

FUNDAMENTALS OF CARBON MARKETS INFRASTRUCTURE

September 17, 2026

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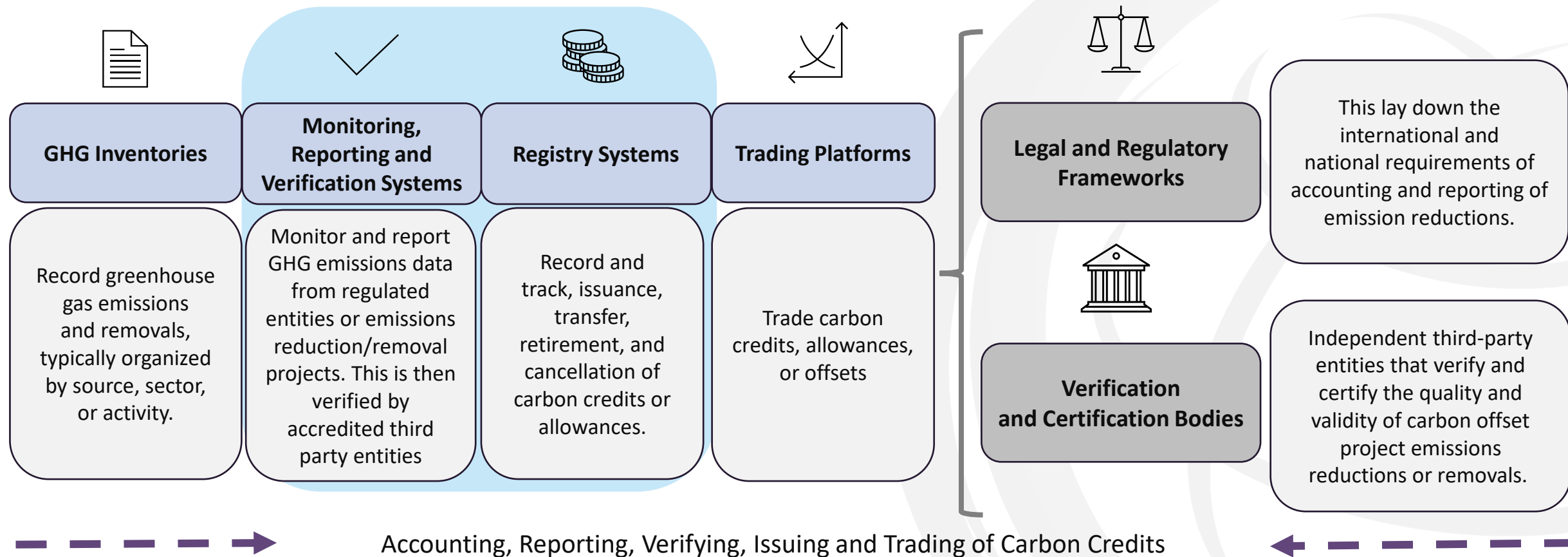
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What would you like to know about Carbon Market Infrastructure?

WHAT IS CARBON MARKET INFRASTRUCTURE?

Carbon market infrastructure refers to the systems and platforms that facilitate the operation and functioning of carbon markets through the support of underlying frameworks and institutions. It encompasses various elements necessary for the monitoring, reporting, and verification of greenhouse gas emissions (GHG) reductions or removals, as well as the issuance, trading and tracking of carbon credits or allowances.



INFRASTRUCTURE CHALLENGES IN SCALING UP CARBON MARKETS?



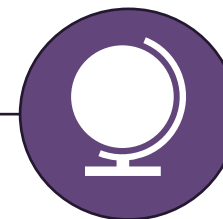
Project Level

- Difficulties in **data collection and verification** due to project complexity and remote location
- Limited **financial resources** and **technical capacity**
- **Complexity of reporting requirements** to comply with standards and protocols
- **Limited interoperability** for integration with national and international reporting systems



Country Level

- **Data quality and reliability** challenges, such as gaps, inaccuracies, and inconsistencies with national inventories and data collection practices
- **Limited technical capacity** in data collection and reporting; and use of advanced monitoring technologies
- **Limited resources for long-term** maintenance of (digital) systems
- **Ensuring compliance** of reporting obligations using data collection methods, reporting standards, etc.



Global Level

- **UNFCCC managed infrastructure**
 - Navigating technical and reporting requirements of Article 6.2 and Article 6.4.
 - Compliance with UNFCCC regulations may pose challenges for market participants
- **Lack of harmonized data due to systems fragmentation**
 - Lack of standardized and comparable data formats and protocols across different jurisdictions

II. DIGITAL MONITORING, REPORTING AND VERIFICATION (D-MRV)

MONITORING, REPORTING AND VERIFICATION



Definition: Multi-step process to measure (after monitoring) the amount of greenhouse gas (GHG) emissions reduced by a specific **mitigation activity** over a period and report these findings towards a reporting framework to be verified by an accredited third party.

M = Monitoring

(usually including monitoring and measurement)



This involves **quantifying greenhouse gas emissions or removals from specific sources or sinks** comparing them with a baseline or a business-as-usual scenario - BAU - (emission reductions: ERs). It often includes the use of scientific instruments, data collection techniques, and calculation methodologies to accurately assess the amount of carbon dioxide equivalents (CO₂e) being emitted or absorbed.

R = Reporting

(internal, national, or international)



Once emissions or removals are measured, this **information needs to be reported to relevant authorities, regulators, or market participants**. Reporting typically involves documenting emissions data, methodologies used for measurement, and any relevant contextual information necessary for understanding the reported emissions and ERs.

V = Verification

(3rd party auditor and QA/QC)



Verification involves **independent assessment and validation of reported emissions data to ensure its accuracy, completeness, and compliance with established standards, methodologies, and regulations**. This is typically conducted by third-party auditors or verification bodies to provide assurance to stakeholders that reported emissions and ERs are reliable and trustworthy.



RATIONALE FOR MRV

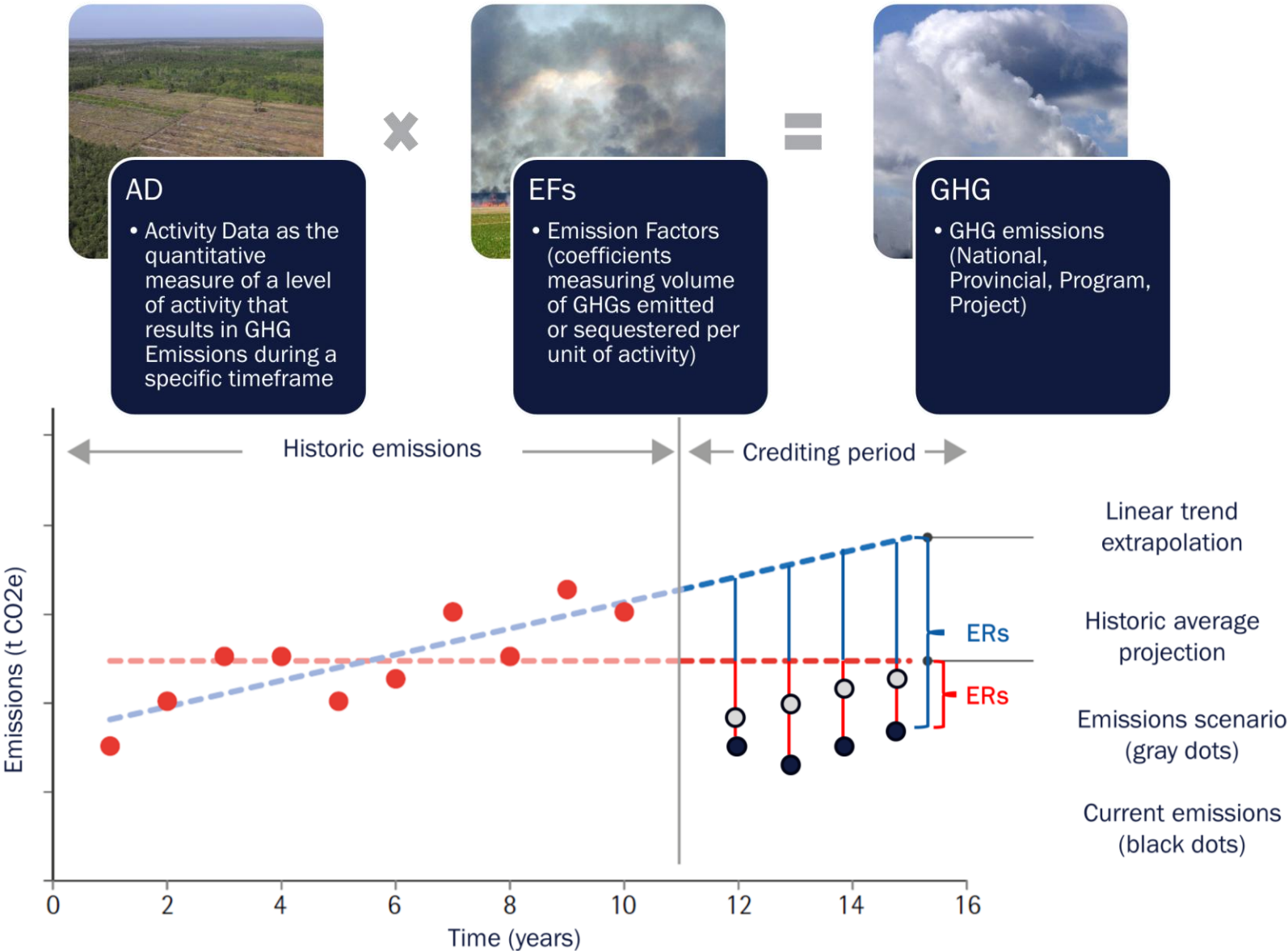


Rationale:

GHG estimation

ERs estimation

e.g. Measurement of ERs, comparing current emissions (under mitigation activity implementation) vs. BAU scenarios (baselines estimated as linear trend or historic emissions average)



ex-ante (counterfactual) during the project registration phase (project design document, including GHG baseline) - gray dots

ex-post (actual) during implementation (monitoring report, including GHG emissions / removals estimates) - black dots

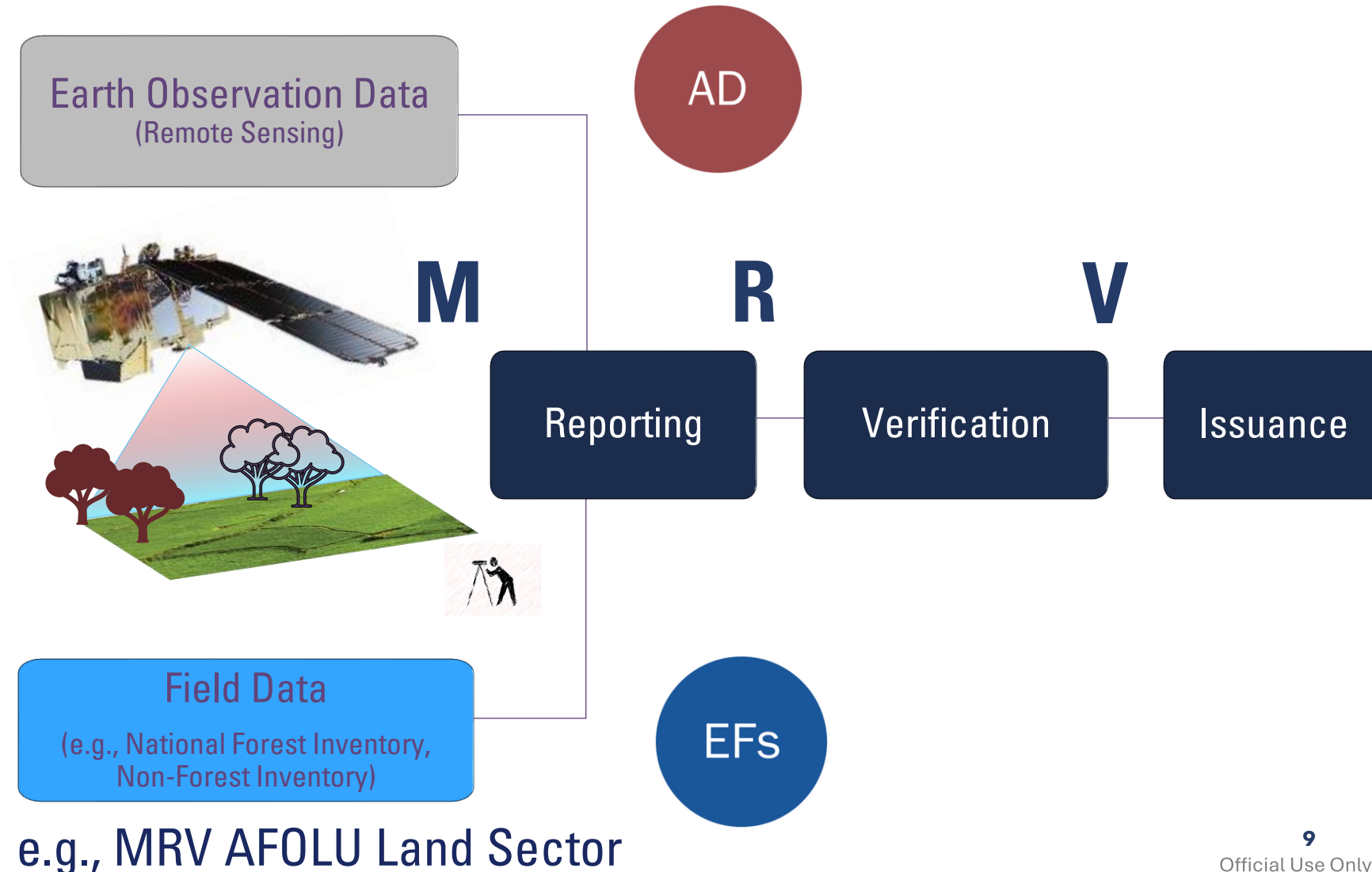
CHALLENGES TO TRADITIONAL MONITORING, REPORTING AND VERIFICATION



Challenges

Limiting factors to access to the carbon finance

- Data collection manually operated
- High uncertainties and biases
- High costs (0.2 -1.6 €/credit)
- Slow (12-24 months per cycle)
- Transaction logs are not integrated



TECHNOLOGIES FOR ROBUST INFRASTRUCTURE

- Technological development is key to driving **efficiency**, enhanced **transparency**, and improved **effectiveness** in carbon markets.
- **Innovation processes** and **open-source** solutions increase participation and improve compliance.

Earth Observation Technologies

Technologies such as Remote Sensing and Satellite Imaging bolster integrity in carbon markets by furnishing precise data on emissions and land use changes, ensuring transparent monitoring and verification of carbon credits.



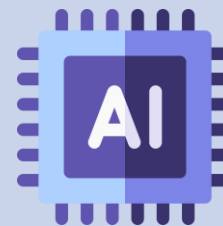
Internet of Things (IoT)

Contribute to addressing integrity issues in carbon markets by enabling real-time monitoring and tracking of carbon emissions from various sources. This ensures accurate data collection and verification, thus enhancing transparency.



Artificial Intelligence and Machine Learning

Provide advanced algorithms for fraud detection, anomaly detection, and predictive analytics to help address integrity issues in carbon markets, thereby enhancing the accuracy and reliability of carbon credit verification processes.



Blockchain and Tokenization

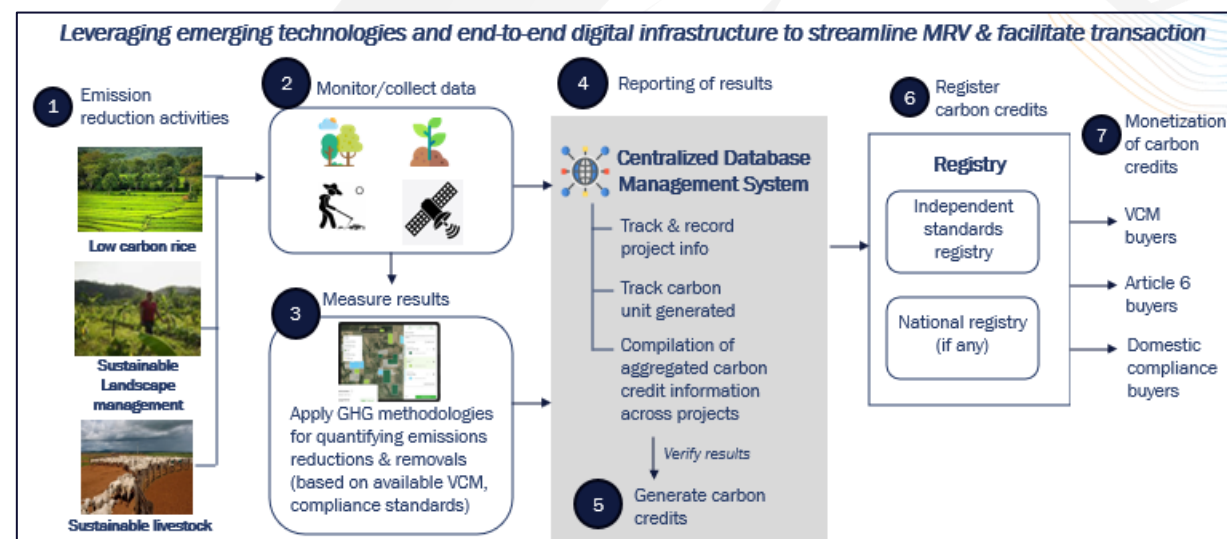
Can ensure the integrity of carbon markets by providing transparent, immutable, and traceable records of carbon credits, thereby reducing the risk of fraud and ensuring accountability throughout the carbon trading process.



DIGITIZATION APPROACH TO MRV

MRV can be digitized, providing key benefits to the overall efficiency of carbon asset generation cycle

- 
Using digital technologies to digitally report, record, and analyze project information
- 
Increasing reporting accuracy, reduces the time required for data collection, lowers the cost of 3rd party verification
- 
Key component in future climate markets to ensure robustness and the smooth functioning of those markets



KNOWLEDGE CHECK- I



What is Carbon Market Infrastructure?



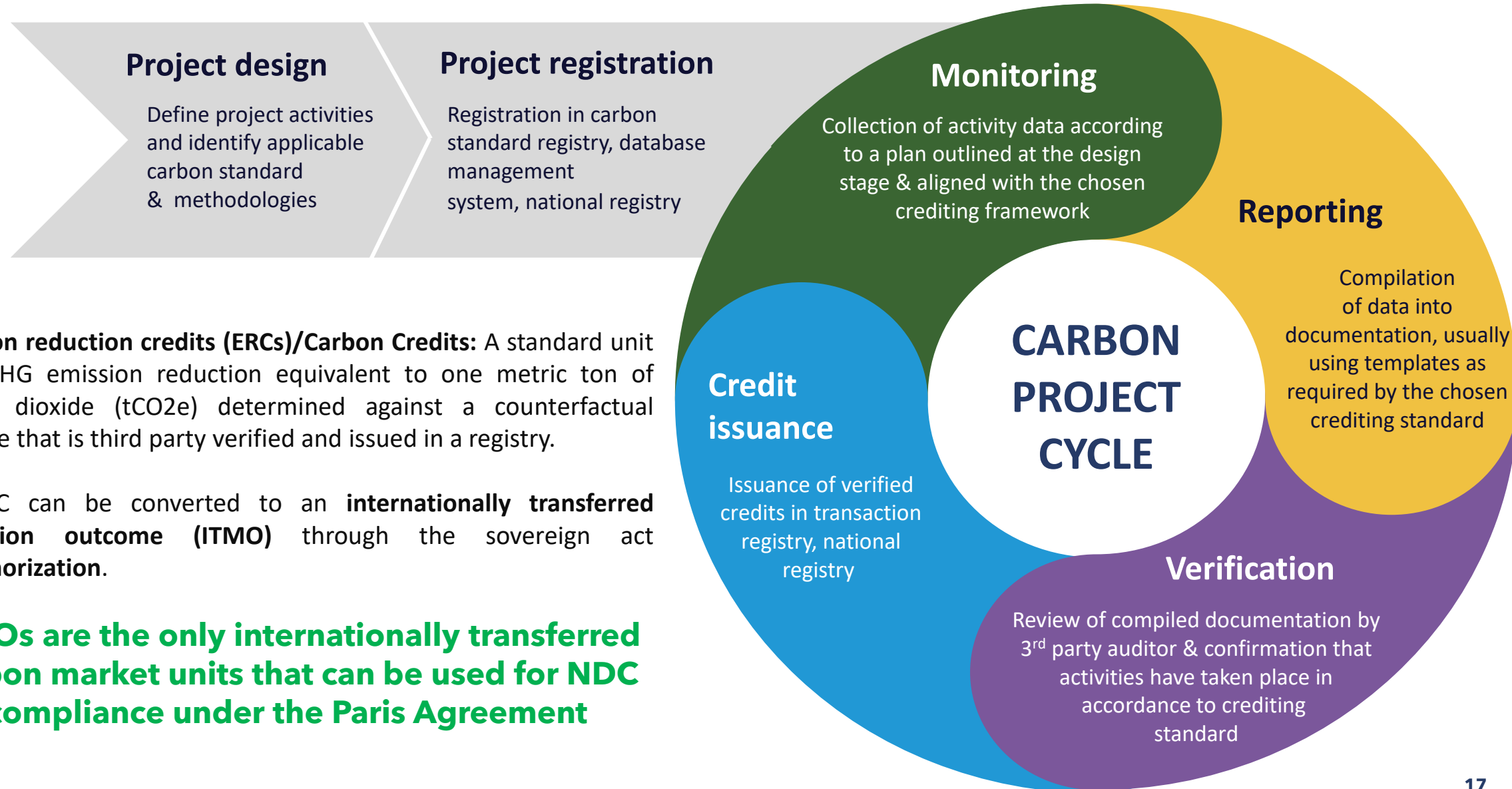
Which of the following is a key benefit of digitizing MRV processes?



How are Emission Reductions (ERs) calculated in a carbon project?

REGISTRY INFRASTRUCTURE

CARBON PROJECT CYCLE



Emission reduction credits (ERCs)/Carbon Credits: A standard unit of a GHG emission reduction equivalent to one metric ton of carbon dioxide (tCO₂e) determined against a counterfactual baseline that is third party verified and issued in a registry.

An ERC can be converted to an **internationally transferred mitigation outcome (ITMO)** through the sovereign act of **Authorization**.

ITMOs are the only internationally transferred carbon market units that can be used for NDC compliance under the Paris Agreement

REGISTRY: PURPOSE AND ROLE

1 Technical Role



A registry is a **centralized online database or platform**, primarily to administer and track the ownership, issuance, retirement, and transfer of carbon credits and/ or allowances



Its fundamental purpose is to **manage system integrity** by ensuring transparency, traceability, and preventing double counting



Registries must deliver a range of functions including tracking issuances, allocations, trades, surrenders, cancellations and retirement

2 Policy Role

Registries are critical infrastructure needed to support three key policy functions

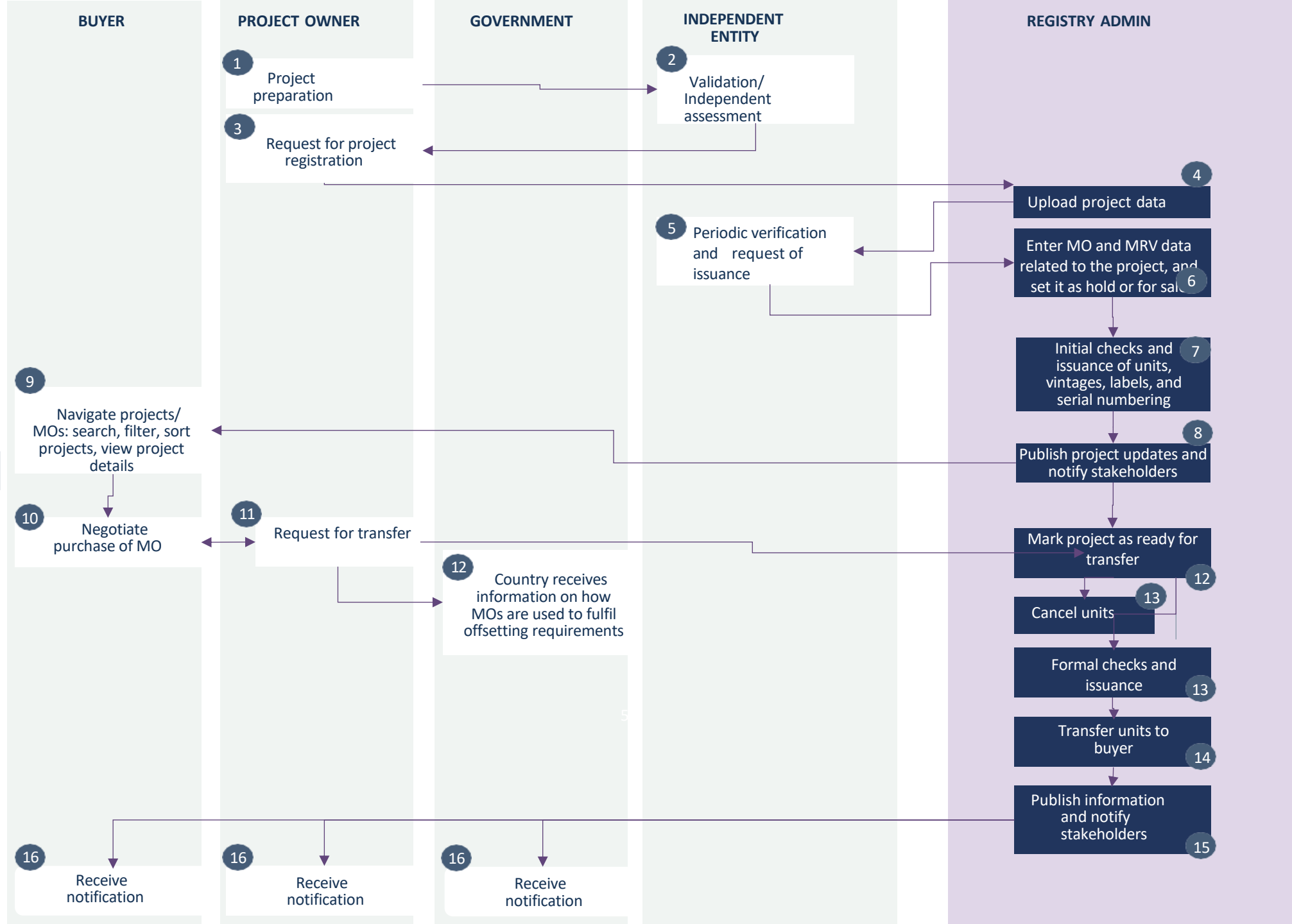
1

Facilitate engagement in **international** markets and meeting minimum UNFCCC requirements "Under Article 6.2: Each participating party must "have", or "have access to", a registry for the purpose of recording and tracking. The registry records authorization, first transfer, use and other relevant actions relating to ITMOs."

2

Facilitate tracking and accurate accounting of **domestic and international** carbon credits (offset mechanism) or allowances (ETS mechanism)

WHERE DOES A REGISTRY APPEAR IN A CARBON CREDIT CYCLE?

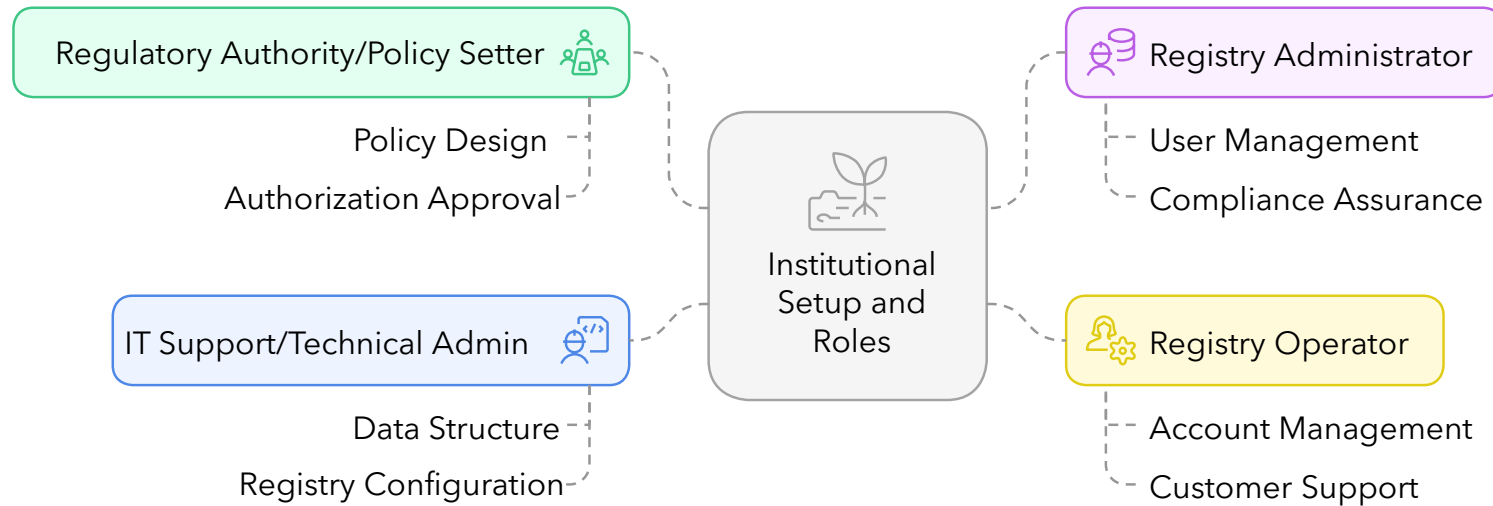


REGISTRY FUNCTION CHECKLIST

Functions required under Decision 6/CMA.4 (Annex I, Chapter I), plus optional functions to consider based on national requirements

MANDATORY		OPTIONAL	
Required under Decision 6/CMA.4		Based on national requirements	
Record issued credits through Unique IDs	Each ITMO must have a unique identifier. IDs may be based on common nomenclatures, subject to future CMA decision.	Support domestic CPIs	Where domestic carbon pricing schemes require issuing, recording, or tracking emissions permits or carbon units — integration with Article 6.2 functions optimises resources.
Record authorisation	Authorisation status and information associated with the ITMOs must be recorded in the registry.	Enable transactions	The registry may operate as a transactional registry, allowing account holders to request and execute transactions.
Track ITMOs	The registry must record actions at a minimum as referred to in Decision 2/CMA.3, Annex, Chapter VI.A.	Information disclosure	Public interface disclosing non-confidential information — issuance and cancellation records, account names, key statistics — to promote transparency.
Accounts for ITMOs	Holding accounts, accounts for use towards NDCs, voluntary cancellation accounts, administrative accounts, etc.	Report auto-prefilling	Features to generate reports aligned with reporting templates. This function is provided by the international registry for AEF reporting.

KEY GOVERNANCE AND INSTITUTIONAL ARRANGEMENTS



▪ **Institutional Setup and Roles:** Institutional and governance framework to provide clarity on key roles including:

- **Regulatory Authority/Policy Setter:** The decision-making body responsible for overall oversight, designing policies, guidelines, and strategies for Article 6 implementation. They approve procedures for authorization and delegate authority.
- **Registry Operator:** Handles administrative tasks such as setting account parameters, opening/closing accounts, informing customers of regulatory changes, and providing support.

• **Registry Administrator:** Manages day-to-day operations, including user and account management, issuance, and cancellation of carbon units. They ensure compliance with regulations and report irregularities. This role requires expertise, reliability, and capacity to manage technical and operational aspects.

• **IT Support/Technical Admin:** Ensures the data structure and registry functions are fit for purpose and can configure the registry for robust transactions.

APPROACHES TO ESTABLISH A REGISTRY

Registry options			
Suitable when:	Bespoke: Develop own registry	Software as a Service: Use available/ existing registry	UNFCCC International Registry
	- Building from scratch or on existing domestic registry which serves similar functions. - Highly customizable, can be designed based on the country's needs to implement domestic CPLs along with participation in international carbon market. - Requires technical capacity and resources for developing and operating its own system.	- Using registry as a service from a third-party service provider - Varying degree of customizability, based on the provider - Requires less technical capacity	- For countries intending to use the registry for the sole purpose of Article 6 - No customizability - Requires less technical capacity

Source: Article 6 Implementation Partnership (A6IP)

APPROACHES TO ESTABLISH A REGISTRY

Key considerations	Registry options		
	Bespoke: Develop own registry	Software as a Service: Use available/ existing registry	UNFCCC International Registry
Support for domestic CPIs	Countries can design its registry to serve various policies and schemes	Varied, depending on each registry	Limited (will not support tracking of unauthorized mitigation outcomes)
Customization	Countries have full control over the registry design	Varied, depending on each registry	Limited
Article 6 reporting	Countries need to ensure that the registry supports Article 6 reporting	Countries need to understand how the information is collected from the registry	Enable auto-prefilling of relevant information
Support/capacity	Require technical capacity and resources to operate	Require understanding of how to operate and services/assistance provided	Assistance is provided by the UNFCCC secretariat

KNOWLEDGE CHECK- II



What is the primary purpose of a Carbon Asset Registry?



Which of the following is NOT a function of a carbon registry?

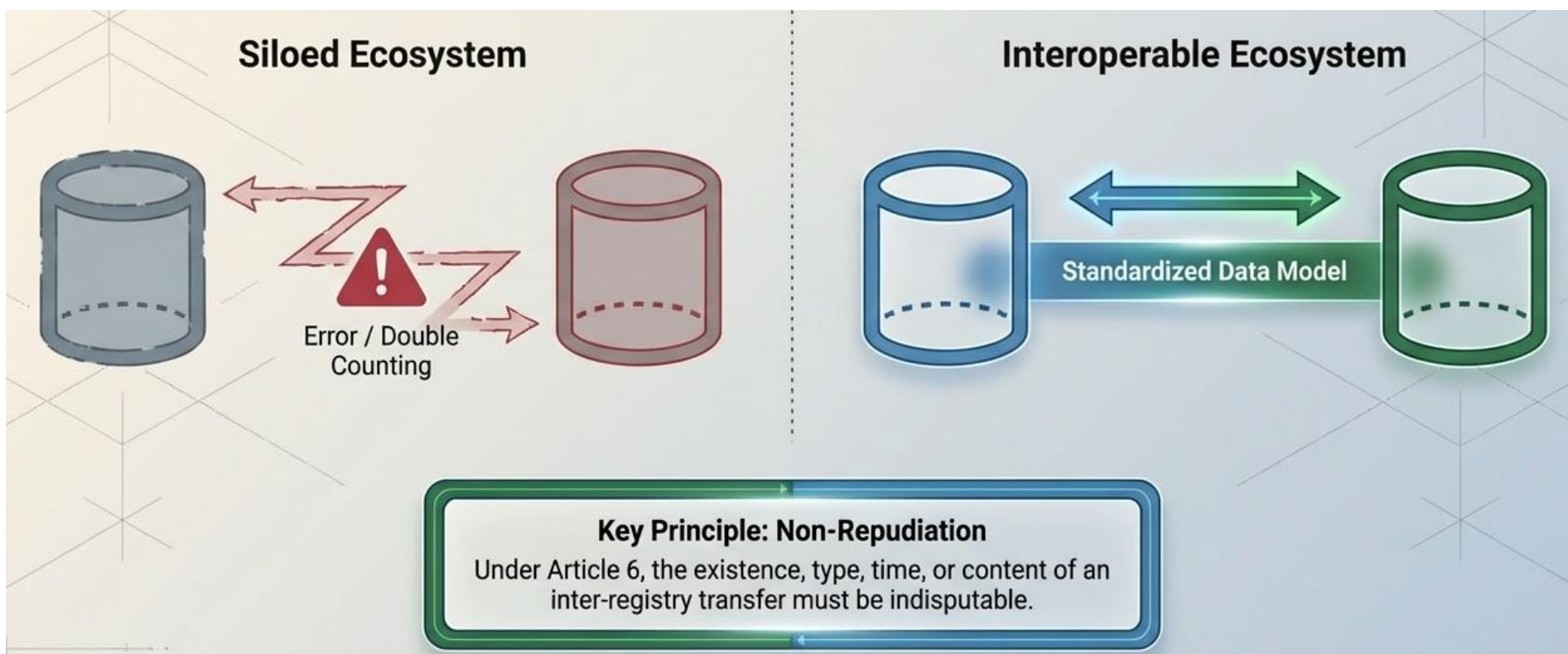
WHAT IS INTEROPERABILITY AND DATA MODELS?

Interoperability

Ability of carbon market systems to seamlessly exchange, interpret, and use data across different jurisdictions, institutions, and digital infrastructures. It enables consistent tracking, validation, transfer, and reporting of carbon credits across voluntary and compliance frameworks, while preserving data integrity.¹

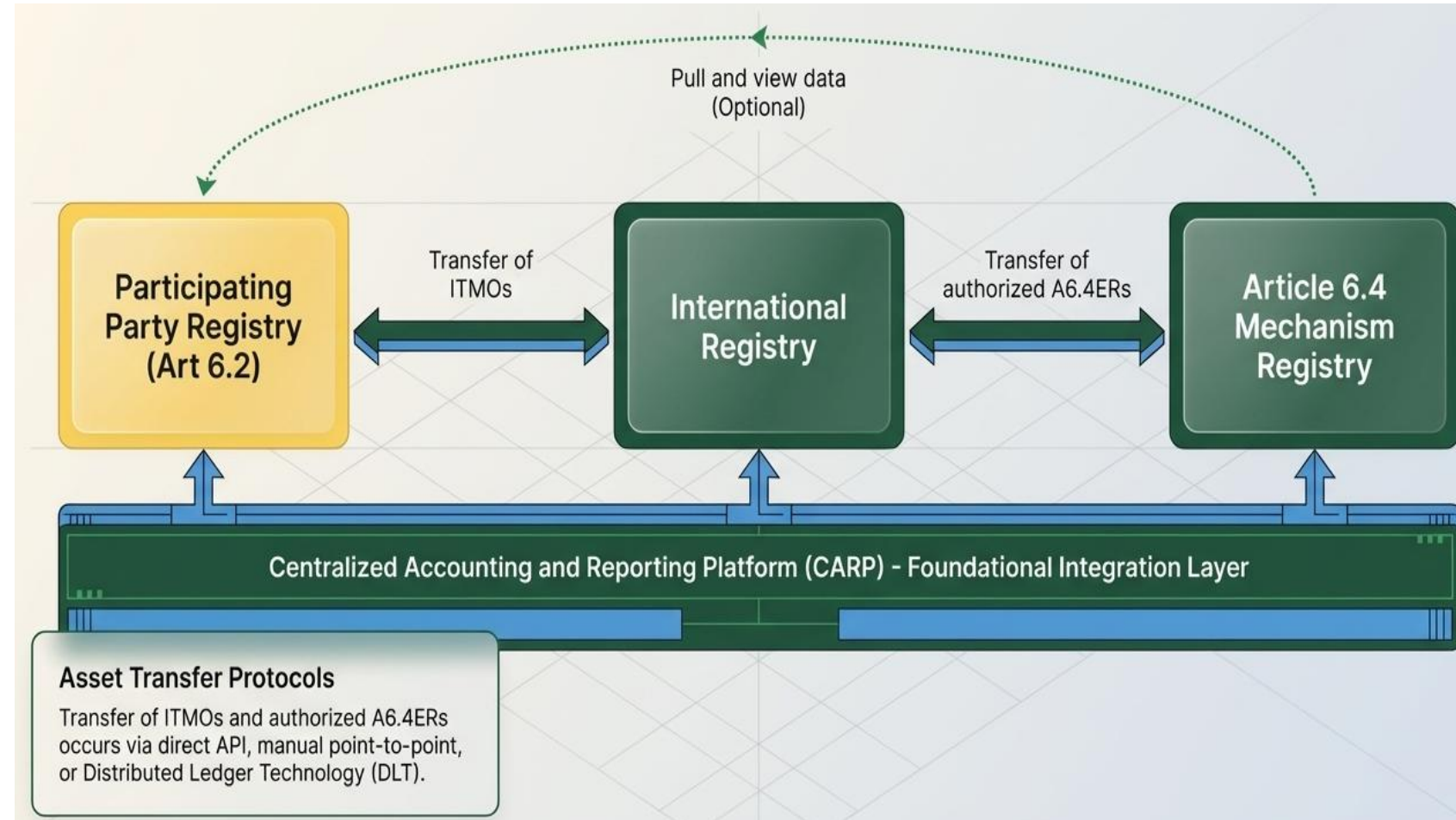
Data model

Data models helps link different databases and exchange information between them. Registries become interoperable, through standardized data fields and formats derived from a shared or mapped data model.



CONNECTIONS OF REGISTRIES UNDER ARTICLE 6

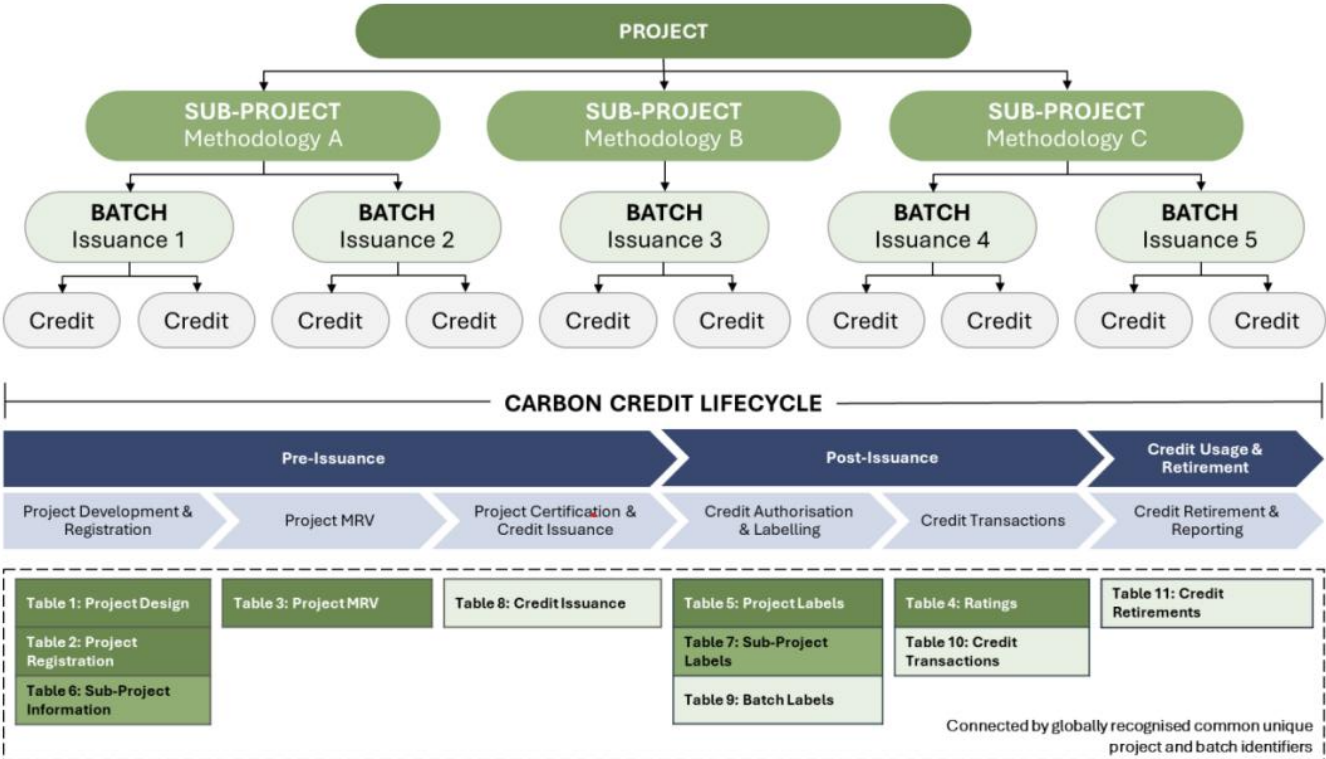
- The need is for interoperability under Article 6, for a party with its own registry (yellow box), it needs to be interoperable with the international registry (under 6.2) and with the mechanism registry (under 6.4)
- Additionally, both international and mechanism registry under the UNFCCC will also be interoperable through an interoperability Hub that UNFCCC is developing.
- The MVP for both International Registry and Mechanism registry is being tested.



COMMON CARBON CREDIT DATA MODEL BY THE CLIMATE DATA STEERING COMMITTEE

The primary goal of the CDSC data model, developed as input to the G20 Sustainable Finance Working Group in 2025, is to address the prevalent data fragmentation and lack of standardization in carbon markets.

- By standardizing data, it intends to:
- Enable **interoperability** of carbon credit data systems across market participants.
 - Strengthen emissions accounting and **reduce the risk of double counting** by assigning unique identifiers.
 - **Reduce transaction costs for buyers** by improving their ability to compare credits.
 - It aims to provide a **voluntary, open-source common foundation** for recording, sharing, and disclosing carbon credit data.



BASELINE DATA TABLES				
Project Design	Project Registration	Project MRV	Rating	Project Labels
Data fields related to the project's design, location, validation process and project developer(s)	Data fields related to the formal registration of the project with relevant registry	Data fields related to verification activities to certify emissions reductions or removals	Data fields related to project or credit rating assessments by third-party evaluators	Data fields related to labels applicable at the project level
Sub-Project Information	Sub-Project Labels			
Data fields related to individual sub-projects under a larger project, such as their specific methodologies	Data fields related to labels applicable at the methodology level			
Credit Transactions	Credit Retirements	Credit Issuance & Authorization	Batch Labels	
Data fields related to the transfer, sale, or exchange of carbon credits between entities	Data fields related to the retirement of carbon credits, including details of the purpose of their retirement	Data fields related to the issuance of carbon credits and/or Article 6 authorizations	Data fields related to labels applicable at the batch level	

ARTICLE 6.2 AEF DATA TABLES				
Submissions	Authorizations	Actions	Holdings (AEF)	Authorized Entities
Data fields related to the history of submissions to Article 6.2	Data fields related to the history of authorisations issued for Article 6.2	Data fields related to the history of actions taken within Article 6.2	Data fields related to the number of ITMOs held by Article 6.2 entities	Data fields related to the history of entities authorized in Article 6.2

AUXILIARY DATA TABLES				
Registry Information	VVB Information	Wallet List	Holdings	Marketplace Information
Data fields related to information about registries	Data fields related to validation and verification bodies	Data fields related to individual wallet owners	Data fields related to the number of credits held by wallet owners by credit batch	Data fields related to credit marketplaces

METADATA TABLES	
Change Log	Information on the changes made to the tables and by whom

Source: [Technical Consultative Note for Delivery of a Common Carbon Credit Data Model](#)

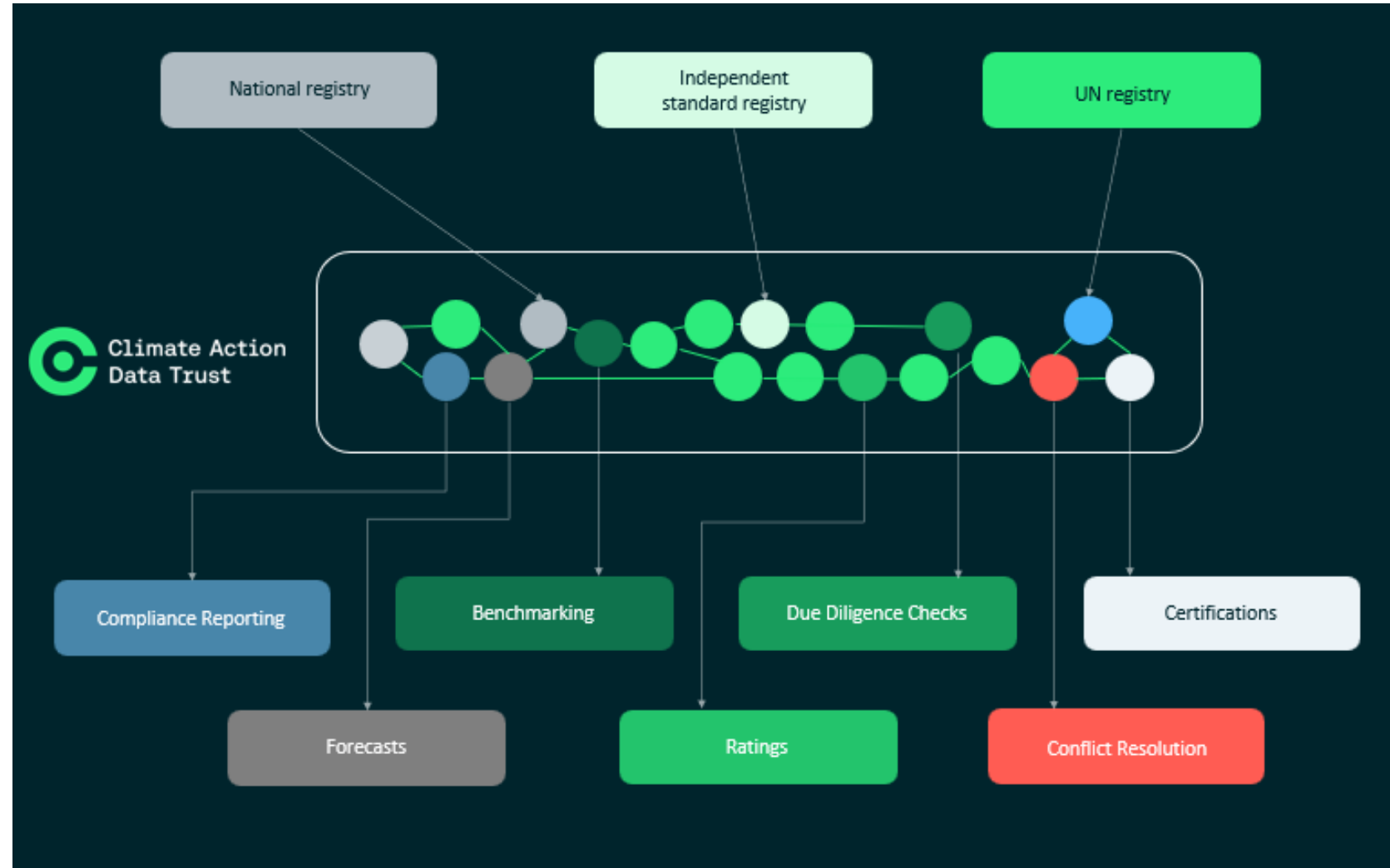
CLIMATE ACTION DATA TRUST: PUBLIC TRANSPARENCY PLATFORM

Linking, aggregating and harmonizing carbon registry data using a common data model

Each registry maintains sovereignty while empowering data discovery and market use cases

Collaborative global governance:

- Council: Chile, Singapore, Senegal, Japan, UK, Bhutan, Verra, Gold Standard, GCC, ACR
- Board: World Bank, Singapore, IETA
- Advisory bodies



CLIMATE ACTION DATA TRUST

AGGREGATE, LINK AND HARMONIZE CARBON MARKETS DATA



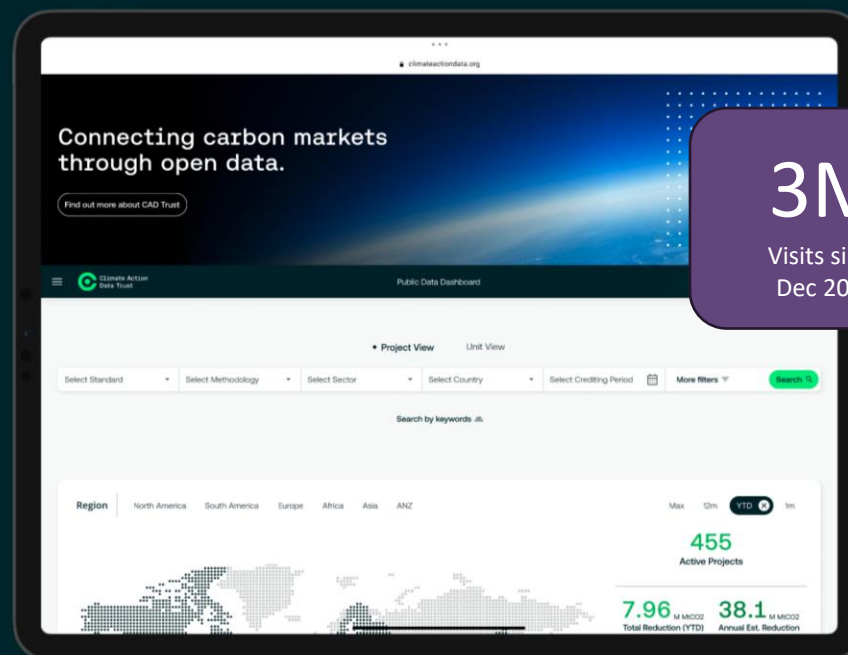
16K+

Projects

3.8B+

Issued units

Data Dashboard



3M

Visits since
Dec 2023

Top visits

- USA 23%
- UK 13%
- Singapore 10%
- Spain 7%
- Brazil 6%
- Rest of World 41%



Gold Standard



CERCARBONO
Certified Carbon Standard

BioCarbon
Standard

TERO CARBON

Asia Carbon Institute

Rainbow



KNOWLEDGE CHECK- III



What does "interoperability" mean in the context of carbon registries?



What is the purpose of the Climate Action Data (CAD) Trust? (Select those that apply)



**How do you think carbon market
infrastructure can help your country?
(Select those that apply)**

RECOMMENDED READING

Technical Guidance on Priority Areas for Carbon Market Infrastructure

These five technical notes provide **assessment frameworks, tools, recommendations and stocktaking efforts** to support informed decision-making on the development and implementation of market infrastructure.



Developed through extensive multi-stakeholder consultation under the **Carbon Markets Infrastructure Working Group (CMI WG)**—a platform convening **40+ entities** across the carbon market ecosystem



Follow-up to the [Roadmap for Safe, Efficient, and Interoperable Carbon Markets](#) Infrastructure launched during COP29, Baku



THANK YOU!

Questions? Write to us:

Gemma Torras Vives: gtorrasvives@worldbank.org

Ritu Ahuja: rahuja2@worldbank.org