coverage timeframes for each tier are based on the CCS project lifecycle, regulatory guidelines, and specific risk assessments
Source: The Energy Policy Institute - ANALYSIS OF LIABILITY REGIMES FOR CARBON CAPTURE AND SEQUESTRATION: A REVIEW FOR POLICYMAKERS

Three ways to account for emissions from leakages

Option 1: Handover at the border

Capture country deducts emissions from NDCs as soon as CO2 crosses over to the storage country; any leakage within storage country's borders to be added to its NDCs

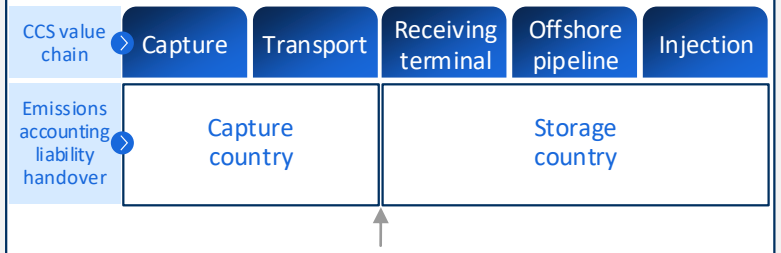


CO2 passed over to storage country's borders during transportation determines emission reductions claimed towards capture country's NDCs

- ⊕ Preference of capture countries
- ⊕ Current IPCC guidelines may be interpreted to be following this approach (i.e. countries report on emissions within their borders)
- ⊖ Does not align with accounting standards where emission reductions are typically certified based on amount injected
- ⊖ Creates accounting complexities for transport operators who will have to clearly delineate the point of border crossing, and may lead to additional costs from extra metering requirements
- ⊖ Countries will need to agree on accounting split for international waters and third-party countries

Option 2: Handover at receiving terminal

Capture country deducts emissions from NDCs after CO2 transferred at receiving terminal at the storage country; any leakage after added to storage country's NDCs

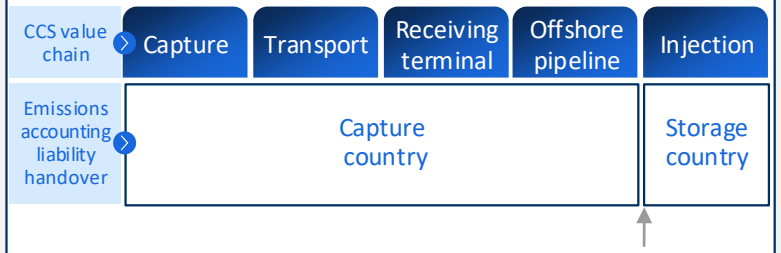


CO2 received at terminal determines emission reductions claimed towards capture country's NDCs

- ⊕ Reduces metering burden of operators, who will only need to measure amount collected and transferred to next operator
- ⊕ Reduces accounting complexities as CO2 streams can be mixed once received at terminal
- ⊕ Reduces liability on storage countries, who already take on long-term risks
- ⊖ Does not align with accounting standards where emission reductions are typically certified based on amount injected
- ⊖ May not be aligned with IPCC guidelines
- ⊖ Capture countries will possibly have to take on accountability for leakages beyond their boundaries

Option 3: Handover at injection

Capture country deducts emissions from NDCs after injection at the storage country; any leakage post-injection to be added to storage country's NDCs



CO2 injected determines emission reductions claimed towards capture country's NDCs

- ⊕ Preference of storage countries
- ⊕ Aligns with accounting standards and carbon MRV process where emission reductions are based on injection amount
- ⊕ Reduces metering burden of operators, who will only need to measure amount collected and transferred to next operator
- ⊖ May not be aligned with IPCC guidelines
- ⊖ Capture countries will possibly have to take on accountability for leakages beyond their boundaries
- ⊖ Operators based on storage country (i.e. at collection hub, offshore pipeline etc.) will be financially liable for capture country's carbon pricing
- ⊖ CO2 streams may not be clearly separated after receiving terminal and before injection

⊕ Pros ⊖ Cons

1. If project proponent is claiming for emission reductions towards a compliance scheme (i.e. an ETS or carbon tax), this will be accounted towards the capture country's national GHG inventory and hence NDCs.

Five recommendations for bilateral agreements on cross-border CCS projects

Options provided to allow for flexibility of different objectives and contexts

Bilateral agreement recommendations	Options		
☆ Agree on ownership rights to the emission reductions	Capture country retains rights to the emission reductions to claim towards their NDCs; no emission reduction benefit for storage country	Capture country retains rights to the emission reductions to generate Article 6.2 ITMOs, may share proportion of ITMOs with storage country	Capture country and storage country has joint ownership of the emission reductions, and can both agree on a split to claim towards their NDCs
☆ Agree on jurisdictional accountability for emissions from leakages and acceptable mechanisms for the adjustment of such emissions	Capture country deducts emissions from NDCs as soon as CO2 crosses over to the storage country; any leakage within storage country's borders to be added to its NDCs	Capture country deducts emissions from NDCs after CO2 is transferred to receiving terminal at the storage country; any leakages after to be added to storage country's NDCs	Capture country deducts emissions from NDCs after injection at the storage country; any leakage post-injection to be added to storage country's NDCs
Agree to share data for emission reduction certification	N/A		
Agree on regulatory responsibility during CO_2 transportation	Regulatory responsibilities determined as per international boundaries. In addition, relevant maritime / 3rd country regulations apply if transferring over international borders or 3rd countries	Countries mutually agree on a 'handover point' where regulatory responsibility shifts from one country to the other	
Agree on dispute resolution mechanisms, including arbitration forums etc.	N/A		

Thank You

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