REGISTRY REQUIREMENTS FOR ARTICLE 6 TRANSACTIONS

Options for host country governments

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TCAF
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Registry Requirements for Article 6 Transactions
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Authors:
Carolina Inclan
Maria Jose Rodezno Ayestas
Marco Della Maggiore
Soffia Alarcon Díaz
Sandra Greiner

Climate Focus
Van Diemenstraat 170
1013 CP Amsterdam
The Netherlands

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List of Acronyms

ACR	American Carbon Registry
AEF	Agreed Electronic Format
AFOLU	Agriculture, Forestry and Other Land Use
API	Application Programming Interface
ART+	Architecture for REDD+ Transactions
BTR	Biennial Transparency Report
CADT	Climate Action Data Trust
CAR	Climate Action Reserve
CARP	Centralized Accounting and Reporting Platform
CATS	Carbon Assets Tracking System
CDM	Clean Development Mechanism
CERs	Certified Emission Reduction Units
CMO	Ghana's Carbon Market Office
COP	Conference of Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
D4C	Digital for Climate
ERCs	Emission Reduction Credits
ETR	Enhanced Transparency Report
ETS	Emission Trading System
GCR	Ghana's Carbon Registry
GHG	Greenhouse Gas
iCRAFT	Innovative Carbon Resource Application for Energy Transition
IETA	International Emissions Trading Association
IPPU	Industrial Processes and Product Use

ITL	International Transaction Log
ITMOs	Internationally Transferred Mitigation Outcomes
JCM	Joint Crediting Mechanism
JI	Joint Implementation
KYC	Know Your Costumer
MCUs	Mitigation Contribution Units
MRV	Monitoring, Reporting and Verification
NDCs	Nationally Determined Contributions
PACM	Paris Agreement Crediting Mechanism
RBCF	Results-Based Climate Finance
SaaS	Software as a Service
TCAF	Transformative Carbon Asset Facility
TGO	Thailand Greenhouse Gas Management Organization
UNFCCC	United Nations Framework Convention on Climate Change
VCM	Voluntary Carbon Market
VCS	Verified Carbon Standard
VCUs	Verified Carbon Units

Introduction

01

1. INTRODUCTION

Carbon registries—databases or platforms that administer, track, record, and transfer compliance and voluntary carbon credits[1]— have historically played a crucial role in the functioning of carbon markets. The use of carbon registries can be traced back to 2000 under the Kyoto Protocol when the United Nations Framework Convention on Climate Change (UNFCCC) established the International Transaction Log (ITL). The ITL is a central platform that connects different registries, allowing the transfer and retirement of carbon credits between countries participating in international carbon market mechanisms, such as the Clean Development Mechanism (CDM) and Joint Implementation (JI). In addition to the UNFCCC infrastructure, domestic and voluntary carbon registries emerged to address the growing demand for carbon trading outside the scope of the Kyoto Protocol.

The adoption of the Paris Agreement in 2015 introduced two new cooperative market-based approaches: The Article 6.4 mechanism or Paris Agreement Crediting Mechanism (PACM) is a UN governed market mechanism modelled after the CDM. The second is an accounting framework for the transfer of so-called Internationally Transferred Mitigation Outcomes (ITMOs), including emission reductions or removals that are generated and transferred in bilaterally designed crediting schemes, under Article 6.2. All Parties interested in participating in cooperative approaches under Article 6.2 must have a registry or access to a registry to track and account for the authorization, transfer, and retirement of ITMOs.

Understanding the registry requirements for participating in Article 6 transactions represents significant challenges for host country governments. This is due to the highly technical nature of the subject as well as the still ongoing negotiations under the UNFCCC on the exact nature and detailed requirements of Article 6 registries.

This report aims to respond to these challenges and provide guidance for host country governments to understand and apply the emerging Article 6 registry requirements. The report has been commissioned by the Transformative Carbon Asset Facility (TCAF), a trust fund of the World Bank that supports developing countries' efforts to implement transformative policies and economy/sector-wide programs beyond project-by-project mitigation activities. Examples include implementing carbon pricing policies, transport, climate-smart agriculture, urban programs, and greening the financial sector.[2] Box 1 presents an example of the first policy crediting program supported by TCAF.

TCAF offers a hybrid funding structure through i) results-based climate finance (RBCF) disbursed as a results-based grant to support the implementation of Nationally Determined Contributions (NDC) under Article 9 of the Paris Agreement, with the verified emission reductions remaining in the country and ii) carbon markets-based finance, under Article 6 of the Paris Agreement, which requires that the emission reductions be transferred as ITMOs.[3]

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[1] A carbon unit represents a metric ton of greenhouse gas emissions reduced or removed.

[2] For more information, see: https://www.tcafwb.org/sites/default/files/inline-files/TCAF_A4_Brochure_0.pdf (accessed 3 April 2024)

[3] For more information, see: https://www.tcafwb.org/sites/default/files/inline-files/TCAF_A4_Brochure_0.pdf (accessed 3 April 2024)

Host country governments engaged in Article 6 transactions under TCAF programs are expected to comply and follow the registry requirements under Article 6. The aim of this report is to support host country governments in navigating these complexities.

The report is structured as follows: After this introduction, Chapter 2 provides a general overview and description of carbon registries. Chapter 3 presents the UNFCCC infrastructure and the registry requirements for engaging in Article 6.2 transactions. Chapter 4 gives an overview of the functionalities offered by existing registries that host countries can choose from and discusses factors that influence the registry choice. The Annex provides an overview of existing carbon market registries for Article 6.

Box 1. The Innovative Carbon Resource Application for Energy Transition Project (iCRAFT) in Uzbekistan.

The Innovative Carbon Resource Application for Energy Transition Project for Uzbekistan (iCRAFT), implemented between TCAF and the Government of Uzbekistan, is the World Bank's first policy crediting program and the first international carbon market initiative in Uzbekistan and Central Asia under Article 6. With USD 46 million in funding, iCRAFT aims to create incentives for energy subsidy reforms that will result in lower energy consumption and GHG emissions.

The program will help generate carbon emission reduction credits (ERCs) that the government can sell in international carbon markets. Until 2028, iCRAFT will disburse results-based payments to reward the phase-out of energy subsidies to reduce GHG emissions. Projections suggest that Uzbekistan could reduce around 60 MtCO$_2$ over the program's life cycle, of which the project will pay for approximately 2-2.5 million MtCO$_2$. A part of those being transferred as ITMOs to TCAF and another part staying in Uzbekistan for domestic NDC compliance following the hybrid structure of TCAF transactions as explained above.

As part of the iCRAFT program, TCAF will provide technical assistance to the government to identify the country's needs regarding policy, technical, and regulatory aspects required for ERC transactions under Article 6. This support will also provide a roadmap to define a clear Article 6 strategy and understand the infrastructure needs, such as registry requirements, to meet the transparency and integrity requirements of Article 6 for tracking and transacting ITMOs.

What are Carbon Registries?

02

2. WHAT ARE CARBON REGISTRIES?

A carbon registry is an online database or platform that administers and tracks the ownership, issuance, retirement, and transfer of compliance and voluntary carbon credits. Registries are a key component in the functioning of carbon markets. Their main tasks are to ensure connectivity between systems and actors, transparency, traceability, and secure transactions, manage carbon projects, facilitate the transfer between different entities, and guarantee accurate accounting of carbon credits to prevent the risk of "double counting"[4], therefore providing market trust.

When assessing the operations of the system, it is relevant to distinguish between two types of registries based on its functionality (both defined under the umbrella of a registry) (see Figure 1):

- **Accounting registry** (or sometimes called *register*). An accounting registry records and tracks serialized carbon credits and any other information specific to the carbon unit (e.g., the vintage of the carbon credit, the identity and location of the project, the project participants, the status of the carbon credit, or verification details) but does not issue or transfer carbon credits. Its main purpose is to ensure transparency and consistency, help to mitigate the risk of double counting of carbon credits, and monitor activities.
- **Transaction registry**. In contrast, a transaction registry is a more sophisticated system, as it has all the features of an accounting registry, plus the capacity to issue carbon credits (and assign a unique serial number), modify its status and, cancel/retire carbon units. Transaction registries may also allow carbon units transfers between multiple account holders within the registry and/or to other registries.

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[4] Double counting typically acts as an umbrella term for i) double use when the same issued carbon unit is counted twice towards achieving climate change mitigation targets, ii) double claiming, where two or more parties claim the same emissions reduction to meet their mitigation targets, and iii) double issuance, where multiple carbon units are registered for the same mitigation benefit under different mechanisms or standards.

Figure 1. Carbon registries
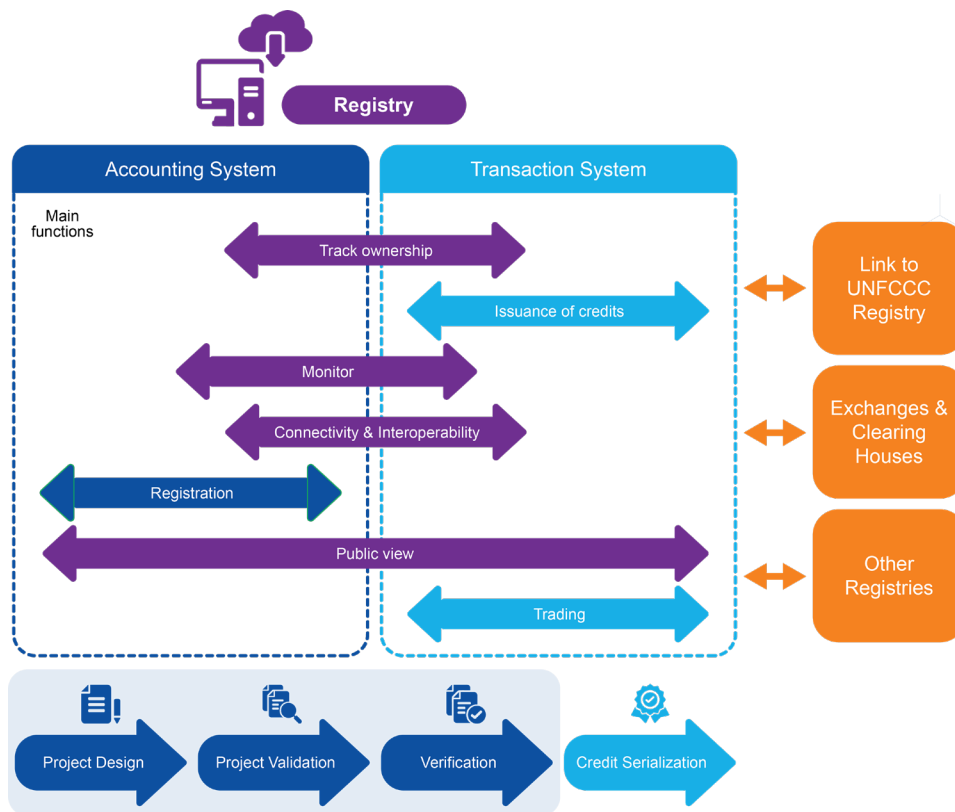
Examples of carbon registries

Registries are built under different data governance structures and rules, each tailored to meet the specific needs and objectives of their respective contexts. Carbon registries emerged under the Kyoto Protocol with the CDM and JI mechanisms. The Kyoto Protocol's compliance system- overseen by the UNFCCC – relied on the ITL as a central registry to track transactions of emission units under the Kyoto Protocol.[5] The ITL was set up as a **transactional registry** that provided a standardized platform for recording and verifying the transfer of emission units between parties, enhancing transparency, and reducing the risk of double counting.[6]

In parallel, voluntary carbon markets standards such as Verra's Voluntary Carbon Standard (VCS), the Gold Standard, the American Carbon Registry (ACR), or the Climate Action Reserve (CAR) also utilize **transaction registries** provided by registry operators for credits issued and traded under these standards (see Table 1). To participate in voluntary markets, project proponents must open an account with a registry operator. Voluntary carbon credits are issued into registries upon verification and approved by validation/verification bodies[7] and assigned unique serial numbers generated for every issued credit, allowing full traceability through the lifecycle of the credit from generation to sale, and eventual use or retirement. These registries

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[5] German Emissions Trading Authority (2017) Robust Accounting of International Transfers under Article 6 of the Paris Agreement
[6] For more information, see:
https://unfccc.int/kyoto_protocol#:~:text=In%20short%2C%20the%20Kyoto%20Protocol,accordance%20with%20agreed%20individual%20targe ts (accessed 3 April 2024)
[7] World Bank (2016) Emissions Trading Registries: Guidance on Regulation, Development, and Administration

are used by multiple stakeholders, including project developers, academics, credit purchasers, brokers and exchanges, marketplaces, and the wider public.[8]

Table 1. Examples of technology providers including registries

REGISTRY PROVIDER	STANDARDS OR PROGRAMS HOSTED
APX - Xpansiv	ACR, CAR, VERRA, ART+, Climate Forward and Massachusetts Carbon Allowance
IHS Markit	ISO 14064 – 2, Plan Vivo, Social Carbon, ACRE Carbon Standard Climate, Community and Biodiversity, Pacific Carbon Standard, UK Woodland Carbon Code, UK Peatland Code, Peru's National Mitigation Registry and OxCarbon Principles-Based Principles
Gold Standard	Impact Registry
BioCarbon	BioCarbon Registry
EcoRegistry	Cercarbono, CarbonPath and the Asia Carbon Institute
Digital for Climate (D4C)	UNDP National Carbon Registry and the World Bank's Core Registry and Enhanced Registry
Global Carbon Council and Global Environmental Markets Ltd	Global Carbon Registry
City Forest Credits	Urban Forest Carbon Project Registry
Universal Carbon Registry	Universal Carbon Registry
World Bank – CATS	Carbon Partnership Facility (FCPF) and the BioCarbon Fund Initiative for Sustainable Forest Landscapes (BioCF ISFL) ER Programs

Domestic or National registries

In more recent years, several host country governments have developed or are currently in the process of adopting or developing mainly **accounting registries** (to track GHG emissions or account for their mitigation efforts (i.e., programs that reduce or remove GHG emissions for NDC compliance) or policy instruments (i.e., carbon taxes). For instance, Colombia developed its National Emission Reduction Registry (RENARE, from its acronym in Spanish) to record information on projects that reduce or remove GHG emissions. RENARE will also register the carbon credits surrendered by entities regulated by the carbon tax to meet their compliance obligations.[9]

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[8] For more information, see: https://www.goldstandard.org/impact-registry (accessed 8 April 2024)

[9] Although the platform's operation was suspended in August 2022, Colombia's Environment and Sustainable Development Ministry has recently reactivated it. More information here. (Accessed 12 July 2024)

Other goverments and mainly economies more advanced in the implementation of mandatory carbon pricing instruments such as Emission Trading Systems (ETS)[10] - which require more sophisticated infraestructure to operate and monitor - have or are developing **transactional registries** that allow and facilitate the issuance and transfer of carbon units. The EU Emission Trading System (EU ETS) operates using the Union Registry, an electronic database that tracks the issuance, holding, transfer, and cancellation of EU emission allowances.[11] Mexico has also recently developed an Emission Allowance Tracking System through which emission allowances and carbon credits (used to compensate part of their compliance) are issued, transacted, and canceled, and where regulated entities interact to comply with their obligations in the ETS.[12]

However, implementing the Paris Agreement, which requires Parties to track progress in implementing their NDCs[13] and the more recent and prominent role governments play in carbon markets, are incentivizing the development of national registries suitable for tracking Article 6 and other carbon market transactions. For instance, Ghana's Carbon Market Office (CMO) has developed Ghana's Carbon Registry (GCR), a **transactional registry** that tracks the authorization, transfer, and use of ITMOs. Where possible, the GCR may also be linked with other countries' registries or platforms.[14] The need for a registry to track and record Article 6 transactions will require governments to decide whether to create an independent registry for these activities or transition to a national accounting system that centralizes their different data management systems (see Box 2).

Box 2. Other types of registries or data management systems operated by governments

Domestic or national carbon registries, can link to and interoperate[15] with other national climate-related data management systems (also so-called registries). Data collection and management systems are a variety of interconnected systems, platforms, and tools designed to collect, analyze, store, and manage data and information. In the context of technology and software, this may include the following:

- Greenhouse gas (GHG) inventories;

- Web applications for measurement, reporting, and verification (MRV) for Nationally Determined Contributions (NDCs) compliance (i.e., for industries or companies under voluntary or mandatory regulations);

- Registries or online data bases for implementing mandatory domestic carbon pricing instruments, such as ETS and carbon taxes.[16]

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[10] ETS are usually implemented with flexibility mechanisms, such as using carbon credits to offset part of their compliance. These offset mechanisms, also called domestic carbon crediting schemes, require a registry to at least issue and track these credit movements.

[11] An emission allowance represents a metric ton of greenhouse gas emissions emitted.

[12] Sistema de Seguimiento de los Derechos de Emisión del Sistema de Comercio de Emisiones. (Accessed 18 July 2024)

[13] World Bank (2016) Emissions Trading Registries: Guidance on Regulation, Development, and Administration

[14] Carbon Markets Office (2022) Ghana's framework on international carbon markets and non-market approaches

[15] Link between registries refers to the bilateral connection between two systems or platforms while interoperability refers to the data exchange between two or more systems.

[16] While registries for implementing carbon pricing instruments such as ETS could be considered carbon registries, it will be crucial for host country governments to assess whether existing systems could also be used for other carbon market transactions. An ETS is an instrument for domestic compliance, transactions, and accounting, while for instance complyting with Article 6 requires international reporting, accounting, and engagement with different jurisdictions and the UNFCCC (see Chapter 3). Carbon taxes are usually simpler and only need an Excel database to track compliance.

- Tracking of mitigation policies, programs or projects (i.e., jurisdictional REDD+ accounting or subnational mitigation programs);

- Other policy repositories related to environmental data and sustainability initiatives (i.e., climate finance flows);

A robust ecosystem of such systems facilitate the collection, sharing, and utilization of data to support decision-making, compliance, and transparency efforts at the national level.

Initiatives to increase transparency in carbon markets

As carbon market activities grow, strengthening their credibility has become increasingly relevant. Responding to these market needs, several initiatives and technologies are emerging, advancing and offering the potential to provide public information to increase transparency, safeguard against double-counting, and build further confidence in the market. For instance, the use of blockchain technology is supporting audit integrity, data transparency, and standardization, providing a robust framework for carbon market operations (see Box 3).

Progress in digital MRV (D-MRV) also presents opportunities to improve accountability by leveraging advanced technologies such as remote sensing, satellite imagery (e.g., for forestation-related activities), Internet of Things (IoT) devices, blockchain, and artificial intelligence to streamline data collection, automate reporting processes, enhance transparency, and improve the credibility of emissions data. By integrating these technologies into a carbon market infrastructure, stakeholders can overcome many of the challenges associated with traditional MRV approaches.[17] Currently digital MRV solutions are at an early stage of development and implementation, but there are already several pilots underway.[18]

Box 3. The use of blockchain: the Climate Action Data Trust (CADT)

Blockchain is a decentralized, distributed and public digital ledger[19] that records transactions across many computers in such a way that the registered transactions cannot be altered retroactively without the alteration of all subsequent blocks and the consensus of the network. Within carbon markets, blockchain can ensure the authenticity of carbon credits, tracing their journey from issuance to retirement, which builds trust among market participants. It also enables direct transactions between carbon credit buyers and sellers without intermediaries, which could help reduce costs and making the market more accessible to smaller entities

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[17] Fuessler et al. (2021) Infrastructure for Article 6 MRV and transfers – the potential of blockchain-based technologies.
[18] World Bank (2022) Digital Monitoring, Reporting, and Verification Systems and Their Application in Future Carbon Markets.
[19] Distributed ledger technology (DLT) is the technological infrastructure and protocols that allow simultaneous access, validation, and record updating across a networked database.

One example is the Climate Action Data Trust (CADT). The CADT, an open-source data management system designed to integrate multiple registry systems, uses blockchain-powered technology to link, aggregate, and harmonize data to enhance transparent accounting and environmental integrity of carbon credit transactions aligned with Article 6 of the Paris Agreement.

The CADT currently interoperates with various carbon credit registries (e.g., Verra, Global Carbon Council, EcoRegistry, BioCarbon Registry, the CDM and Bhutan's national registry), mirroring its data in its system.[20] The goal of the CAD Trust is to offer free public access to such information, enabling public and private sector users to use it for benchmarking, double counting risk checking, and compliance reporting.[21] It has launched a dashboard to visualize data, where users can monitor the carbon credits produced by over 17,300 projects.

The CADT was jointly developed by the World Bank, the International Emissions Trading Association (IETA), and the government of Singapore.

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[20] For more information, see: https://climateactiondata.org/registries/ (accessed 15 April 2024)

[21] For more information, see: https://www.theclimatewarehouse.org/tools/simulation-3 (accessed 15 April 2024)

Registries under Article 6

03

3. REGISTRIES IN THE CONTEXT OF ARTICLE 6 OF THE PARIS AGREEMENT

Within the framework of Article 6 of the Paris Agreement, registries will play a crucial role in ensuring transparency, accountability, and effective implementation. The UNFCCC secretariat will provide the infrastructure to ensure a comprehensive framework that accounts, tracks and facilitates international cooperation under Article 6. Parties (including host country governments, the primary audience for the report) will also be required to have or have access to a registry to engage in transactions under Article 6.2. This section presents the key elements of the secretariat's infrastructure and focuses on the registry requirements that Parties must meet to participate in Article 6.2.

3.1. The UNFCCC Article 6 infrastructure

The Article 6 guidance agreed at COP26 marked the start of a new era of carbon market infrastructure for transparency and accounting. At its center stands the UNFCCC-managed infrastructure:

- **The Centralized Accounting and Reporting Platform (CARP)**. CARP will publish the (non-confidential) information submitted by Parties in the context of the Article 6 reporting requirements[22] and will hosts the following infrastructure:

  - **The Article 6 database**. The Article 6 database will act as the repository of information on Article 6 transactions. Its information will undergo a consistency check performed by the UNFCCC secretariat.[23]

  - **The international registry**. The international registry is an online platform that will record the issuance, transfer, and cancellation of ITMOs and facilitate the transfer of units between Parties under Article 6.2. Parties can decide whether to use it to manage their Article 6.2 operations or create their own registry.[24]

- **The Article 6.4 mechanism registry.** The mechanism registry will track Article 6.4 Emission Reductions (A6.4ERs), both unauthorized Mitigation Contribution Units (MCUs) and authorized A6.4ERs (i.e., ITMOs). It will be connected to the international registry, making the two registries interoperable[25] to exchange information including but not limited to the information required to transfer ITMOs.[26] Countries are still discussing whether authorized A6.4ERs can be transferred between the two registries, and

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[22] Decision 2/CMA.3, annex, paras 35 and 36. See the CARP (interim solution).

[23] Decision 2/CMA.3, annex, B. Article 6 database.

[24] To connect with the international registries Parties must follow the interoperability requirements as presented in the Decision 6/CMA.4, annex I, para 24.

[25] Decision 6/CMA.4, annex I, para 23.

[26] UNFCCC (2022) Technical paper on options for operationalizing the guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement and in decision 2/CMA.3.

whether mitigation contribution (unauthorized) A6.4ERs can be transferred between the mechanism registry and Party registries.[27]

Figure 2 presents an overview of the UNFCCC infrastructure and Box 4 the timeline from pending issues.

Figure 2. Overview of the UNFCCC Article 6 infrastructure and (possible) connections with Party registries

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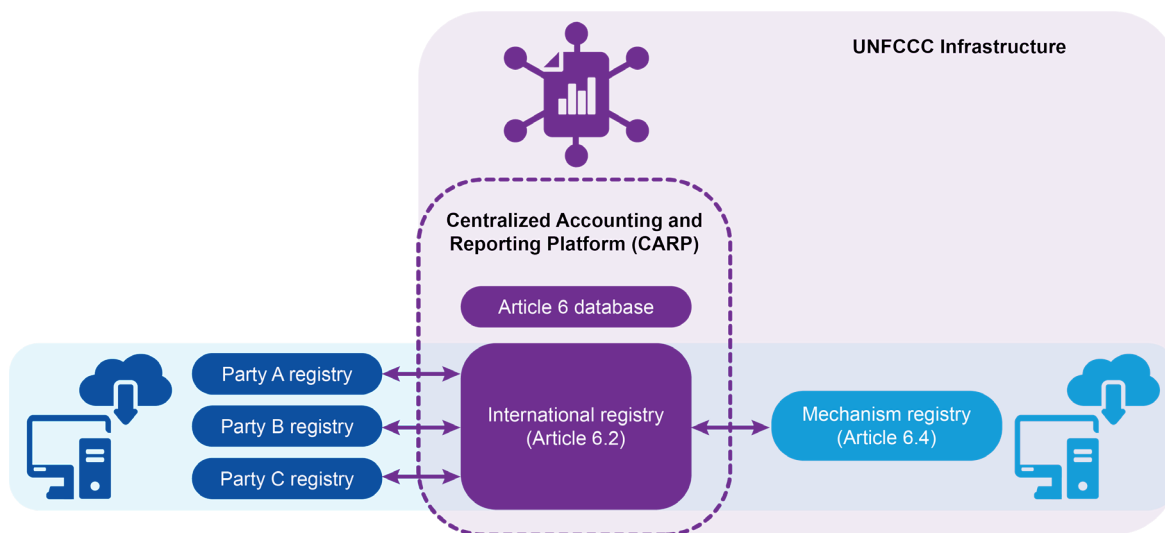
Box 4. Timelines of UNFCCC registries

This box presents an overview of the status of operationalization of the registries under the management of the UNFCCC secretariat.

International registry

According to Article 6 guidance from COP27, the secretariat must make the international registry available to Parties "not later than 2024,"[28] and must provide an interim solution in the meantime.[29]

Based on consultations with the secretariat, the interim solution will be available in October 2024 and it is being built out from the CDM mechanism registry. While the final roll out date is not clear yet, the secretariat has started examining the proposals from selected bidders, but a contract has yet to be awarded. The bidders are proposing different timelines: one offering an off-the-shelf solution proposes a delivery timeline of six months, whereas a tailored solution offered by the other two would take approximately 14 months.

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[27] The following draft decisions were not adopted by the Parties. UNFCCC (2023) Draft decision -/CMA.5, para 34: "In addition to enabling the ability to pull and view data and information on holdings and the action history of authorized A6.4ERs, the connection between the international registry and the Article 6, mechanism registry shall enable the transfer of authorized [A6.4Ers] from the mechanism registry accounts to accounts within the Party-specific sections of the international registry." And UNFCCC (2023) Draft decision -/CMA.5, para 25.: "In addition to enabling the ability to pull and view data and information [on authorized A6.4ERs], the Article 6.4 mechanism registry shall […] enable the transfer of A6.4ERs to participating Party registries that request this connection […]."

[28] Decision 6/CMA.4, para 33. "Implement the international registry in accordance with the guidance contained in annex I, chapter I.C, while prioritizing the requirements as per annex I, chapter I.A–B, and make it available to participating Parties not later than 2024."

[29] Decision 7/CMA.4, annex I, Chapter IV.

Additionally, Parties at COP28 failed to provide additional guidance on the accounts in the international registry and the possibility to transfer authorized A6.4ERs from the mechanism registry, which will have to be reassessed at COP29. At present it is unclear what kind of impact this lack of guidance will have on the overall timeline.

Article 6.4 mechanism registry

At COP27, Parties agreed on the operations of the mechanism registry (with further guidance to be adopted by Article 6.4 Supervisory Body and further guidance by Parties on the interoperability expected at COP29).[30] Based on consultations with the secretariat, the contract to be awarded to develop the UNFCCC registry infrastructure will also cover the 6.4 mechanism registry, so a timeline between six and 14 months for the full rollout can be expected.

3.2. Registry requirements for Article 6.2

When considering the Article 6.2 registry requirements, Parties should distinguish two different roles registries can play:

    a.   Meeting recording and tracking requirements under Article 6.2;

    b.   Contributing quantitative data to meet reporting requirements under Article 6.

Moreover, Parties will need the quantitative information (i.e., the total amount of ITMOs first transferred and used) stored in the registry to apply corresponding adjustments as required in the Article 6 guidance.

a) Recording and tracking requirements

A fundamental aspect of the Paris Agreement is setting robust tracking and monitoring infrastructure to assess the progress of countries in achieving their emission reduction targets. Article 6 guidance outlines specific requirements for Parties participating in Article 6.2 cooperative approaches, primarily focused on recording and tracking all ITMO movements and thus upholding the integrity of ITMO transactions[31] (see Table 2).

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[30] Decision 7/CMA.4, annex I, Chapter IV.

[31] Decision 2/CMA.3, annex, para 4. "Each participating Party shall ensure that: […] (d) It has arrangements in place that are consistent with this guidance and relevant decisions of the CMA for tracking ITMOs."

Table 2. Sources of information on registries under Article 6.2

SOURCES OF INFORMATION ON REGISTRIES UNDER ARTICLE 6.2	RELEVANT SECTIONS
Decision 2/CMA.3, annex, Guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement	II. Participation, Para 4(d) VI. Recording and tracking, A. Tracking
Decision 6/CMA.4, annex I, Guidance relating to decision 2/CMA.3, annex, chapter VI (Recording and tracking)	I. Guidance relating to the registries referred to in decision 2/CMA.3, annex, paragraph 29, A. Form, functions and processes, and B. Tracking and recording methods

According to the Article 6.2 guidance,[32] each participating Party to a cooperative approach shall have, or have access to, a registry for tracking and recording several actions performed on ITMOs and containing accounts. It does not matter if the registry is under the control of the host Party itself or not, as long as the host Party has *access to* the registry.

The registry requirements are listed in Table 3.

Parties can decide which type of registry to use to meet such requirements, including the option of using the international registry provided by the secretariat. The international registry will have the same functions outlined in Table 3.

Table 3. Registry requirements (forms, functions, and processes of registries) under Article 6.2 (Decision 6/CMA.4 annex I, para 1)

REGISTRY REQUIREMENTS UNDER ARTICLE 6.2
o   Has accounts for ITMOs
o   Records the actions related to ITMOs (i.e., authorization, first transfer, transfer, acquisition, use towards NDCs, authorization for use towards other international mitigation purposes, and voluntary cancellation (including for overall mitigation in global emissions, if applicable)
o   Tracks, maintains records and accounts for ITMOs, including through unique identifiers
o   Produces, maintains, and compiles records, information, and data consistently with the annual information submitted in the agreed electronic format (AEF)[33]

Parties should also consider guidance on the tracking and recording methods and how ITMOs should be uniquely identified in the registry (see Table 4). It is possible to track and report ITMOs in blocks (i.e., the identifier is connected to a collection of more than one ITMO).[34]

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[32] Decision 2/CMA.3, annex, para 29 and Decision 6/CMA.4, Annex I, para 7.

[33] The agreed electronic format refers to a standardized digital structure that Parties will use to submit information to the Article 6 database.

[34] For example, the ITMO identifier TH1-BCH-S0334-57-2022-16829924-16830920-1-0 identifies a block composed of 997 ITMOs. See Thailand Carbon Credit Registry.

Table 4. Elements that an ITMO identifier should, at a minimum, include (Decision 6/CMA.4, annex I, para 5)

MINIMUM ELEMENTS OF ITMO IDENTIFIER
o   The identifier of the cooperative approach
o   The identifier of the originating Party registry
o   The identifier of the first transferring Party
o   The serial number
o   The vintage of the underlying mitigation outcome

Finally, Parties that do not intend to use the international registry, must consider the matter of interoperability and implement appropriate measures to mitigate risks to the consistency of data.

b) Reporting requirements

Parties can also set up their registries with their reporting requirements in mind so that reporting is as smooth as possible, with no data inconsistencies. Article 6 guidance requires Parties the reporting of the i) (updated) initial report and ii) the annual information (see Table 5). Additionally, Parties are require to submit the regular information under Article 13.

Table 5. Sources of information on reporting of quantitative data under Article 6

SOURCES OF INFORMATION ON REPORTING OF QUANTITATIVE DATA UNDER ARTICLE 6.2	RELEVANT SECTIONS
o Decision 2/CMA.3, annex, Guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement	o IV. Reporting, B. Annual information and C. Regular information, para 21(c), para 23(c), (d), (e), (f), (h), (j)
Decision 6/CMA.4, annex VII, Draft version of the agreed electronic format referred to in **Under this context, the registry can support submitting accurate quantitative data in the Article 6 and Article 13 reporting requirements (see Figure 3), specifically for:**	
o decision 2/CMA.3, annex, chapter IV.B (Annual information)	

- **Preparing the annual information**. In the case of annual information, the data is submitted by host Parties to the Article 6 database following the AEF.[35] The registry

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[35] The AEF is now in a draft version, aiming for finalization at COP29 in November 2024. UNFCCC (2022) Draft version of the agreed electronic format referred to in decision 2/CMA.3, annex, chapter IV.B (Annual information).

should be developed considering the data categories contained in the AEF tables (such as definitions of ITMO actions and activity types and sectors) to facilitate the submission of the annual information (see Figure 4). The international registry, if used by the host country, will allow automatic pre-filling of the AEF.

- **Preparing the regular information**. While Parties must include annual information as part of the Biennial Transparency Report (BTR) under Article 13, the data for reporting will be provided by the annual information.

The information to be submitted as part of the **(updated) initial report** does not rely on the registry, which has no role at this stage of the host country reporting.

Figure 3. Overview of Article 6 reporting and the role of registries in the context of Article 6 and Article 13 reporting
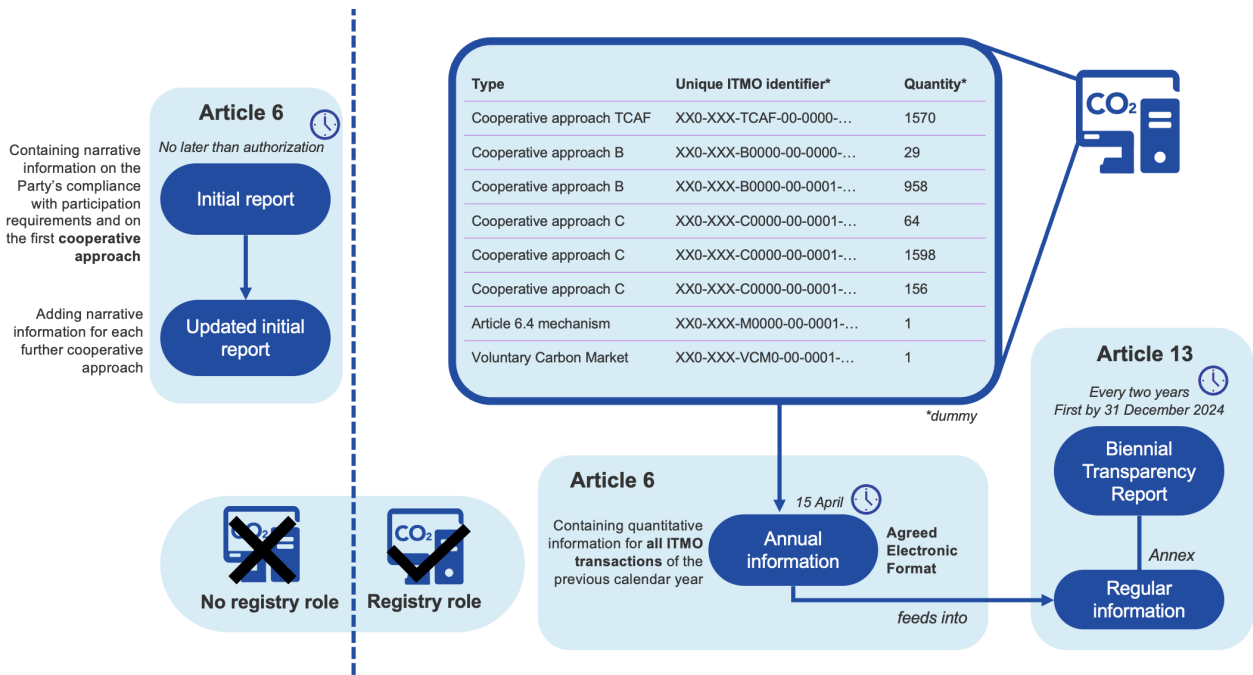

Table 1: Heading

Party	Party
Reported year	Year

a The annual period from 1 January to 31 December during which actions occurred.

Table 2: Actions

Article 6 database record ID	Cooperative approach*a*	ITMO											
		Unique identifier				Metric and quantity				ITMO details			
		First unique identifier*b*	Last unique identifier*c*	Underlying unit block start ID*d*	Underlying unit block end*e*	Metric*f*	Quantity (expressed in metric)*g*	Quantity (t CO₂ eq)	Conversion factor (reporting Party)*h*	First transferring participating Party*i*	Vintage*j*	Sector(s)*k*	Activity type(s)*l*
	Cooperative approach											Energy	
												IPPU	
	Article 6.4 mechanism											AFOLU	
												Waste	

Figure 4. Part of the draft AEF (Source)

3.3. Role of registries in the country's climate governance accounting infrastructure

The registry can play a role in the overall climate governance accounting infrastructure of the country. Through interactions with other data management systems or online platforms, registries can contribute to the streamlining of reporting processes, ensuring comparability and consistency across various data flows, and contributing to the broader objectives of climate policy planning and NDC implementation (see Figure 5). To ensure smooth interactions, governments must consider the design and technology of the different systems (see section 4).

Figure 5 Interaction of registries with the GHG inventory and MRV systems for reporting requirements
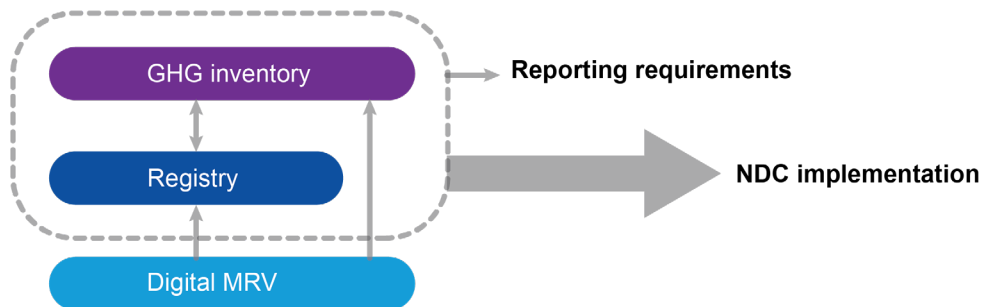
Interaction with GHG inventory

Cross-checking between the registry and the GHG inventory is crucial to ensure that the emissions reductions or removals are accounted by the inventory. This is because authorizing mitigation outcomes not reflected in the GHG inventory as ITMOs (and applying corresponding adjustments) would mean undermining the achievement of the national NDC targets. In technical terms, this is called "inventory visibility": some types of activities may generate emission reductions that are not always visible in the GHG inventory, depending on its accuracy (Tier 1, 2, and 3).[36]

Keeping a close eye on the GHG inventory at every update by making sure that the mitigation outcomes in the registry are visible can further mitigate overselling risks.

Moreover, the data provided by the GHG inventory plays a key role in the application of corresponding adjustments and in meeting the reporting requirements.[37]

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[36] Schneider et al. (2022) Visibility of carbon market approaches in greenhouse gas inventories
[37] Decision 18/CMA.1, annex, para 77(d)(i) and (ii).

Interaction with NDC implementation

Countries may have national information systems to keep track of NDC implementation (i.e., MRV of climate policies) with the primary purpose of streamlining reporting under the UNFCCC on NDC progress and informing climate policy planning.[38] Depending on the national arrangements, i.e., the use of either integrated or independent information systems, the role of the registry may differ.

An integrated national information system (such as in Kenya and Vanuatu) offers multiple benefits since it alleviates the reporting burden on data providers by requiring them to report to only one system, guaranteeing comparability and consistency across various data flows for different reporting obligations. Despite the higher initial setup costs and time required for independent systems, operating multiple independent information systems is likely to be more costly in the long term.[39] Several countries have opted for an integrated MRV system that includes a national registry.

The information contained in the registry checked against the data in the GHG inventory (e.g., types of activities and total generated emission reductions) can help to understand the status of NDC implementation, also feeding into the process of NDC updates and informing the national Article 6 strategy.[40]

Interaction with project-level digital MRV

Monitoring, Reporting, and Verification (MRV) for carbon activities are pivotal in ensuring the transparency, accuracy, and integrity of emissions reduction efforts. Traditionally, MRV processes have relied on manual data collection, often resulting in inefficiencies, delays, and potential inaccuracies. However, the emergence of digital MRV solutions presents a transformative opportunity to revolutionize how emissions data is monitored, reported, and verified.

At the project level, D-MRV is functional for the issuance of any carbon credit reflecting the emissions reductions that have taken place. For example, digital sensors can collect data in landfill projects on the quantity and makeup of biogas generated at the landfill site. This is the case of the digital MRV pilot implemented for the Copiulemu landfill gas project located in Chile. The analysis of the gas composition enables the determination of methane percentage, whose destruction contributes to emission reductions for the project. In the future, the output of digital MRV approaches at the project level could therefore feed into the processes of the national registry system before the issuance and authorization of ITMOs,[41] or even directly into the national GHG inventory.[42]

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[38] Cardoso (2019) A road map for establishing information systems for climate action and support, p. 5.

[39] Ibid., p. 21.

[40] Michaelowa et al. (2021) Promoting Article 6 readiness in NDCs and NDC implementation plans.

[41] Espejo et al. (2022) Innovative MRV Systems and Transaction Registries: Key Partners for Unlocking Finance and supporting sustainable production systems.

[42] ClimateCHECK (2022) Digital Measurement, Reporting and Verification (MRV) - Report on Pilot Projects, Roadmap and Resources

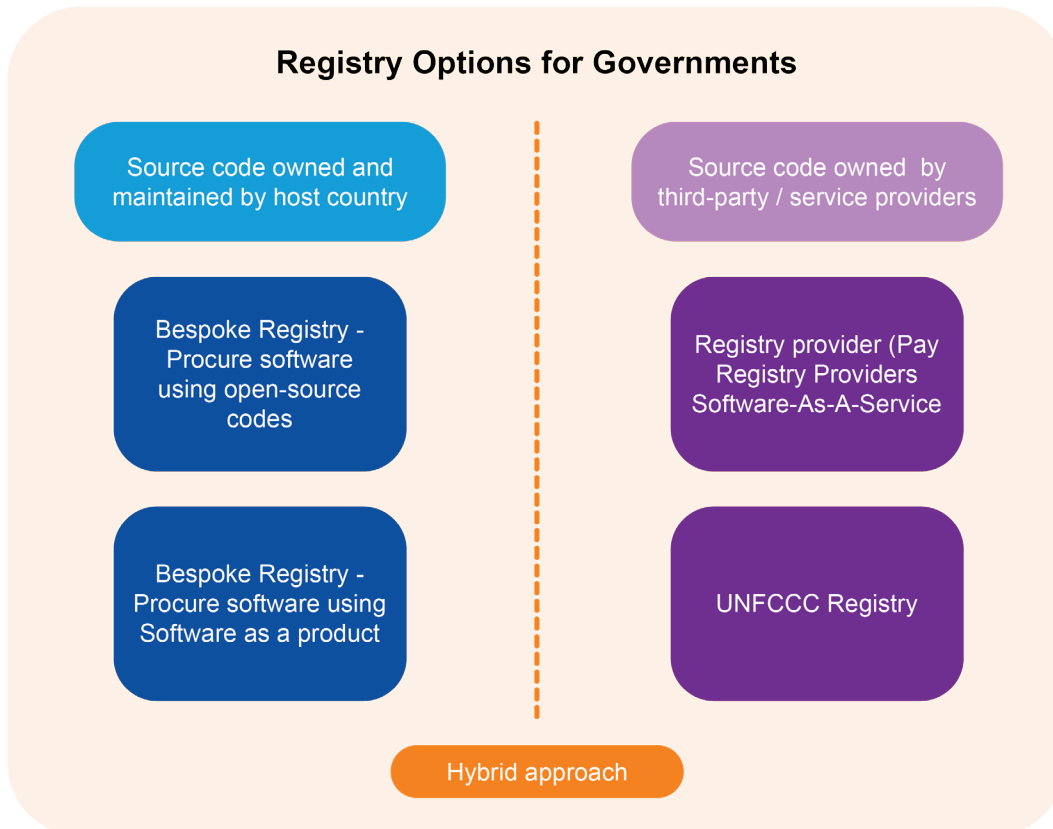# Functionalities and Options for Host Country Registries

04

4. FUNCTIONALITIES AND OPTIONS FOR HOST COUNTRY REGISTRIES

Host country governments can choose among the following options for a registry to comply with Article 6.2 requirements:

a) Develop a bespoke registry which entails building a domestic registry from scratch using proprietary or open source software codes;

b) Use a Software-As-A-Service (SAAS) which is available from third-party registry providers;

c) Use the UNFCCC international registy or;

d) Follow a hybrid approach where host governments use a combination of options to suit their needs.

Based on the ownership of the registry, these options can be categorized into registries where the source code is owned and maintained by the host country or registries where the source code is owned and provided by a third-party (see Figure 6).

Figure 6 Registry options for host country governments

Registry Options for Governments

Source code owned and maintained by host country

Source code owned by third-party / service providers

Bespoke Registry - Procure software using open-source codes

Registry provider (Pay Registry Providers Software-As-A-Service

Bespoke Registry - Procure software using Software as a product

UNFCCC Registry

Hybrid approach

When selecting an option its level of sophistication (for instance, whether they need an accounting or a transactional registry) and the number of functionalities (e.g., simple tracking, enhanced data security features, transfer of carbon units), host countries should consider several key factors, such as the following:

- **The expected volume of Article 6 transactions and whether the host country will engage with several buyers under multiple cooperative approaches.** High transaction volumes require a more advanced registry, while a simpler data management system might suffice when engaging in fewer transactions or buyers (some buyers, such as Switzerland, might already have a sophisticated registry to handle transactions).

- **Existing data management systems for climate accounting in the country**. For instance, countries with existing MRV registries can adapt or expand such systems instead of starting a carbon registry for Article 6 transactions from scratch.

- **The administrative and legal framework needed to set up the registry and ensure proper functioning**, such as having a governing body responsible for everseeing its operation and regulations and guidelines that outline procedures to register and tracking information.

- **The financial and human resources and skills available for the registry's design, operation, and maintenance** (e.g., the more sophisticated the system, the higher the costs and human capacity and skills needed in the short, medium and long term).

4.1 Registry options

To date, the registry operating and ownership decision has varied among host countries. Some governments rely on a national registry when engaging in Article 6 transactions (such as Indonesia[43]). Some of them are aiming to minimize costs by relying on pre-existing infrastructure for MRV purposes (such as Thailand[44]) or, when that is not possible, by setting up new systems with the help of capacity building initiatives. Governments that are more advanced in the process such as Ghana and Tanzania have established dedicated new infrastructure (See Box 5) while others will rely on third party registry systems.[45]

a) Bespoke registry: build a national registry

Host country governments can build a domestic registry administered by their national authorities, granting them full ownership and oversight of their infrastructure and tracking system. A national registry can be particularly helpful for host countries that aim to participate in multiple cooperative approaches (e.g., engaging in Article 6.2 and participating in carbon projects from the voluntary carbon market). Countries that are implementing domestic carbon

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[43] Minister of Environment and Forestry of the Republic of Indonesia (2022) Procedure for Implementation of Carbon Pricing; For more information, see: https://srn.menlhk.go.id/index.php?r=home%2Findex
[44] For more information, please see Thailand Carbon Credit Registry
[45] Adelphi and Gold Standard (2023) Implementing Article 6 – An Overview of Preparations in Selected Countries

pricing systems will also benefit from using a national registry tailored to their needs.[46] Governments will also have to consider whether to develop the registry independently from private registry systems or develop a registry using existing infrastructure from registry providers. Both options can help countries link or interoperate with existing national or international data management systems.

To effectively operate this option, governments must ensure sufficient technical and legal capacity to operate it. In general, building a bespoke national registry entails working with project developers that use either a private source code subject to modifications for certain fees or an open-source software:

- **Software-as-a-product (Private software).** In this case, software developers/ programmers (individuals or firms) are requested to build software based on the requirements of the government. The programmers write a code using an existing licensed (subject to modification) software. For example, Colombia's National Registry was developed by their own government software engineers and is hosted and maintained by them.

- **Open-source software.** An open-source is a source code that anyone can modify, and enhance. In the context of registries, software developers can adjust the software to any of the government requirements, including those of an accounting registry and/or a transaction registry that allows for tracking and transfer of unit ownership/holding from issuance to cancellation/retirement. For example, Costa Rica's National Registry uses open-source software to manage and operate the different modules of its system. Another example is the Digital for Climate (D4C) Working Group, which provides a joint registry offering, including the UNDP National Carbon Registry and the World Bank Core Registry. Both systems are modular, have opensource software, and technical documentation can be reused and tailored by countries. Examples of countries that deployed the UNDP and World Bank opensource registry systems include Namibia and the Royal Kingdom of Bhutan, respectively.[47]

Bespoke Registries require governments to allocate budgets (either national or international) to pay for the upfront costs of designing and building it. Depending on the requirements, costs tend to be high at the beginning and often decline with time as governments fulfill their needs to operate a registry. Furthermore, governments are compelled to assign human resources to activities such as support to users, IT administration, maintenance and operation, technological updates, troubleshooting hardware, software, and network issues and installing and configuring hardware and software components when needed.

As displayed in Table 6, these registries have the potential to be scalable as governments worldwide implement systems to connect externally, increase transparency and operate more complex markets. Furthermore, as software systems become more sophisticated and interconnected, magnifying benefits and risks, especially with other registries integration, governments must ensure the resilience of these systems against cyber threats.

By building bespoke registries, governments are entitled to directly list, track, certify, and authorize carbon units under Article 6 transactions. Depending on the functionalities of the registries that host countries require, registries will be able to interoperate with other platforms such as other registries to avoid double counting, MRV systems, GHG national inventories as

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[46] World Bank (2022) Infrastructure to Meet Reporting Requirements under Article 6

[47] World Bank (2023) State and Trends of Carbon Pricing 2023 International Carbon Markets

well as Exchanges and Clearing Houses to increase liquidity. Box 5 presents the case of Ghana that has developed a comprehensive Article 6 framework, including a registry.

> **Box 5. Ghana's Carbon Registry**
>
> Ghana has developed one of the most comprehensive Article 6 frameworks to date.[48] It covers various aspects such as eligibility criteria, procedures like authorization and project development, institutional setups, and operationalizing mechanisms such as Article 6.4 and the VCM.[49] Amongst institutional arrangements, Ghana has established the Carbon Markets Office (CMO), hosted within the climate change unit of the Environmental Protection Agency. The CMO deals with day-to-day management, including running the Ghana Carbon Registry (GCR), which tracks the authorization, transfer, and use of ITMOs.[50] All activities seeking to create authorized mitigation outcomes must be registered in the GCR. Alternatively, developers can opt to have authorized mitigation outcomes issued in the registries of recognized independent mechanisms, but they must inform the CMO about it within seven days. The GCR will then record the activity in the developer's account. Where possible, the GCR may also be linked with other registries. When registries are not linked, the cancellation will be done in one registry and created in the other one before conducting the transfer.[51]

b) Software as a Service (SaaS) by Third-Party Registry Providers

Host countries can also hire a software provider that can host the application and related data using its own servers and databases to publicly list origin, ownership, certification and status of carbon units (i.e. authorization or retirement). Registry providers can also support transactions and linkage with other registries. These independent providers are constantly updating their registry infrastructure to allow the transfer and tracking of carbon credits authorized by host countries as ITMOs under Article 6 transactions.[52] Third-party registry providers offer two options:

Option 1. Utilize third-party registry provider services and infrastructure

Opting for a third-party registry provider would suit countries that do not intend to engage in several cooperative approaches or develop a transactional registry and have limited budget. Under this case, governments would engage with a registry provider for accounting and/or transaction purposes. The registry provider would be responsible for operating the system, ensuring linkages and interoperability with other registries (if required and if data is compatible), and complying with Article 6 requirements, such as labelling carbon credits after receiving the host country authorization, receiving evidence that the host country has applied corresponding adjustments, and meeting their reporting, recording, and tracking obligations under the Article 6.2 guidance.[53]

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[48] Climate Finance Innovators (2023) The Landscape of Article 6 Implementation

[49] Carbon Markets Office (2022) Ghana's framework on international carbon markets and non-market approaches

[50] For more information, see: https://gcr.epa.gov.gh/about-us/ (accessed 3 April 2024)

[51] Carbon Markets Office (2022) Ghana's framework on international carbon markets and non-market approaches

[52] Gold Standard (2022) Guidance on Functionality to Support Attribution and Management of VERs Authorised for use Under Article 6 of the Paris Agreement; VCS (2023) Article 6 Label Guidance

[53] Gold Standard (2022) GHG Emissions Reduction & Sequestration Product Requirements

Registry providers support voluntary standards but some of them host services for mandatory carbon pricing programs and might have the technical capabilities to support Article 6 transactions. Table 1 shows a list of registry providers around the world with the standards and programs they host or ultimately aggregate. Figure 7 lays out the simplified process to account and transfer ITMOs utilizing a registry provider. In this case, host countries will utilize the registry provider's infrastructure to advertise their carbon units and keep track of any movements transactions with other countries or buyers.

Figure 7. Use a third-party registry provider
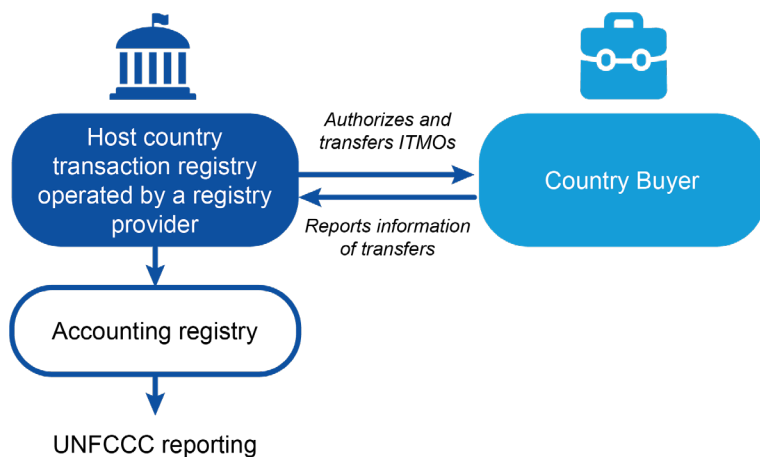
Source: Authors

Depending on the commercial arrangement and the business model of the service provider (see table 6) transaction fees – paid by buyers – could help defray the registry's use, maintenance and hosting cost. Allowing buyers to pay up for an aggregated transaction could help alleviate the registry cost for host countries. The main advantage of this approach is that countries can delegate all technical support to the registry operator including Know Your Costumer (KYC) (and associated authentication) as well as users' training, security and system updates. Engaging with registry providers may allow governments to customize their website (i.e. frontend) and domain and potentially add some basic accounting, transaction and interoperability functionalities. This often results in a great deal for countries who want to semi-customize their webpages but do not have the technical capacities to operate neither the registry's front end nor the back end.

Option 2. Utilize standard or government-operated registries

Host country governments can also opt for using carbon standards or government-operated registries when engaging in bilateral transactions. For instance, host country governments might be able to authorize ITMOs in the third-party's registry but would still be responsible for recording and tracking their movements and apply corresponding adjustments using their own accounting/transaction systems.

For instance, host country governments that have entered into bilateral cooperation agreements with Switzerland must conduct the associated ITMO transactions in the Swiss Emissions Trading Registry operated by the KliK Foundation for Climate Protection and Carbon

Offset. The KliK Foundation bought, transferred, and registered 1,916 ITMOs[54] to the Swiss Emissions Trading Registry account in December 2023. To prevent double counting, host countries must communicate any emissions balance reflecting its NDC adjusted on the basis of corresponding adjustments.

Host countries can also use the independent standards registries, such as the Gold Standard, for transactional purposes. Some standards are updating their registry infrastructure to make sure that a) carbon credits issued by their standard can be authorized by host countries as ITMOs under Article 6 transactions, and b) ITMOS can be properly tracked.[55]

Under this case, host country governments have no direct contract with the registry provider, but would need to authorize ITMOs and be responsible for recording and tracking their movements in a national database or their own accounting registry. The standard or government-operated system would be responsible for maintaining the registry, ensuring linkages with other registries, and complying with Article 6 requirements, such as labelling carbon credits after receiving the host country authorization, receiving evidence that the host country has applied corresponding adjustments, and reporting to enable countries to meet their reporting, recording, and tracking obligations under the Article 6.2 guidance.[56]

Opting for a private registry would suit countries that do not intend to engage in several cooperative approaches or that have authorized activities where carbon credits can be issued by a specific standard.

Figure 8. Use of a standard or government-operated registry
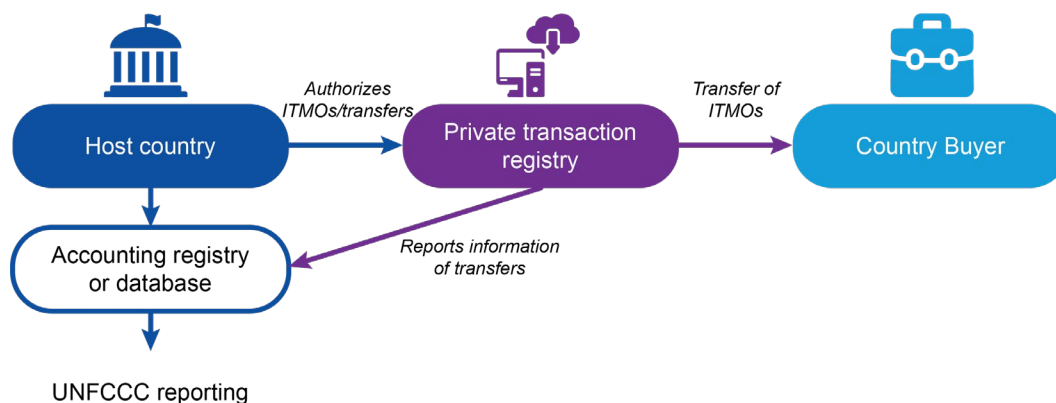
Source: adapted from World Bank. 2022. Infrastructure to Meet Reporting Requirements under Article 6. Article 6 Approach Paper Series

c) Option 3. Utilize UNFCCC registry

Parties can use the international registry that will be managed and overseen by the UNFCCC Secretariat. Using the UNFCCC registry is also considered a SaaS by third-party registry providers. The international registry will combine the registry sections of each participating Party. The UNFCCC Secretariat has key responsibilities in managing this registry, including

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[54] In this context, 1 ITMO represents a tonne of CO2e reduced.

[55] Gold Standard (2022) Guidance on Functionality to Support Attribution and Management of VERs Authorised for use Under Article 6 of the Paris Agreement; VCS (2023) Article 6 Label Guidance

[56] Gold Standard (2022) GHG Emissions Reduction & Sequestration Product Requirements

ensuring security, maintaining quality standards, overseeing registry software, monitoring system changes as well as limiting development and operational costs.

The international registry is open for use by Parties who would like to engage in Article 6 transactions and may not have the technical nor financial capabilities to operate an accounting/transaction registry. In this scenario, any Party can request access to the international registry. The UNFCCC expects to offer an interim solution for the international registry by October 2024 and a fully operational registry in six to 14 months by the time the report is written (see Box 4). As mentioned above, host country governments can choose the type of functionality of the international registry they want to use (accounting and/or transactional).

If host countries decide to adopt the international registry, governments should be aware that there are limitations such as scalability and other operational-type of restrictions over some functionalities necessary to collect, store and interoperate data.

Summary of criteria to assess the type of registry

Each option laid out above has trade-offs that should be carefully considered, such as the functionality, technical and administrative capacities of the government authorities that will operate the registry, costs, custom approach to the national context, and level of engagement in Article 6 activities.

Table 6. Criteria to assess the type of registry

Categories to assess	Bespoke Registry	Software as a Service (SaaS)[57] by Registry Providers	International registry[58]
Time to onboard[59]	6-12 months	1-2 months	Once ready, it could be relatively fast
Customizable[60]	Yes	Yes, just front end, not back end	No
Data migration[61]	Yes, ideally using REST	Depends on the data type of the SAAS company	N/A
Maintenance to conduct technology		Depending on the business model but generally no as it	Yes

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[57] SaaS is a software delivery model where software applications are hosted and maintained by a service provider and accessed by users over the internet. In this model, users subscribe to the software on a subscription basis, typically paying a recurring and/ or maintenance fee. SaaS eliminates the need for users to install, manage, and maintain the software locally, offering benefits such as scalability, accessibility, and cost-effectiveness. (Proprietary for the most part, open source is also possible with no possibilities of modifying the source code).

[58] UNFCCC (2023) Implementation of the Centralized Registries (Article 6) and UNFCCC (2023) Functional requirements and associated cost estimates for the international registry

[59] Time to onboard is the duration required to familiarize a new user or client with a system or service. This includes the processes of signing up, learning the system's functionalities, and integrating the service into the daily operations.

[60] This refers to the ability of a registry or online platform to be modified according to user needs or specific Requirements. High customizability allows for significant user control over functionality, interface, and performance settings, often crucial in specialized and/or sophisticated trading registry applications or diverse user environments.

[61] Data migration is the process of transferring data between storage and/or management systems to selected formats or computing environments. This process is critical in system upgrades, consolidation, and cloud adoption, requiring rigorous methodologies to ensure data integrity and minimize downtime.

upgrades and data storage [62]	For private source code: It depends but maintenance fees are charged upon request by the government For open sources: no	is included in the transaction fee	
Business model [63]	Pay per feature and/or Pay per transaction	Subscription Pay per feature added Pay per transaction	TBD
Customer support service included [64] **(e.g. KYC)**	No	Yes	Yes
Requieres dedicated IT staff (from the government side) [65]	Yes	No	No
Robust security [66]	Depends on how much the country is willing to invest in Systems and Operational Control (SCO)	Yes	Yes
Software updates [67]	Depends on how much the country is willing to invest in updates	Yes, regularly.	Yes
Supports many data types [68]	Depends on how much the country is willing to invest	Yes	No
Scalability [69]	Yes	No (unless the country is willing to pay for additional features)	N/A

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[62] It refers to the continuous support and service provided to software or systems after initial purchase. This typically includes regular updates, technical support, enhancements, ensuring the system remains functional and secure over time.

[63] A business model delineates the commercial structure supporting the viability and operation of a registry. This often encompasses revenue generation strategies, such as subscriptions, licensing, services and consulting, advertising, transaction payments, leasing and renting and, sale of user data that ensure profitability over time.

[64] Customer support, particularly in contexts such as Know Your Customer (KYC), involves helping users through services designed to verify the identity of clients and maintain records. This is crucial for compliance with financial regulations and for ensuring secure and trustworthy customer relationships.

[65] This term refers to the allocation of IT staff dedicated specifically to a project or system. The number or proportion of dedicated IT staff is often indicative of the project's complexity and the level of support required for its operation and maintenance.

[66] Robust security in technology refers to comprehensive safeguards designed to protect systems and data from various threats, including unauthorized access, attacks, and data breaches. Effective security measures are dynamic and encompass physical, administrative, and technical controls.

[67] Software updates involve the modification of software to enhance functionality, correct errors, and address security vulnerabilities. Regular updates are essential for maintaining operational efficiency, compatibility with other technologies, and security standards.

[68] Supporting many data types refers to a system's ability to handle various forms of data, such as text, images, audio, and video, as well as more complex data structures. This capability is crucial in ensuring flexibility and broad applicability across different data-intensive applications.

[69] Scalability is the capability of a system or a process to handle a growing amount of work, users or functionalities or its potential to accommodate growth. For registries, scalability is crucial for ensuring that systems can evolve in response to increasing user demands, operational and compliance needs.

Interoperability[70]	Depends on how much the country is willing to invest	Yes, if it allows APIs or connectivity with other platforms Connectivity usually occurs with platforms or external marketplaces approved by the own registries for specific activities (e.g., operating an exchange platform, hosting auctions, operating a retail aggregator marketplace).	Yes
Data storage[71]	Depends on how much the country is willing to invest	Yes	Yes
Operations (QA/QC)[72]	Depends on how much the country is willing to invest	Yes	Yes
Public acceptance[73]	Yes	Maybe	Yes
Software source (registry ownership)	1. Open source 2. Private source code [74] In both options, countries ideally own the source code and thus they can modify it using their own dedicated IT staff or a software development firm	Proprietary (registry provider owns the source code and thus governments cannot modify it) Proprietary (UNFCCC owns the source code)	
Implications on national budget[75]	Yes	It depends on the commercial arrangement with the registry provider but transaction fees can make up the cost of the initial investment and the maintenance going forward	No

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[70] It is the capability of different registries or online systems or applications to exchange and make use of data information across a variety of operational and technological boundaries, promoting seamless interaction and functionality within a larger ecosystem.

[71] Data storage pertains to the methods and technologies used to store and preserve digital data. Data storage solutions vary widely, from local servers and personal devices to cloud-based systems, and are fundamental in ensuring data redundancy, security, and quick access.

[72] Operations involving QA/QC (Quality Assurance/Quality Control) refer to the systematic processes and procedures used to ensure that a product, service or data stream adheres to a defined set of quality criteria or meets the requirements of the client or customer.

[73] Public acceptance refers to the degree to which the general public approves and adopts a new technology or system. This concept is vital in contexts where user endorsement directly impacts the success of a technology. In a registry context, public rejection may originate from multiple factors such as language, development of local capacities, budgets, etc.

[74] Platforms owned, controlled and operated by specific entities that restrict access, modification, and redistribution of their software.

[75] It refers to the systematic planning, allocation, and monitoring of financial resources within an organization or government. In the case of registries, government budgets set up by policies are critical for ensuring operational efficiency and financial health, guiding spending decisions in accordance with operational objectives.

Short term costs[76]	High (lower for open-source)	Low	TBD
Long term costs[77]	Low	High	TBD
Provider[78]	Software development consultant/company	IHS Markit, APX and/or potential standard or government registries. See table 1	UNFCCC

d) Using a Hybrid approach

Host country governments can also choose a mixed approach, such as developing a national accounting registry for recording and tracking purposes while relying on a third-party registry for ITMO transfers and transactions.This approach can support host countries in communicating with different registries and allow full flexibility when engaging with different cooperative approaches (e.g., using existing standards to authorize ITMOs, engaging in bilateral transactions, and defining their projects and methodologies). The crucial aim for host country governments is to record and track all the ITMO movements related to their countries' Article 6.2 transactions. Examples of hybrid modes include utilizing an open-source registry or a simple data management system for accounting purposes and the UNFCCC or buyers registry (e.g., such as Switzerland) for transaction purposes. The World Bank, for instance, has developed the Carbon Asset Tracking System (CATS) for host countries that engage in the Bank's emission reduction (ER) programs to act as a transactional registry (See Box 6). Using a hybrid approach could help governments with limited budgets operate both accounting and transaction registries simultaneously that rely on two different but compatible technological systems.

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[76] This encompasses all immediate expenditures necessary for the implementation and initial operation of a project or system. In technology, this typically includes setup costs, initial hardware and software purchases, and the first phase of staff training and deployment.

[77] It refers to the aggregated expenses associated with a project or system over an extended period. These costs include direct and indirect expenses such as maintenance, upgrades, technical support, troubleshoot and the operational costs of staffing and hosting

[78] In a registry context, providers are entities that supply technology services or products. These can range from storage, computing services, accounting and trading platform technologies to full-scale IT solutions, integral to data information and management online platforms and exchanges.

Box 6. The Carbon Asset Tracking System (CATS)

The World Bank's (WB) Climate Finance Mobilization Unit (SCCFM) established in 2021 a centralized (ER) Transaction Registry – CATS – to enable the issuance and transaction of ER units as required by the Forest Carbon Partnership Facility (FCPF) and the BioCarbon Fund Initiative for Sustainable Forest Landscapes (BioCF ISFL) programs. The system was implemented as an in-house solution and started to operate under the following assumptions:

1. The WB issues Ers in CATS on behalf of and for the benefit of the host countries when governments don't have transaction platforms.
2. The WB transfers such Ers within CATS between different holding accounts, subject to the host country's contractual obligations.
3. The WB – as CATS operator – provides a secure and transparent transactional platform for all issued ER units, minimizing risks for account holders.

CATS provides all the elements for users to meet the requirements from both ER programs. CATS also facilitates the implementation of ERPAs (ER Payment Agreements), allowing the issuance and transfer of "contracted Ers" (i.e., committed volumes of Ers between parties).

In 2023, SCCFM started CATS 2.0 to enhance and consolidate the platform as a transactional registry solution for all the WB programs generating carbon credits and offering a robust, transparent, and secure service adapted to the new Paris Agreement market framework. In May 2024, with the issuance and first payment of 0.5 million Ers (USD 7.5 million) under the Uzbekistan iCRAFT Program, TCAF joined the list of WB ER programs with results transacted through CATS.

4.2 Registry functionality

The registry's functionality will depend on whether it is an accounting or a transaction registry. An accounting registry (or a simpler data management system such an Excel spreadsheet) is more suited to countries hosting few carbon projects and beginning to set up their carbon market infrastructure. Such a registry would need to meet the requirements under Article 6.2, such as tracking and recording ITMOs' actions and containing accounts (see full requirements in Table 3), and be designed to facilitate reporting to the UNFCCC. Under this scenario, host countries will have to use an external transaction registry that handles the transfer of ITMOs. In the future, and as governments advan'e in carbon market activities, they may dedicate resources to building a national transaction registry.

A transaction registry is more suited to governments experienced in carbon markets or with existing registry infrastructure in place. Developing and managing a transaction registry requires higher costs, expertise, and staff resources (see Table 6). The international registry,

for instance, will serve as both a transactional and an accounting registry, and it is up to the host country to define if it will use it and for which functionality.[79]

Interoperability between registries

Host country governments should consider how their chosen registry type will interoperate with other registries. For instance, an accounting registry will aim to exchange data or information across registries and the transaction registry, data and information about the transfer of carbon credits, including ITMOs. This choice affects the compatibility of the registry hence increasing the technological needs and complexities of the registry.

Interoperability occurs in the backend of any software system (see Figure 12) via an Application Programming Interface (API). APIs enable communication between different software applications, which can be running on different servers, devices, software architecture and programming languages. In the context of registries, interoperability is defined as the ability to securely communicate and automatically link, share or exchange data irrespective of geographical, political, or organizational boundaries. In order to successfully allow registry systems to interoperate, host countries who decide to build an accounting and/or transaction registry from the ground up must ensure a RESTful API web service is built so that two or more computer systems can securely integrate.[80]

If host countries decide to build a bespoke registry, it is a key factor for the success to establish an API service since the beginning. For countries who decide to adopt a third-party registry, governments should make sure that such systems integrate an API and thus, allow interoperability between multiple systems, applications, or users.

Benefits of interoperability

- **Streamline data management and efficiency**. System interoperability allows data and information on carbon units to be exchanged more cohesively without being disrupted by system incompatibility. By allowing integration with different registries, governments can better handle and consolidate several fragmented data streams and data access. Interoperability removes repetitive, redundant data and information and ensures all participants receive timely access to accurate and relevant information. Registries can operate in real time with minimum data processing.

- **Promote scalability**. Data interoperability enhances a host country's ability to expand operations and adapt to dynamic market trends. With interoperable systems, governments share data at scale without being restricted by structural and operational limitations.

Use cases

- UNFCCC Registry. Interoperability supports links between host country registries and the UNFCC to ensure Article 6 operations are tracked and recognized in both systems.

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[79] UNFCCC (2023) Functional requirements and associated cost estimates for the international registry

[80] JavaScript Object Notation (JSON) and REST architecture is the most widely used data format for data interchange on the web. It is advisable that host governments adopt these languages as they use conventions that are familiar to programmers

- Standard-setters, government registries, and registry aggregators. Interoperability increases carbon credit integrity and transparency around projects and credit retirements to avoid double selling or double counting of carbon credits.

- Exchanges and auction platforms. Interoperability can support trigger liquidity in either primary or secondary markets as well as develop more standardized processes to sell environmental commodities.

Figure 12. Example of interoperability between registries
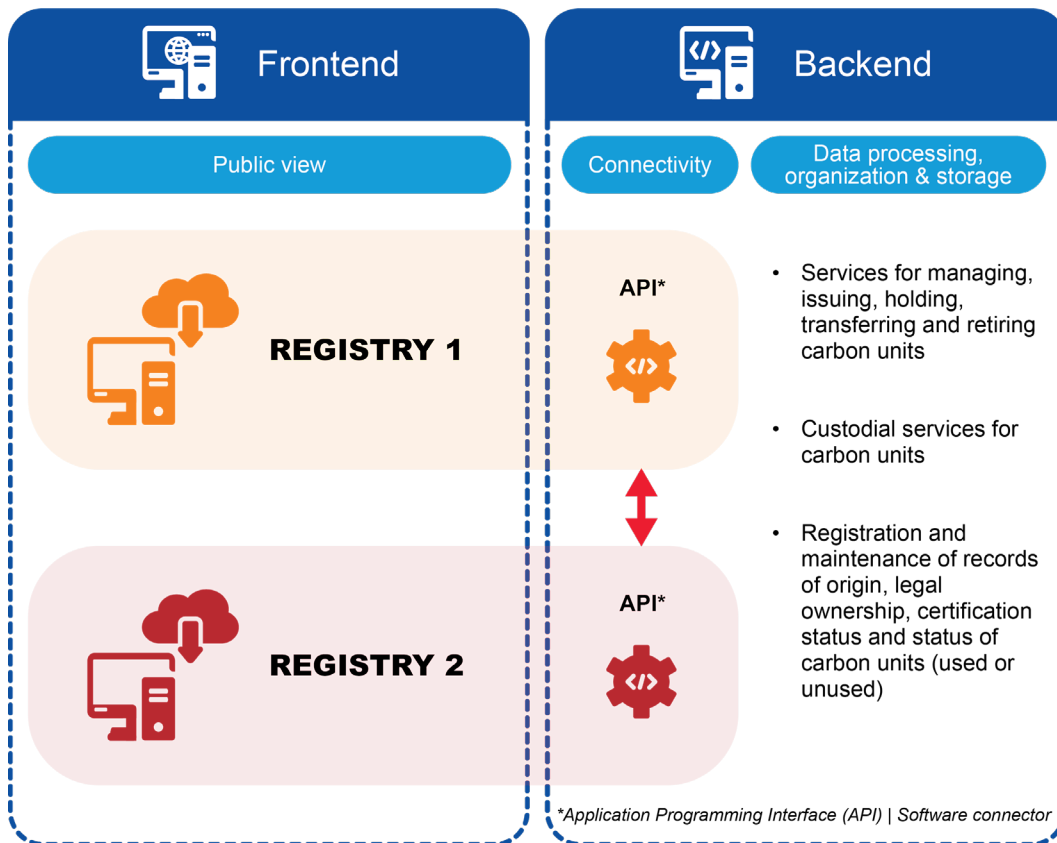
Source: Authors

4.3 Recommendations

Host country governments should align the registry's option and level of sophistication with the expected volume of transactions and cooperative approaches under Article 6, the country's existing data management systems, its legal framework, and the capabilities of its human and financial resources. In a strict sense, it is best practice and request by the Article 6 guidance for all governments to have an accounting registry, even if this is in the form of an Excel spreadsheet to track and record ITMO movements.

Governments who would like to adopt an accounting registry system (i.e., software) should ensure that the registry meets the following:

- It is open and accessible to all participants (developers, government officials, etc);

- It allows for adequate levels of transparency, with appropriate recordkeeping and reporting;

- It facilitates to comply with the UNFCCC reporting requirements.

On top of the above, host country governments should consider the following elements when deciding to build or use a transaction registry:

- The software should be free from abusive, fraudulent, manipulative, evasive, or disruptive activity;

- Governments should ensure the public disclosure of credit purchases and retirements;

- The registry should be central to carbon credit integrity and transparency around projects and credit retirements;

- If interoperability is allowed, registries with explicit permissions should ensure that external marketplaces are not double selling or double counting carbon credits;

- To increase efficiency and optimization, governments should avoid having small individual systems to address different accounting needs but aim for a centralized management system (i.e., adapting existing systems from MRV or carbon pricing instruments with the Article 6 registry). Despite its higher initial setup costs and time required for building or adapting it, operating multiple systems is likely to be more costly and require more time to operate in the long term;

- Governments should ensure that the registry has the potential for scalability and technology upgrades, such as managing an increasing volume of transactions, adapting to evolving reporting requirements, or enhancing data security.

- If the government builds its own registry, it should ensure that it owns the source code so it can be easily adjusted in the future.

5. ANNEX 1: REGISTRY LANDSCAPE

Overview of existing open-source registries related to Article 6

Institution	Registry Name	Function	Transactional registry
UNFCCC	International registry under Article 6.2	It is part of the digital infrastructure for tracking and recording ITMOs of the Parties participating in cooperative approaches under Article 6.2.[81]	Yes
UNFCCC	Article 6.4 mechanism registry	It is a standardized electronic database that ensures the accurate accounting of the issuance, holding and acquisition of issued Article 6.4 emission reductions (A6.4Ers), in particular, Mitigation Contribution Units (MCUs), authorized A6.4Ers and Certified Emission Reduction Units issued by the Clean Development Mechanism (CDM) established by the Kyoto Protocol (CERs) eligible for transition from the CDM.[82]	Yes
Gold Standard	Impact Registry	It is the platform where Gold Standard projects, including carbon credits, are managed. It allows for issuing, holding, transferring, and retiring credits, ensuring transparency and credibility. It also supports the labelling and administration of Gold Standard Verified Emission Reductions (VERs) for use under Article 6 of the Paris Agreement.[83]	Yes
Verified Carbon Standard	Verra Registry	It is the main repository for all information and documentation on Verra projects and units. It provides guidance on how Verified Carbon Units (VCUs) under the Verified Carbon Standard (VCS) Program can receive Article 6 Labels, indicating authorization for specific uses by host countries under Article 6 of the Paris Agreement.[84]	Yes
UNDP	National Carbon Credit Registry	This registry helps countries manage national data and carbon credit trading, tailored to their needs. It is supported by a cloud-based monitoring, reporting, and verification system (iMRV Tool) and an Article 6.2 platform developed by the UNDP. It also recognizes leading market-based standards like Gold Standard, Verra, GCC, and ISO.[85]	
World Bank	Core Registry	It is an open-source national carbon registry that provides basic manual entry functionalities to upload projects and units' data in sync with the CADT (see below). Provides basic manual entry functionalities to upload projects and units' data.[86]	
	Enhanced Registry	This platform provides advanced features for countries, including project management, unit issuance, and transaction tracking between registry account holders. It can also track workflows, manage project types and	Yes

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[81] Decision 2/CMA.3, annex, paragraph 29 and 30

[82] UNFCCC (2023) Modalities for operation of the Article 6.4 mechanism registry

[83] Gold Standard (2022) Guidance on Functionality to Support Attribution and Management of VERs Authorised for use Under Article 6 of the Paris Agreement

[84] VCS (2023) Article 6 Label Guidance

[85] For more information, see: https://www.theclimatewarehouse.org/work/digital-4-climate (accessed 4 April 2024)

[86] Ibid.

	CAD Trust	It is an open-source metadata system designed to facilitate the integration of multiple registry systems. It currently interoperates with various carbon credit registries (Verra, Global Carbon Council, EcoRegistry, BioCarbon Registry, the CDM and Bhutan's national registry), mirroring data across them. It links, aggregates, and harmonizes credit registry data to enhance transparent accounting and environmental integrity of carbon credit transactions, in line with Article 6 of the Paris Agreement [88]	No

methodologies, and generate reports on project and sector performance. [87]

Overview of active national registries for the operation of Article 6

Country	Registry Name	Functions	Transactional registry
Ghana	Ghana Carbon Registry (GCR)	Ghana's national registry, which tracks the authorization, transfer, and use of ITMOs – in line with Article 6. All activities seeking to create authorized mitigation outcomes must be registered in the GCR. [89]	Yes
Indonesia	Sistem Registri Nasional (SRN)	Web-based system that supports the implementation of carbon pricing instruments in Indonesia. Internationally traded units are recorded in the here. [90]	tbc
Peru	RENAMI	A platform that enables the collection, registration, monitoring, and management of information on emissions reduction or removal activities that generate credits for domestic, international or voluntary carbon markets, and activities that transfer emissions internationally, either for use under Article 6, for other schemes such as CORSIA, or for other international offsetting purposes. [91]	Yes
Thailand	Thailand Carbon Credit Registry	Thailand's national registry, used for tracking and recording ITMOs. [92]	Yes
Switzerland	Swiss Emissions Trading Registry	Countries engaging in transactions with Switzerland or with the Klik Foundation for Climate Protection and Carbon Offset are required to affect the transaction in the Swiss Emissions Trading Registry. [93] Countries that have used the registry: Peru, Ghana, Senegal, Georgia, Vanuatu, Dominica, Thailand, Ukraine, Morocco, Malawi, and Uruguay	Yes
Nepal	Under development	Nepal will most likely use third-party infrastructure; however, this is yet to be finalized and will be addressed in the Operations Manual currently under development. [94]	TBC
Countries with registries under development: Kenya, Nigeria, Rwanda, Vanuatu, and Zimbabwe. [95]			

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[87] Ibid.

[88] For more information, see: https://climateactiondata.org/registries/ (accessed 15 April 2024)

[89] For more information, see: https://gcr.epa.gov.gh/about-us/ (accessed 3 April 2024)

[90] Adelphi and Gold Standard (2023) Implementing Article 6 – An Overview of Preparations in Selected Countries

[91] Ibid.

[92] Ibid.

[93] Adelphi and Gold Standard (2023) Implementing Article 6 – An Overview of Preparations in Selected Countries

[94] Ibid.

[95] Adelphi and Gold Standard (2023) Implementing Article 6 – An Overview of Preparations in Selected Countries; GGGI (2023) Implementing Article 6 of the Paris Agreement: Options for governance frameworks for host countries

6. ANNEX 2: GLOSSARY

ARTICLE 6/CARBON CREDITS	
ARTICLE 6.2 COOPERATIVE APPROACHES	Article 6.2 of the Paris Agreement establishes the framework for voluntary cooperation between countries in their efforts to achieve their nationally determined contributions (NDCs) and promote sustainable development. This involves the use of internationally transferred mitigation outcomes (ITMOs) between two or more parties. Countries can engage in cooperative approaches, such as emission reduction or removal projects, joint implementation, and emissions trading, to collectively enhance their climate action. The article provides guidelines for the accounting of emissions reductions, ensuring environmental integrity and avoiding double counting.
ARTICLE 6.4 MECHANISM	Article 6.4 establishes a centralised mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development. This mechanism aims to promote the reduction of emissions on a global scale while fostering sustainable development in the host country. It is the successor of Kyoto Protocol's Clean Development Mechanism.
ITMO	ITMOs are a key component of the Paris Agreement's Article 6. Parties can transfer and use ITMOs to meet part of their NDCs, facilitating international cooperation. The process involves the authorisation of mitigation outcomes as ITMOs, which can then be transferred and counted towards the mitigation efforts of another country. ITMOs can be used for the following purposes: Achievement of NDCs; International Mitigation Purposes (IMP) (e.g., compliance under Carbon Offsetting and Reduction Scheme for International Aviation, CORSIA) Other mitigation purposes (i.e., voluntary climate commitments).
CORRESPONDING ADJUSTMENTS	To prevent double counting and maintain the overall mitigation ambition, corresponding adjustments are required when accounting for ITMOs. Parties involved in the transfer and use of ITMOs must make adjustments to their emissions balance to ensure that the same emission reduction is not counted more than once. Parties are required to submit detailed reports on their mitigation activities, including the generation and transfer of ITMOs, to the United Nations Framework Convention on Climate Change (UNFCCC).
AUTHORIZATION	(ITMO) authorization pertains to the approval granted for the transfer of carbon credits or emission reductions between parties under Article 6 of the Paris Agreement.
ISSUANCE	Issuance refers to the allocation or creation of carbon credits or allowances to a project or entity upon meeting predefined criteria and fulfilling requirements under a carbon market scheme. Once issued, these credits or allowances can be traded or sold within the market to offset emissions or comply with regulatory obligations.
REGISTRIES	
INTEROPERABILITY	It is the capability of different registries or online systems or applications to exchange and make use of data information across a variety of operational and technological boundaries, promoting seamless interaction and functionality within a larger ecosystem.
SCALABILITY	Scalability is the capability of a system or a process to handle a growing amount of work, users or functionalities or its potential to accommodate growth. For registries, scalability is crucial for ensuring that systems can evolve in response to increasing user demands, operational and compliance needs.
OPEN-SOURCE REGISTRIES	A platform where the source code is available to the public for use, modification, and sharing under defined licenses.
PROPIETARY REGISTRIES	Platforms owned, controlled and operated by specific entities that restrict access, modification, and redistribution of their software.
OTHER SYSTEMS/PLATFORMS	
DATA INFORMATION AND MANAGEMENT SYSTEMS	A variety of interconnected systems, platforms, and tools designed to collect, analyze, store, and manage data and information. In the context of technology and software, this may include greenhouse gas (GHG) inventories, web applications, measurement, reporting, and verification (MRV) systems, and policy repositories related to environmental data and sustainability initiatives.

SOFTWARE AND DATA	
SOFTWARE AS A SERVICE (SAAS)	SaaS is a software delivery model where software applications are hosted and maintained by a service provider and accessed by users over the internet. In this model, users subscribe to the software on a subscription basis, typically paying a recurring and/ or maintenance fee. SaaS eliminates the need for users to install, manage, and maintain the software locally, offering benefits such as scalability, accessibility, and cost-effectiveness. (Proprietary for the most part, open source is also possible with no possibilities of modifying the source code).
SOFTWARE AS A PRODUCT	Software as a product refers to traditional software delivery models where software is developed, packaged, and sold to users as a tangible product. In this model, users purchase licenses or copies of the software to install and run on their own hardware infrastructure. Software as a product typically involves one-time purchases or perpetual licenses, with users responsible for managing and maintaining the software themselves. (could be open source or proprietary).
SOFTWARE PROVIDERS	In a registry context, providers are entities that supply technology services or products. These can range from storage, computing services, accounting and trading platform technologies to full-scale IT solutions, integral to data information and management online platforms and exchanges.
SOURCE CODE OWNER	The source code owner is the entity or individual who holds legal ownership and control over the source code of a software product. Ownership determines who can modify, distribute, and license the code, critical in proprietary registries where the code is a commercial asset.
DATA GOVERNANCE	It involves the oversight, management, and control of data assets to ensure accessibility, reliability, and integrity throughout their lifecycle. This includes establishing policies, standards, and procedures to manage data privacy, compliance, quality, and usage effectively in an organizational context.
DATA MIGRATION	Data migration is the process of transferring data between storage and/or management systems to selected formats or computing environments. This process is critical in system upgrades, consolidation, and cloud adoption, requiring rigorous methodologies to ensure data integrity and minimize downtime
DATA STORAGE	Data storage pertains to the methods and technologies used to store and preserve digital data. Data storage solutions vary widely, from local servers and personal devices to cloud-based systems, and are fundamental in ensuring data redundancy, security, and quick access.
REGISTRY OPERATIONS	
LONG TERM COSTS	It refers to the aggregated expenses associated with a project or system over an extended period. These costs include direct and indirect expenses such as maintenance, upgrades, technical support, troubleshoot and the operational costs of staffing and hosting.
SHORT TERM COSTS	This encompasses all immediate expenditures necessary for the implementation and initial operation of a project or system. In technology, this typically includes setup costs, initial hardware and software purchases, and the first phase of staff training and deployment.
FEES	In the context of registries, fees refer to the charges incurred for accessing, visualizing, and registering data as well as the issuance, retirement and/or cancellation of carbon units. In regulatory registries, fees might be associated with compliance submissions.
BUDGET	It refers to the systematic planning, allocation, and monitoring of financial resources within an organization or government. In the case of registries, government budgets set up by policies are critical for ensuring operational efficiency and financial health, guiding spending decisions in accordance with operational objectives.
BUSINESS MODEL	A business model delineates the commercial structure supporting the viability and operation of a registry. This often encompasses revenue generation strategies, such as subscriptions, licensing, services and consulting, advertising, transaction payments, leasing and renting and, sale of user data that ensure profitability over time.
PUBLIC ACCEPTANCE	Public acceptance refers to the degree to which the general public approves and adopts a new technology or system. This concept is vital in contexts where user endorsement directly impacts the success of a technology. In a registry context, public rejection may originate from multiple factors such as language, development of local capacities, budgets, etc.
SOFTWARE SETUP AND MAINTENANCE	

MAINTENANCE VIA AN ONGOING SUBSCRIPTION	It refers to the continuous support and service provided to software or systems after initial purchase. This typically includes regular updates, technical support, enhancements, ensuring the system remains functional and secure over time.
OPERATIONS (QA/QC)	Operations involving QA/QC (Quality Assurance/Quality Control) refer to the systematic processes and procedures used to ensure that a product, service or data stream adheres to a defined set of quality criteria or meets the requirements of the client or customer.
SUPPORTING MULTIPLE DATA TYPES	Supporting multiple data types: Supporting many data types refers to a system's ability to handle various forms of data, such as text, images, audio, and video, as well as more complex data structures. This capability is crucial in ensuring flexibility and broad applicability across different data-intensive applications.
TIME TO ONBOARD	Time to onboard is the duration required to familiarize a new user or client with a system or service. This includes the processes of signing up, learning the system's functionalities, and integrating the service into the daily operations.
CUSTOMIZABLE	This refers to the ability of a registry or online platform to be modified according to user needs or specific requirements. High customizability allows for significant user control over functionality, interface, and performance settings, often crucial in specialized and/or sophisticated trading registry applications or diverse user environments.
UPDATES	Software updates involve the modification of software to enhance functionality, correct errors, and address security vulnerabilities. Regular updates are essential for maintaining operational efficiency, compatibility with other technologies, and security standards.
SECURITY	Robust security in technology refers to comprehensive safeguards designed to protect systems and data from various threats, including unauthorized access, attacks, and data breaches. Effective security measures are dynamic and encompass physical, administrative, and technical controls.
CUSTOMER SUPPORT (E.G., KYC)	Customer support, particularly in contexts such as Know Your Customer (KYC), involves helping users through services designed to verify the identity of clients and maintain records. This is crucial for compliance with financial regulations and for ensuring secure and trustworthy customer relationships.
USES DEDICATED (NUMBER OF IT STAFF)	This term refers to the allocation of IT staff dedicated specifically to a project or system. The number or proportion of dedicated IT staff is often indicative of the project's complexity and the level of support required for its operation and maintenance.

7. FULL LIST OF RESOURCES

What are carbon registries?

German Emissions Trading Authority (2017) Robust Accounting of International Transfers under Article 6 of the Paris Agreement

World Bank (2016) Emissions Trading Registries: Guidance on Regulation, Development, and Administration

World Bank (2022) Digital Monitoring, Reporting, and Verification Systems and Their Application in Future Carbon Markets

Interaction with NDC implementation

Cardoso (2019) A road map for establishing information systems for climate action and support

Howard et al. (2017) Features and implications of NDCs for carbon markets

Michaelowa et al. (2021) Promoting Article 6 readiness in NDCs and NDC implementation plans

Nyokabi (2020) Implementation of an Integrated MRV Framework- Kenya Experience

Singh et al. (2016) MRV 101: understanding measurement, reporting, and verification of climate change mitigation

UNDP (2023) A Ready-To-Install "National Transparency System" as a Digital Public Good

Vanuatu (2019) Vanuatu's Integrated Monitoring Reporting and Verification (MRV) Tool for Climate Action Tracking

UNFCCC Article 6 infrastructure

Michaelowa et al. (2023) Interlinkages of registries and implications for functions and structures in the context of Article 6

UNFCCC (2022) Operations of the registry for the mechanism established by Article 6, paragraph 4 of the Paris Agreement

UNFCCC (2022) Technical paper on options for operationalizing the guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement and in decision 2/CMA.3

Recording and tracking requirements

The World Bank (2022) Infrastructure to Meet Reporting Requirements under Article 6

Reporting requirements

Falduto et al. (2021) Understanding reporting and review under Articles 6 and 13 of the Paris Agreement

ICAT (2023) Transparency for cooperative approaches under the Paris Agreement: A guide to navigating the links between Articles 6 and 13

UNFCCC (2022) Reference Manual for the Enhanced Transparency Framework under the Paris Agreement

UNFCCC (2023) Article 6.2 - Manual for the accounting, reporting and review of cooperative approaches

Interaction with GHG inventory

Schneider et al. (2022) Visibility of carbon market approaches in greenhouse gas inventories

Spalding-Fecher and Gald (2023) The Invisible Activity – Challenges for Clean Cooking Programs under Article 6

Interaction with project-level digital MRV

Baumann (2020) What is digital MRV? Digital measurement, reporting and verification to enhance climate actions and sustainability

Climate Warehouse (2022) End-to-End Digital Ecosystem for Climate Markets

Neo Climate Solutions (n.d.) Digital MRV - integrated Monitoring, Reporting, and Verification tool (iMRV Tool)

Factors influencing registry choice

UNFCCC (2023) Article 6 Registry Systems Administrator Forum Concept Note

UNFCCC (2023) Nominations for the voluntary forum of Article 6 registry system administrators and technical experts

UNFCCC (2023) Survey on the choice between establishing a national registry or using the international registry

GGGI (2022) Guidance on Governance Models for Host Country Engagement in Article 6

Michaelowa, et. Al (2023) Interlinkages of registries and implications for functions and structures in the context of Article 6

World Bank (2022) Infrastructure to Meet Reporting Requirements under Article 6

Registry options

Adelphi and Gold Standard (2023) Implementing Article 6 – An Overview of Preparations in Selected Countries

Gold Standard (2022) Guidance on Functionality to Support Attribution and Management of VERs Authorised for use Under Article 6 of the Paris Agreement

VCS (2023) Article 6 Label Guidance

Gold Standard (2022) GHG Emissions Reduction & Sequestration Product Requirements

Registry functionality

UNFCCC (2023) Modalities for operation of the Article 6.4 mechanism registry

UNFCCC (2023) Functional requirements and associated cost estimates for the international registry