# Voluntary Ecological Markets (VEM) Overview

Version 2

InterWork Alliance
A Global Blockchain Business Council Initiative


Geneva | London | New York | Washington, D.C. | Austin | Seattle

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# Foreword

It has been a little over a year since we published the first version of the Voluntary Ecological Markets (VEM) Overview. Since that time, the dedicated taskforce behind its creation has continued to reach further to get more feedback and voices contributing to this important work. This, along with another companion document, a Digital Measurement, Reporting and Verification Framework, are an ongoing work in progress.

The VEM taskforce is part of the InterWork Alliance (IWA), a Global Blockchain Business Council (GBBC) initiative, and is made up of professionals and practitioners from a wide array of organizations who have developed a vision for combining our collective knowledge and expertise in ecological markets and distributed ledger technology, i.e., blockchain, to outline how multiple organizations can work together to scale and improve the level of trust and transparency in the environmental market instruments and their associated environmental claims. It is important to acknowledge that the concepts and proposed specifications outlined in this paper are intended to:

- Establish a Foundation - the following is intended as an initial set of draft contributions the taskforce curated based on discussions to date.
- Evolve on an Iterative & Interoperable Basis - we anticipate providing regular (at least annual) updates to this overview as we look to improve its quality, broaden its interoperable utility, and drive consensus around it.
- Remain Agnostic on Implementations - the specifications outlined here are platform and use case neutral, meaning that they are not for any specific blockchain or non-blockchain platform.

DISCLAIMER: This document is intended as an introduction and basis for further dialogue and cooperation with all relevant stakeholders. Neither the individual taskforce members nor their organizations have agreed to or adopted this document in its entirety. The following is an incomplete, pioneering work in progress intended to cultivate further cooperative effort on the keystone elements and best practices for tokenization of ecological assets with the intention to align around a common governance set of standards, specifications and classification systems. We encourage participation and collaboration with other organizations and actors within the industry as well as regulators and welcome their feedback and commentary for the next version. The taskforce members do not presently endorse any specific regulatory treatment, and do not formally endorse or ratify any particular independent efforts to develop market governance frameworks (e.g. ICVCM/Core Carbon Principles).

We encourage those that can join us in the GBBC/IWA or are already members not currently active in our group to reach out and engage with us.

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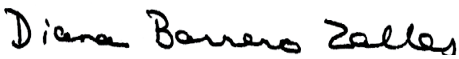

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# Market Background

This, the second version of the Voluntary Ecological Markets (VEM)[1] Overview, establishes a model set of standards for tokenization, contractual extensions, workflows, and analytics for voluntary ecological markets. These standards are based on the IWA's Token Taxonomy Framework (for token standards) and InterWork Framework (for smart contract standards), and intend to serve as foundations for using distributed ledger techniques[2] (DLT) to create an auditable and scalable ecosystem.

Essential components of any market are buyers and sellers and mechanisms for matching them together, thereby facilitating the negotiation of transactions and ultimately the exchange of value between them.

Among the legacy "carbon" markets, there are two major types of markets - voluntary and compliance – and several different kinds of carbon assets, most of which are generically referred to as "carbon credits".[3] Voluntary markets are not currently administered by, or subject to, the regulatory control of governments, which means participants choose to engage as a result of natural market forces and/or a sense of social or environmental responsibility.

1 The term Voluntary Ecological Markets is used herein instead of the traditional "voluntary carbon markets" to identify both carbon offset and carbon removal assets. The taskforce chose to use a broad definition of ecology rather than just carbon, as the same techniques and instruments defined for carbon can be repurposed for other ecological benefit types like water. However, the voluntary carbon market is the most advanced, relatively speaking, so it will be used as the canonical example in the VEM.

2 Distributed ledger techniques commonly found in blockchains like tokenization and Smart Contracts.

3 Carbon credits, and more specifically the property rights to the environmental claims associated with such credits, can be sold and transferred from a seller account to a third-party buyer's registry account. Such credits have been defined by U.S. regulators to be nonfinancial intangible commodities issued by standards bodies into an owner's registry account based on verification of evidence substantiating emissions reduction, avoidance, or removal in accordance with specific methodologies and protocols. The credits, and more specifically the property rights to the environmental claims associated with the credits, can be sold and transferred to a third-party buyer's registry account. - The U.S. Commodities Futures Trading Commission (CFTC) generally recognizes "environmental commodities," including emissions allowances, carbon offsets, carbon credits and renewable energy certificates, as commodities akin to wheat and soybeans rather than "commodity interests," such as futures or swaps. Agricultural and exempt commodities that can be physically delivered and consumed are nonfinancial commodities. Environmental commodities are intangible commodities that can be physically delivered and consumed and therefore qualify as nonfinancial commodities. See, e.g., definition of "Swap," "Security-Based Swap," and "Security-Based Swap Agreement"; Mixed Swaps; Security-Based Swap Agreement Recordkeeping, 77 Fed. Reg. 48208, 48232 - 48256 (Aug. 13, 2012); see, also, Retail Commodity Transactions Involving Certain Digital Assets, 85 Fed. Reg. 37734, 37741 (June 24, 2020). The GBBC is currently considering responding to the CFTC RFI: Request for Information on Climate-Related Financial Risk (87 FR 43501)

The governance of voluntary markets is often de facto in nature and segmented into several different fields: (i) the rules, standards, specifications, and methodologies established and administered by independent standards bodies for the registration and issuance of verified offset units (known as "offsets" or "carbon credits"), (ii) the terms and conditions associated with the generation, maintenance, and retirement of assets on dedicated registry systems, and (iii) the rules and procedures governing bilateral and exchange-traded transactions.

Compliance markets, on the other hand, are creatures of laws and regulations that establish market-based greenhouse gas (GHG) emissions limits or other environmental regulatory obligations. Such laws and regulations often create tradeable compliance assets that are administered in turn by one or more governmental agencies. For example, in a government cap-and-trade market there can be at least two different kinds of tradable assets that can be used for compliance, both often referred to as "carbon credits". One is a permit, known as an "allowance", which can be issued and distributed by a governing body. An allowance allows the company which holds it the right to emit an amount of carbon dioxide or other GHG. The other is a certified emission reduction, also known as a verified "offset", which is issued to projects that successfully demonstrate such reductions in accordance with program rules. Both carbon allowance and offset credits represent one metric ton of carbon dioxide equivalent (identified as tCO2e) emissions, where tCO2e indicates the number of metric tons of CO2 emissions with the same global warming potential as one metric ton of the relevant GHG(s) emissions.

Carbon offsets, whether generated as part of a voluntary program or compliance market, provide an end-use company a means to cost-effectively offset its own GHG emissions while giving the organization flexibility to prioritize and allocate resources and capital into longer-term direct emissions reductions achieved by cleaner technologies, fuels, and supply chains. By purchasing offsets, companies are also helping finance climate action. The company can claim near-term reduction goals and sell any surplus credits to organizations that do not have enough credits to cover their own emissions.

In addition to allowances and offsets, there is also a third new type of carbon credit, called a "removal", which represents the removal and sequestration of 1 tCO2e from the atmosphere. While companies with science-based targets have generally agreed to seek reductions first, removals can be used by end-use companies to go beyond offsetting as they strive towards achievement of net-negative emissions.

# Document Overview

Given the diversity of types of "carbon credits" and the claims to environmental benefits they convey, the intent of this paper is straightforward. It aims to define the lifecycle for the creation of a carbon credit for what we are labeling the "voluntary ecological markets," recognizing the potential digitization of verified offsets (reduction or avoidance) or removals.

Based on diligence on standard carbon market design, the VEM Taskforce has concluded the voluntary markets can generally be defined in four key phases:

1. Generation and Registration of Verified Supply
2. Establishing Voluntary Demand
3. Buying and Trading
4. Retirement and Carbon Accounting

Each of these phases are connected, modeling out the lifecycle of an ecological market with standardized roles as well as token and contract specifications within each phase. In this document, the phases are covered in separate sections, where roles can play a part in each phase.

Approaches for tokenizing CO2e can fall into two different categories depending on the nature of the environmental claim and resulting environmental asset– empirical vs. counterfactual (ie. measured against an "expected" business as usual baseline). The empirical category refers to tokenization of at least one unit of physical CO2e emissions, which represents the existence of actual emissions data. The second counterfactual category refers to a claim based on the verified reduction, avoidance, or removal of one unit of CO2e emissions, which represents the absence or non-existence of emissions derived from a calculated baseline or business as usual status quo.

Each type of claims are intangible assets of varying degrees of economic value, yet when evaluated in the context of ESG, carbon accounting, or achievement of net zero goals, tokenized emissions can be treated as a debit and tokenized counterfactuals (i.e. offsets and removals) as credits. For purposes of this document we are only addressing the tokenization of counterfactual assets - issued CO2e offsets and removals.

# Voluntary Market Roles - General

Roles in the VEMs define an individual or organization that performs specific functions in the lifecycle of the marketplace. The legacy roles identified generically below anticipate that some roles may be combined or segregated in the future as voluntary market design and digital infrastructure evolves.

## Supplier/Seller

A project supplier/seller is the role that performs the actions, in either an Ecological Project or Program (EP), for creating the evidence, via a process that generates the source data to be verified against an independent "Quality Standard", for the creation of an ecological asset (i.e. carbon credits). The supplier becomes the initial owner of the ecological credit issued. There can be multiple parties that are a part of the supplier role:

- Owner: the organization or individual that implements or performs the GHG reduction or avoidance activity, or owns the assets used in the activity that is the source of the benefit claims. For an Ecological Project, this might be a farmer that owns or leases the land and performs the mitigation activity.

- Sponsor: the organization or individual that finances the activities generating the benefit claims. I.e., a bank or investment fund.

There can be multiple different participants, owners, sponsors, and developers where their identity is recorded in the EP.

## Standards Body

A standards body is an organization that administers and governs one or more "Quality Standards" used by Project Suppliers. These standards are a set of emissions reduction or removal methodologies or protocols establishing the science-based definitions, metrics, and criteria upon which CO2e reductions can be credibly achieved by different types of projects and activities. The standards body issues verified credits for an EP that has demonstrated, validated, and verified reductions in accordance with those methodologies and protocols (often referred to as measurement, reporting and verification (MRV) standards). The creation of science-based standards for MRV is a rigorous discipline that requires independence from commercial influence in the pursuit of accurate accounting of benefit or emissions claims.

## Issuing Registry

An issuing registry is an independent organization (often run by or affiliated with a standards body) that administers and governs a centralized or decentralized registry for carbon credits that have been verified for issuance by a Standards Body. The issuing registry sets clear terms of use and conditions for opening and maintaining registry accounts, as well as for transacting and retiring credits (and their associated environmental benefits). An issuing registry has historically maintained a centralized registry of accounts that enable credits to be transacted directly via the registry itself, or as part of reference contracts or values on networks, exchanges, or marketplaces.

In the context of tokenization, an issuing registry, in collaboration with a standards body, may choose to establish specific terms of license and use for issuing reference or other tokens, as well as for maintaining accountability and recordkeeping of tokenized benefits. Some registries may also partner with standards bodies to maintain a native token of a carbon credit on its own system and issue a reference token on a DLT or other system for distribution.

## Validation and Verification Body (VVB)

A VVB is an organization that is authorized or certified by a Standard Registry to validate and verify MRV claims issued by an EP. They independently assess whether the project achieved the emissions reductions reported as an integrity check. As an ancillary benefit, they often also offer technical infrastructure and assistance to help suppliers. This role is commonly called the "verifier".

## End-Use Buyer

An individual or organization that purchases verified credits issued by a registry. In the voluntary market these are usually corporate buyers using credits as offsets for unavoidable emissions to meet their stated ESG goals, but could evolve into speculative or institutional buyers.

## Wholesale Market Participants

An individual or organization that purchases verified credits issued by a registry for purposes of resale or brokerage on behalf of other buyers and sellers.

## Exchange or Marketplace

An organization that interconnects suppliers, issuing registries, and buyers by providing a rules-based trading platform and accompanying infrastructure to match buyers and sellers together, providing services like transaction settlement, clearing, portfolio and risk management, and market price discovery. Suppliers can list their credits on an exchange, buyers can trade directly or via a broker on the exchange, and issuing registries can collaborate with exchanges to settle all transactions and ensure market integrity.

## Financial Intermediary

An organization (e.g. commercial corporate bank) that provides market or other financial services for Project Suppliers/Sellers and End-Use Buyers like financing, risk management, custody, reporting, etc.

# Voluntary Market Projects/ Programs

Ecological Projects (EP) or "programs of activities"[1] are the unique and verified source for ecological benefit claims. It is important to have trust in the identity of the EP for all participants to be able to trace the ecological benefit token back to its source project. Key details that are important for the supplier, validation and verification body ("VVB"), registry, and buyer in the market are recorded in the Ecological Project or Program object. The token specification for an EP using the Token Taxonomy Framework (TTF) is given in the figure on page 14.

Each overall project can be made up of one or more sub-layers of "Modular Benefit Project(s)". One project or program of activities, for example, can allow its proponent to generate separate and "stackable" claims for multiple benefit types. For example, an EP may want to create carbon-related and water-related claims from the same project, where each credit type will require different quality standards and may have different verifiers and registries as well as methodologies for each type of project. What projects generally cannot do is generate two separate assets related to the same or overlapping environmental benefit (known as "double counting" or "double claiming").

Every Ecological Project or "Program of Activities" could generically be deemed in the context of tokenization to have the following:

- Unique identifier ("Id"): An identifier that is issued and independent of the "name" of the project. The Id is used to reference the project and link it to its claims, verification, and credits issued to it.
- Name: A name is recommended, but not required, to be unique.
- Description: A brief description of the project and activities.
- Address(s) of Project: This can be a collection of addresses to support mailing, legal registration as well as physical addresses.
- Owner(s): One or more references to the Id(s) of the project or program owner(s).
- Ecological Project Info: Metadata, defined below, about the project.
- Modular Benefit Projects (MBP): A project has one or more MBPs based on the type of claim that the

1 e.g. mitigation activities

project will be making. For example, a project can make both carbon reduction and carbon removal claims and would need a MBP for each type of claim it will make.

- Ecological Project Info contains:
  - Link to Project Data: A verified link to more project data like marketing materials or a website.
  - Country: The host country for the project.
  - Project Scale: One from the list of - Micro, Small, Medium, or Large
  - Media Links: A collection of verified links to photos or videos
  - OPTIONAL: Registry or Verifier Id: If different, this could help with correlation in cases where the connected registry or verification platform has a different Id than the network's.

A Modular Benefit Project for example, could therefore contain:

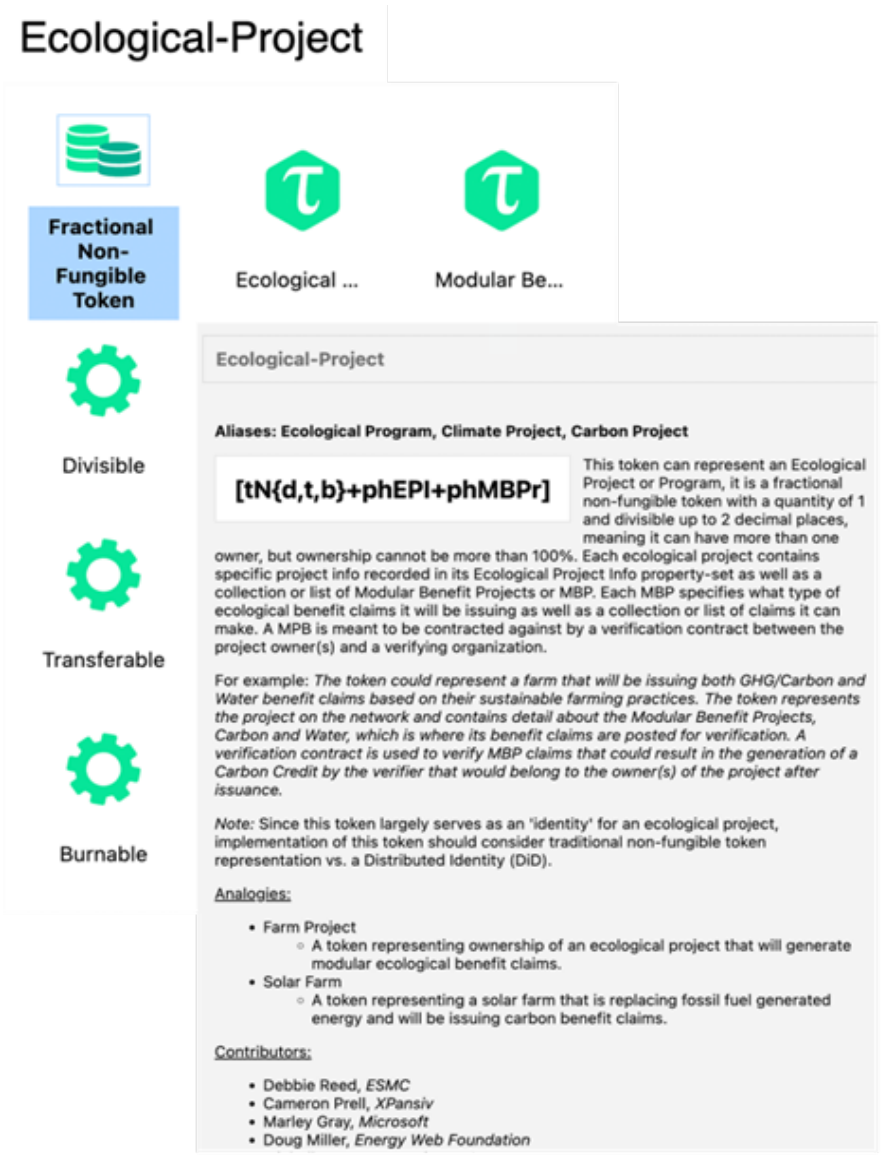
- Unique identifier ("Id"): An identifier that is issued and is independent of the project. The Id could be used to establish a compound identifier by combining the EP Id with the MBP Id for the complete project identification.
- Description: Information about the types of activities and claims being made.[2]
- Geographic Location:
  - Basic GNS/GPS for Programs
  - Area (ex. GeoJSON) for Projects
- Targeted Benefit Type (Examples):
  - Carbon: Reduction/Removal + Natural/Technology
  - Water
  - Nitrogen
  - Phosphorus
  - Sediment
- Developer(s)
- Sponsor(s)
- Claim Sources: A list of registered claim sources (i.e., IoT devices, satellite data providers, evidence collection applications, etc.)
  - Unique Identifier
  - Source Type: Device, Application, Reference Data
  - Source Identifier: I.e., serial number, application key, certificate
- Claims contains:
  - Unique identifier (Id): An identifier that is issued and independent of the MBP. The Id is used to establish a compound identifier linking the claim with its MBP and EP.
  - Co-benefits: One or more options from a list of the added benefits we get above and beyond the direct benefits of a more stable climate, these map to the UN Sustainable Development Goals.

2 This document is not intended to describe or govern what kinds of claims a project could legitimately make.

- A collection of Claim Checkpoints, where each checkpoint represents a portion of the claim as it builds over time. A checkpoint includes:

    - Verified Link: Is a reference to the source data the claim is based on. This contains a URI pointing to the data file which can be verified. The data file should be accompanied by either a signature or a hash so that the integrity can be verified. For example, this can be accomplished using the W3C DID specification.
    - Date Range: The date span for which the claim is being made.
    - Environmental Effects Before: A measure of the claim before project activities.
    - Environmental Effects After: A measure of the claim after project activities.

## Token Specification for an Ecological Project Using the Token Taxonomy Framework (TTF)



# Lifecycle for Verified Credits

The generation and issuance of registered ecological assets resulting from ecological projects and programs is very similar to other physically-settled assets, they are composed or manufactured via a dedicated supply chain. Whereas physical finished goods are manufactured using parts or components from upstream suppliers, e.g., nuts & bolts, etc.; an ecological asset is issued or created upon approved verification from upstream participants. The type and extent of substantiating evidence required to verify an ecological claim, i.e. carbon removal, depends on the activity being performed to remove the carbon and the methodology (e.g. the applicable "Quality Standard") employed to measure it. Such substantiating evidence is historically packaged by the project proponent and delivered to a VVB for verification. Upon VVB validation and verification of the substantiation, the evidence is next delivered downstream to the Standards Body for approval and Issuing Registry for issuance or minting of the finished ecological asset.

In legacy voluntary markets, upon formal issuance and registration of the verified ecological claim, a nonfinancial intangible asset is ready for sale or retirement. How this process, often called origination, is carried out is vital to the creation and credibility of high-quality ecological products. Given their intangible nature, there is a correlation in asset value with the credibility of the "Quality Standard", the project activities, and the verification process. Buyer trust and confidence in each lead to greater return on investment for those doing the work to benefit our environment.

In the context of tokenization, the taskforce believes in the need for standard data representations and clear roles and responsibilities of the participants in the supply chain for these intangible assets to:

- Establish a standard token or digital asset representation for claims and credits, used by the ecological project (or EP), VVB, and issuing registry.
- Collaborate with other initiatives to align terminology and recommendations with token and contract definitions produced using the IWA tools and frameworks.
- Provide specifications that represent the shared set of data (schema or common data model) required by market participants allowing for credit comparison and rapid quality determination to increase confidence in the market.
- Record and link ecological projects and tokens to the "Quality Standard" (i.e. technique and accounting methodology) to enable quality grading of credits based on aspects like geography, sequestration type, scientific measurement, etc.
- Prevent the double crediting or spending of credits by removal projects or emissions reporters.

# Tokenizing Environmental Benefits – Basic Flow

Here are the high-level, potential "greenfield" steps the market could take for establishing an ecological project and having a digital ecological asset issued for it:

1. An ecological project owner defines their ecological project and determines the type of environmental benefits it seeks to achieve and associated claims. Such benefits will be measured by and/or against and based on a Quality Standard established by a credible standards body that matches and maps to the activity the EP will be implementing/conducting.

2. The project owner will register with the applicable Standards Body and Issuing Registry and obtain all necessary authorizations in accordance with the rules and requirements of each.

3. The project owner may contract with a certified VVB authorized by the standards body to verify the EP data against the Quality Standard for which they are registering, including an Ecological Claim token. Once contracted, the project owner can submit the necessary materials for a claim token, which consists of the data required (evidence) by the Quality Standard for the period of the claim. The claim token will be linked to the submitted EP and the applicable Modular Benefit Project, with references to its raw data and any reference claim data.

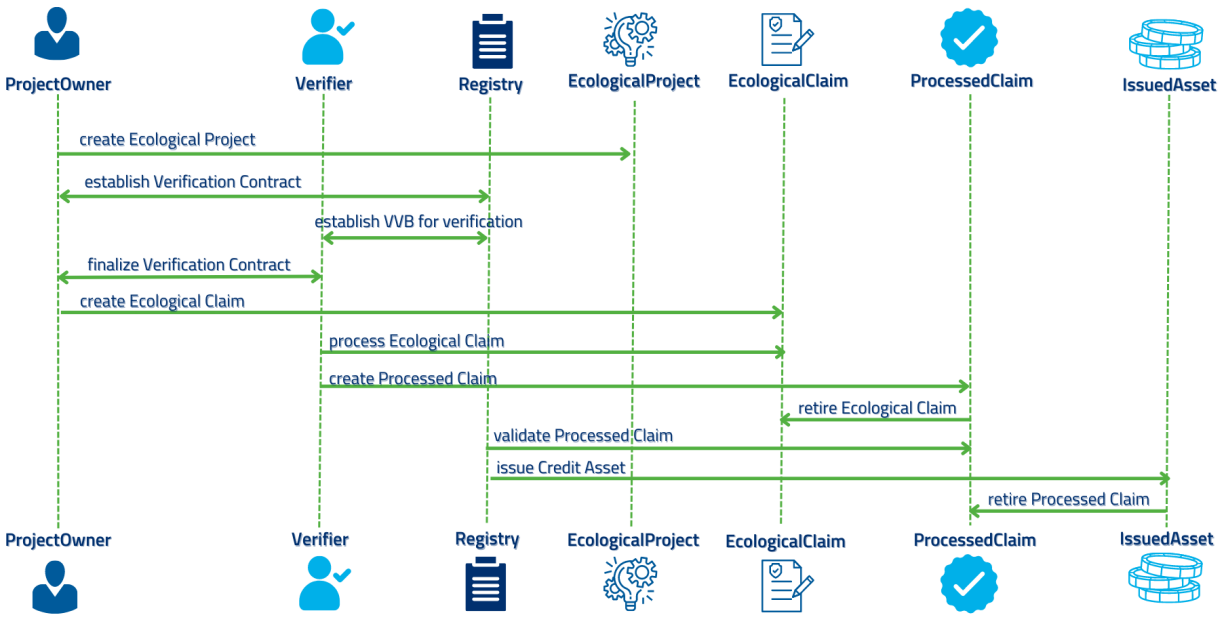
4. The contracted VVB will validate and verify the registered claim by encumbering the claim token and then processing it against the associated Quality Standard. Once completed, a Processed Claim token is created and the claim that was verified is marked as processed/retired with the link to the Processed Claim token. The processed claim contains the amount of the claim, a carbon reduction or removal, which consists of the marked-up claim data and verification report.

5. A processed claim is then picked up by the authorized issuing registry for the applicable Quality Standard. After optional additional checks (KYC[1], quality, etc.), the registry creates a credit in the amount verified by the processed claim. The issuing registry may choose to maintain the native credit on their own system and issue a reference token on a DLT or other system for distribution.

6. This is generically referred to as an Ecological Benefit Token but is tokenized as a specific type of token based on the Quality Standard and EP type. On the registry and ledger where the token is implemented, the owner of the credit is the ecological project owner. The Processed Claim token is then credited/retired along with the Id for the credit issued against the claim, preventing the processed claim from being credited more than once.

1 Know Your Customer

Ecological Project Sequence




# Origination - Supply of Verified Ecological Credits

The verification process for a tokenized ecological project should result in the creation of a high-quality digital asset, a credit token of some defined (and ideally interoperable) type, whose value can easily be determined and quickly be compared with other tokens of the same type[1]. However, all the data needed to verify the integrity and value of the token should not all reside within the token itself but be available in other data constructs involved in the verification process.

## *Proposed Roles/Steps*

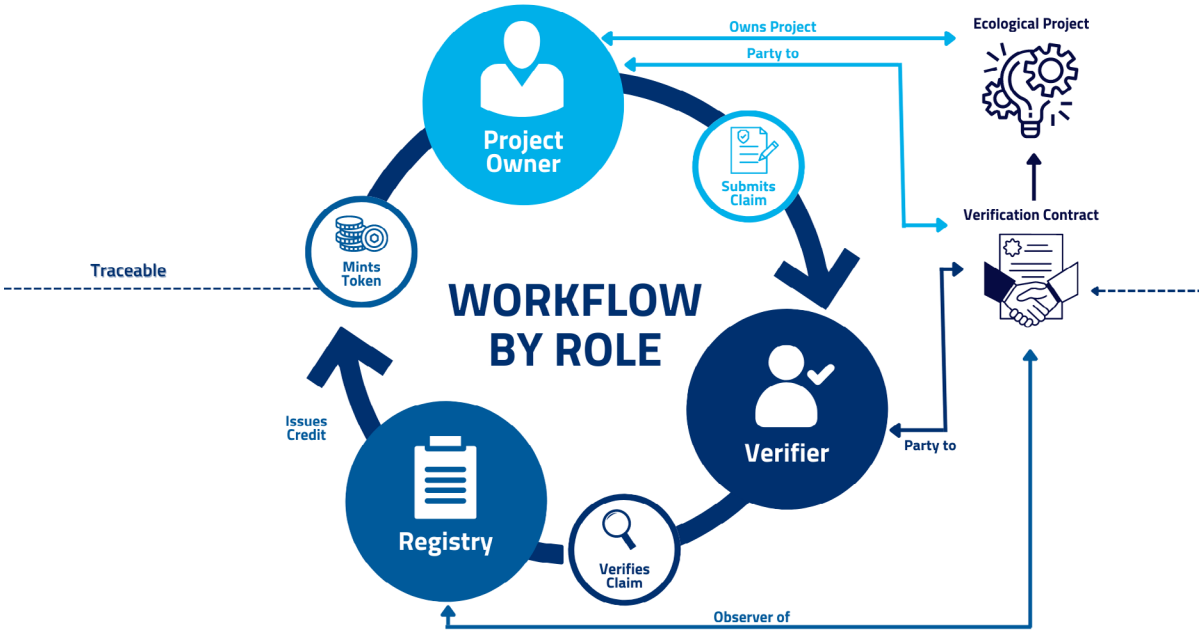
The process or workflow for creating verified supply involves at least 4 recommended roles:

- Project owner/supplier - the entity (person or company) that owns the project whose activities will be the source of benefit records and registers emission reduction project or program of activities with a standards body or its agent in accordance with all measurement or monitoring, reporting and verification (MRV) processes.
- Standards body - the entity that establishes, governs and owns the Quality Standard for the applicable EP should license the ability to tokenize an issued carbon credit to the project owner/ supplier or the VVB.
- VVB (verifier) - Project validation and verification should be based on the applicable Quality Standard for measuring the results of the activity being conducted by the project.
- Qualifying issuing registry - the issuing registry affiliated or authorized by the standards body, shall generate and issue the verified number of carbon credits and/or any native tokens after VVB approval of the EP. The issued unit represents the actual intangible value that becomes the property of the project owner that registered the EP.

1 To be clear, approaches for tokenizing CO2e can fall into two different camps, first as an emission, which represents actual emissions of CO2e, and second as an issued carbon offset or removal reflective achievement of a counterfactual "reduction", "avoidance" or "removal" of actual emissions. This document is only focused on the latter. Additionally, GBBC work is underway to address potential pathways for tokenizing actual CO2e emissions.

The project owner shall then be able to (if applicable) (1) redeem a token issued prior to VVB approvals, (2) issue a reference token tied to the underlying asset, or (3) otherwise take ownership of any native token or direct representation of the underlying carbon units issued by the registry.

Workflow Diagram




# Tokenizing Issued CO2e Reduction and Removal

Historic and current carbon offset credits are issued per metric ton of CO2, which can represent any greenhouse gas (GHG) in carbon equivalence, which is where the 'e' comes from in tCO2e. Today, registries issue a batch of credits to an ecological project by issuing a serial number for the batch, that is a combination of data fields like the issuing registry, project identifier, vintage, etc. and has a way of indicating the number of tCO2e represented in that batch. These batches can be split between the issued lower bound and upper bounds of the serial number.

**Examples**

***Gold Standard***

GS1-1-IN-GS4707-12-2020-22221-1-57

- Represents 57 tCO2e
- Can be split in two:
    - GS1-1-IN-GS4707-12-2020-22221-1-10 = 10 tCO2e
    - GS1-1-IN-GS4707-12-2020-22221-11-57 = 47 tCO2e

***Verra***

6592-326764745-326764844-VCU-034-APX-IN-1-1020-01012017-31122017-0

- Represents 100 tCO2e
- Can be split in two:
    - 6592-326764745-326764794-VCU-034-APX-IN-1-1020-01012017-31122017-0
    - 6592-326764795-326764844-VCU-034-APX-IN-1-1020-01012017-31122017-0

1 tCO2e is the smallest amount any serial number can represent, meaning it cannot represent .50 tCO2e.

## *Potential Impacts of Tokenization*

Issuing a token instead of, or in addition to, a registry serial number does not change much on the surface of the VEMs. However, there are enhancements and new functionalities introduced by tokenization that may provide additional credibility, transparency, and scalability to the VEMs. The most notable impact is improved accountability (known as "measurement, reporting and verification" or "MRV"), as will be discussed further below.

Another example impact is the potential to fractionalize assets or ownership to such assets. An issuing registry or authorized party, for example, could tokenize any number of verified CO2 tons in a single token that can then be split into fractional units. The taskforce is agnostic on the topic but has proposed to allow for a tokenized carbon credit to be split to 4 decimal places - meaning that the smallest unit that can be represented would be .0001 tCO2e. This could allow for the "micro" scaling of distribution, sale, and retirement for tokenized credits provided proper environmental benefit accounting can be maintained.[1]

An often more controversial new function may be the potential to enable multiple owners of tokens or environmental benefits, i.e., fractionalizing the property right to the environmental claim itself. Fractionalizing the token, however, would arguably be up to the owner of the token unless otherwise proscribed by the Standards Body or the Issuing Registry. While this functionality adds flexibility and reduces friction in the trading of credits, it may also diminish trust and accountability in terms of carbon accounting and prevention of double counting.

- Retirement is a one-way operation that removes the credit from circulation.
- An asset must be owned to be retired.
- The retiring party gets to apply the credit towards the debit, in this case to offset emissions.
- The issuing authority, or registry, will require approval and KYC for the retiring party.
    - Distribution enabling micro-transactions, i.e., .01 tCO2e may roll up retirements under a distribution channel omnibus account. For example, a large retailer offering POS offsetting.
    - Controls/Audits for micro-transaction roll ups may be required to ensure that these distribution channels are not being "gamed" to skirt retirement rules by other parties.
- Retirement meta-data
    - Party retiring
    - Reporting period it applies to (calendar year)
    - Beneficiary, country, or jurisdiction it will count towards NDCs[2]
    - Purpose

1 Registries have historically controlled who may purchase a credit, using it as an offset, and often auto-retiring credits once a batch has been bought. Fractionalization would remove the need for the Registry to perform splits as well as control the sale of the credits but can introduce the capability to approve a retirement. However, as stated, without adequate governance controls in place, this could also increase the number of retirement requests due to many splits.

2 UNFCCC - Nationally Determined Contributions

- Use of omnibus accounts to encumber/hold tokens to be tokenized on another platform will require additional controls:
    - If issued in fractions, micro-transactions, on the other platform, it is recommended to roll-up retirements or mirror fractional 1-1 on the source platform and pass retiring party information. The latter may become a burden for issuers that require restrictive policies to be able to control micro-retirements.
    - Fractional retirement will require retiree's information for approval if registries can handle the retirement load.
    - If fractionalization is key to the distribution method like retail POS – the POS vendor can be the retiring party, with audit controls.

Tokenization can foster asset or "smart contract" standardization, i.e., for project criteria terms for buying, selling, and trading CO2, including:

- Symbol or product code (like a CUSIP or SEDOL) for similar assets (e.g., of similar quality standards).
- Standard Trade Amounts.
- Minimum Trade Amounts.
- Price quotation standards including standard price increments.
- Supporting settlement processes.
- Supporting market data, including creation of benchmarks and indices.
- Risk controls including trade, compliance, and counterparty controls.

The VEM has defined a new property-set[3] along with two carbon token specifications that represent carbon reduction and removals.

3 A property-set is a Token Taxonomy Artifact that represents a collection of properties or attributes, which are often referred to as labels.

# Potential Alignment with Market Governance, Terminology and Emerging Principles

In 2021, the taskforce decided to participate with the large number of organizations and thought leaders seeking to drive integrity and scale for the VEMs through the Taskforce for Scaling Voluntary Carbon Markets (TSVCM). The TSVCM's findings and recommendations have been used to launch the Integrity Council for Voluntary Carbon Markets (ICVCM), to carry the work forward into practice. Out of these efforts came proposed Core Carbon Principles (CCP)[1]. The taskforce has not formally adopted or agreed with the CCPs or the other recommendations of the ICVCM. We encourage the ICVCM to collaborate with this taskforce.

As of this writing, the CCPs are still open to public comment and their future is uncertain and often controversial[2].

For purposes of demonstrating potential alignment, however, the taskforce has taken our first pass at converting the CCPs into a set of properties or attributes that can be attached to tokenized carbon credits in anticipation of their adoption. The benefit of isolating these attributes into a dedicated CCP property-set is that it allows for them to be updated, or even replaced independently by a different set of attributes, if the need arises.

- The CCPs in public consultation are Additionality, Mitigation Activity Information, no double counting, Permanence, Program Governance, Registry, Robust Independent 3rd party verification, Quantification of emission reductions and removals, Sustainable development goal (SDG) impacts and safeguards, and transition towards net-zero emissions.

- We cannot provide an open standard approach for these CCPs in a single property-set, but we can reflect them using a combination of a property-set paired with token definitions to represent carbon offsets and removals.

The CCP property-set example can reflect the values developed by the ICVCM as well as other properties that all carbon offsets or removals would have. This means that tokenization efforts can include attachment of this, or other market best practice property-sets, to different template specifications.

1 The Core Carbon Principles (CCPs) and Assessment Framework (AF) will set new threshold standards for high-quality carbon credits, provide guidance on how to apply the CCPs, and define which carbon-crediting programs and methodology types are CCP-eligible

2 https://www.bloomberg.com/news/articles/2022-03-16/carney-s-bid-to-boost-carbon-market-scaled-back-amid-controversy?leadSource=uverify%20wall#xj4y7vzkg (paywalled)

## *EXAMPLE: Developing a Core Carbon Property-Set*

The Core Carbon Principles property-set contains:

- Asset Id: A string that can contain the issuing registry's master id or serial number that resides on their registry system. Could be empty or the same as the token's id if not needed.
- Issuance Date: The date the token was issued.
- Vintage: Refers to the year that the emissions reduction or removal took place or will take place.
- Generation Type: Generated, Ex-post or Ex-ante, where Generated indicates near real-time issuance typically reserved for high-precision activities that can be verified and issued in shorter time frames; Ex-post is based on verified evidence and factored based on historical results; Ex-ante are forward estimates of reduction or removals.
- Quality Standard: The quality standard used to determine and issue an ecological benefit token. These can be a voluntary or compliance/regulatory standard.
- Mitigation Activity: The mitigation activity that is used to generate the ecological benefit token, a combination of:
    - Category: Reduction or Removal
    - Method: Biological, Technological, or Both
- Durability: This is the recommendation that replaces permanence for CCPs as it includes the risk profile and not simply true or false. [see Durability]
- Replacement: This is set if this token replaces a revoked or adjusted token, i.e., a reversal event that requires a credit be replaced with one from a reserve pool.
- Paris Agreement Compliance: This is set if using Paris Agreement specific attributes:
    - Corresponding Adjustment: None, Paris Agreement Compliance, or Pending
    - Letter of Approval: A verified link to the jurisdiction's approval for CA.
- Quantified SDG Impacts: The Co-benefits or SDGs with quantified impacts.
- Adaptation of Co-benefits: The adaptation of co-benefits  consistent with the host country's priorities, consistent with the provisions under Article 7.1 of the Paris Agreement.

# Introducing Two Carbon Credit Tokens

Up to this point, we have generically referred to the assets created as "ecological benefit" tokens, making sure to not limit the types of ecological or environmental aspects that would seem likely to have these types of assets generated, e.g., renewables, carbon, water, waste, etc. However, we did need to get more specific, so we chose to focus on carbon credits, in this case two different carbon credits.

These two credits share many of the same properties and behaviors, but also have significant differences. Here we will provide an overview of the two carbon credit tokens, highlighting their similarities and focusing on their differences.

## Token Overview

| **Token Name** | ***Ecological Project or Program*** | ***Carbon Reference Token*** | ***Carbon Reduction or Removal Unit*** | ***Ecological Claim*** | ***Processed Claim*** |
|---|---|---|---|---|---|
| **Token Symbol** | EP | CRT | CRU | N/A | N/A |
| **Description** | Identity of a project or program and its ecological benefit claims | Represents one metric ton of 1 tCO2e not in atmosphere | Represents one metric ton of 1 tCO2e removed | Represents scientific standard benefit claims for project/program | Represents processed, verified claim against the associated registry standard |
| **Type** | NFT, divisible | Fungible, divisible | NFT, divisible | NFT | NFT |
| **Key Attributes** | Project identifiers, project info, modular benefit project info, claims | Unique ID linking to registry, Date of issue, Verification standard | Unique identifier, CRT data | Identifier, Co-benefits, checkpoints, Environmental Effects After | Amount of claim, reduction or removal, claim data, verification report |
| **Linked Tokens/Data** | Project/program owner, Country, Project Scale | Project/MBP/Claim(s), Contract/Verified Claim(s) | Project/MBP/Claim, Contract/Verified Claim, CRT, Owner, Issuer | Modular Benefit Project, raw/claim data | Marked up claim data, verification report |
| **Use Cases** | Farm project; Carbon capture and sequestration program | Verifier (VVB) has verified a carbon removal claim | Verifier (VVB) has verified a carbon removal claim | Farm project; Carbon capture and sequestration program | Process token to claim to ecological benefit token (CCP, CRU) |
| **Market Demand** | | Traded, Used to offset CET | Traded, Used to offset CET | Operational | Operational |

# Carbon Reduction/Removal Unit (CRU) Token

A Carbon Removal Unit is the foundational unit of value, that we believe can represent the verified claim that can be retired to net or remove emissions from an organization, product, or jurisdiction[1]. This token could be a non-fungible token (NFT), meaning a CRU token is not interchangeable with other tokens of the same type. It represents 1 metric ton of GHG emissions reduced or removed by a project or program. The technique for the reduction or removal, its measurement and verification methodology shall be found in the Verification Contract and the issuing standard registry.

The CRU is a digital asset which can be traded directly or more commonly in derivative contracts employed by financial markets. The market determines price using the associated information found in the related entities on the network. The specification for a CRU Token is shown in the figure on page 25.

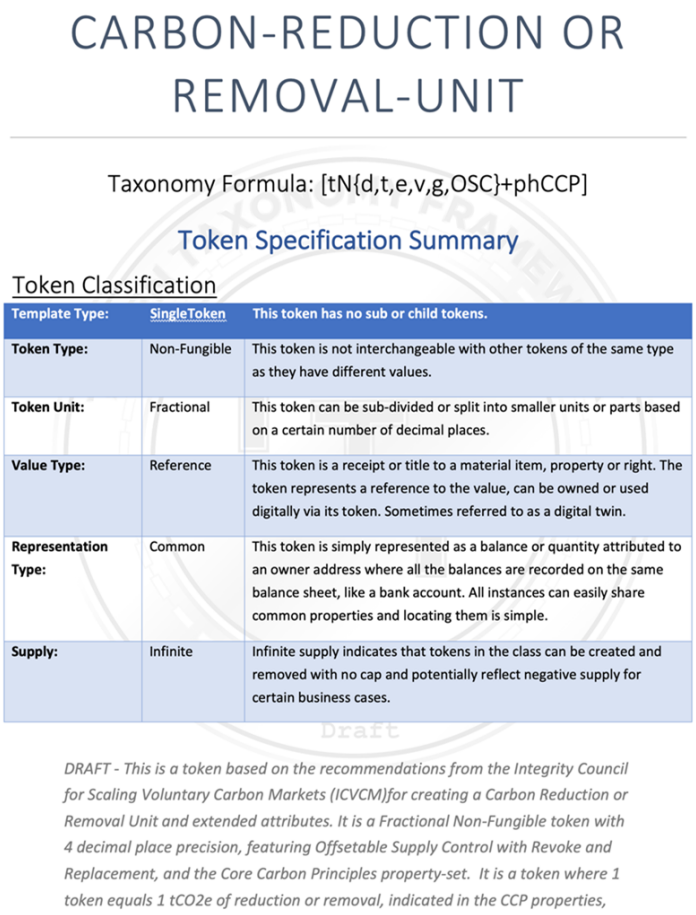
The CRU has standard data elements which represent the shared view required by the parties in the carbon market from suppliers, buyers, VVBs, registries, and exchanges, and are based on the recommendations from the ICVCM.

CRUs have the following behaviors and properties:

- A non-fungible token (NFT) that represents 1 Carbon Reduction or Removal Unit or CRU, a unit representing one metric ton of CO2 (tCO2)
- Is divisible, transferable, encumberable, revokable, delegable, offsetable and mintable with role support.
- Quantity: The amount of CO2e in tonnes, can have up to 4 decimal place precision.
- Owner: The Id of the account that is the owner of the token.
- Listing Agent Id (optional): If the CRU is listed on a marketplace or exchange.
- Core Carbon Principles (CCP): A set of properties that every CRU will have.
- Climate Labels (optional): Name/value pair of additional climate labels for compatibility.
- Issuer: The Id for the issuing standard registry.
- Retired (optional): True or false for implementations where it is not implicit.
- Offset Applied to Id (optional): A link to an ESG Scorecard or goal that the offset should apply.
- Processed Claim Id: The Id of the processed claim the token is based from

1 One of the primary outcomes of this taskforce is a focus establishment of a foundational base, “native”, or “primitive” unit of value that represents the unique characteristics of the work process, evidence, validation, and verification behind the issued credit. Like legacy carbon credits, this foundational unit could be considered a nonfinancial intangible asset that physically settles. CRUs under this approach could transact in physical markets or act as the base or underlying asset that is referenced, bundled, or packaged as part of other types of digital products or smart contracts. There are a wide range of possibilities for distribution of the CRUs as secondary digital assets. This document does not address or attempt to define those other “reference tokens” or other digital assets. The asset type and regulatory treatment for such products are the subject of ongoing deliberations with regulators.

### Example of a CRU Token Formula Using the TTF's Taxonomy



CARBON-REDUCTION OR REMOVAL-UNIT

Taxonomy Formula: [tN{d,t,e,v,g,OSC}+phCCP]

Token Specification Summary

Token Classification

| Template Type: | SingleToken | This token has no sub or child tokens. |
|---|---|---|
| **Token Type:** | Non-Fungible | This token is not interchangeable with other tokens of the same type as they have different values. |
| **Token Unit:** | Fractional | This token can be sub-divided or split into smaller units or parts based on a certain number of decimal places. |
| **Value Type:** | Reference | This token is a receipt or title to a material item, property or right. The token represents a reference to the value, can be owned or used digitally via its token. Sometimes referred to as a digital twin. |
| **Representation Type:** | Common | This token is simply represented as a balance or quantity attributed to an owner address where all the balances are recorded on the same balance sheet, like a bank account. All instances can easily share common properties and locating them is simple. |
| **Supply:** | Infinite | Infinite supply indicates that tokens in the class can be created and removed with no cap and potentially reflect negative supply for certain business cases. |

Draft

*DRAFT - This is a token based on the recommendations from the Integrity Council for Scaling Voluntary Carbon Markets (ICVCM)for creating a Carbon Reduction or Removal Unit and extended attributes. It is a Fractional Non-Fungible token with 4 decimal place precision, featuring Offsetable Supply Control with Revoke and Replacement, and the Core Carbon Principles property-set. It is a token where 1 token equals 1 tCO2e of reduction or removal, indicated in the CCP properties,*

## Using CRU

CRUs can be held for their value or spent to offset reported emissions in either a voluntary or regulated environment. When an owner offsets a CRU, it is applied towards an ESG Goal or another target and is retired or burned and cannot be offset again. See ESG Scorecard.

### *Issues with CRU*

Narrowing down the list of attributes to cover most demand signals may run into limits when it comes to value variables like:

- Year scale for Global Warming Potential (GWP) for calculating GHG CO2e:
  - 100yr GWP vs. 20yr GWP for methane (CH4) that has greater warming potential in the 20yr vs. 100yr GWP.

### *Additionality*

Additionality, for carbon removal, is whether it would have happened without the existence of the project. This is a complicated and controversial topic—relying on logic that can be difficult to prove in either direction.

- There is not a single, clear market agreement for how to calculate the baseline against which a project's impact gets measured. Project developers can misuse baselines, resulting in inflated credit values. Baselines against which removals are estimated must be set conservatively to minimize risk of over-crediting.
- No common authoritative standard exists on how carbon finance and corporate procurement of credits contribute to additionality. Some projects have received criticism because payments for carbon credits are only a percentage of the entire project funding stack or because landowners don't know that the project is generating carbon credits.

### *Baseline*

Establishing an accurate and fair baseline to measure progress, like reductions measurement, requires a baseline level to be established. Historically, establishing a baseline has been troublesome for validation of claims.

### *Leakage*

Some projects inadvertently shift emissions from one geographic area to another area that is not counted in the project claim. Activity leakage occurs when an activity is displaced from one geographic area to another one. Market leakage occurs when a project reduces the supply of a specific product, but market demand encourages others to provide that product instead. For example, carbon removal might be achieved in one area by letting trees grow longer but may indirectly result in trees being cut elsewhere to satisfy timber market demands. To improve leakage determinations, registries should develop stronger science-based benchmarks for leakage that are informed by research.

## Durability

Having a carbon credit designed specifically for carbon removal requires that new properties and behaviors be introduced. As the credit is the result of verified claims of carbon removal, i.e., sequestration, the length of time the carbon will remain removed, and the risk of reversal will need to be understood.

This, combined with additional properties that provide details as to the granularity of the data collected in the origination process make carbon removals non-fungible assets, meaning they cannot be exchanged 1 for 1 based on their face value in tonnes. The VEM has defined a new property-set used to capture and verify the durability characteristics of a carbon removal credit to support aspects like:

- Issuers providing details about the "permanence" of a sequestration/storage technique used by the Ecological Project, including digitization of data capture and validation.
- Buyers understanding the value of a carbon removal credit with higher durability ratings.
- As removals have a reversal risk it will be important to indicate the risk associated with a removal and the supported mitigation plan if a reversal occurs.
- Supporting pricing based on durability for markets, including standardization of market terms such as tick sizes and creation of historical market data.
- Allowing for fungible pools of credits to be created across different sequestration methods/ techniques that have the same quality and durability values.

- Supporting pooling of assets with the same durability into composite products for investment and larger purchase.

Determining what attributes/properties of a credit can reflect a credit's durability, without buyers "glazing over" granular details that should be available in related MRV data, will need to be evaluated by issuers, markets and buyers. This taskforce is recommending these properties as a starting place for Durability attributes, known as a Property-Set, for a token issued for carbon removal.

## *Durability Property-Set*

The Durability property-set is found in the Core Carbon Principles property-set and is used to expand the information provided for the permanence principle defined in the CCPs.

- Storage Type: Materials | Biological | Geological - where the carbon is sequestered.

- Durability Term: Number of year(s)
    - A market reference can be used and determined to apply general term labels for the type of removal by markets:
    - Example references:
        - ***Low***—In general, these are solutions that sequester carbon for less than 100 years. Forestry and soil approaches are the main examples.
        - ***Medium***—In general, these are solutions that sequester carbon for hundreds of years to 1,000 years. Biochar is the main incumbent medium-durability approach.
        - ***High***—Solutions that sequester carbon for thousands of years. Biomass approaches with geologic storage (including bio-oil), direct air capture, and mineralization are the best-known approaches in this category.

- Degradable: 0 – 100 % - 0 is expected to be permanent.
    - Factor – The factor is a description of quality, where a premium could be expected for "0" for example and where buyers could expect a discount for factor ratings higher in the scale. This could also be described in "buckets" like bond ratings, where the factor could be used to rate the most durable tokens (as AA for example) or lower durability .
    - Type – linear, exponential, etc.

- Reversal Mitigation: The "risk of reversal" profile associated with the credit:
    - Reversal Risk: Low |Med | High
    - Durability Insurance Type: Buffer Pool | Refund - Over time reversal insurance strategies and products should enter the market, options like setting up a buffer pool of like credits that can be used to replace credits that were reversed.
    - Insurance Provider: Ecological Project | Insurance Product | Issuing Registry | Retirer | Other
        - Who is responsible for managing the risk mitigation strategy/product?
    - Link to Insurance Policy (optional): a verified link to the insurance policy/product.

Additionally, tokens that will implement the Durability Property-Set should also include the following behavior:

- Revocable: Tokens that implement durability should implement the revocable behavior to support revocation and replacement due to a reversal event.

The full proposed durability property-set schema can be reviewed here.

### Note on the Impact Durability will have on Verification Contracts

Because some removals, usually nature based, will have degradation risks, an audit of a credit's durability should be conducted and be discoverable. This taskforce is recommending that this audit information should be recorded in the Verification Contract between the Ecological Project/Modular Benefit Project, the VVB, and the Issuing Registry.

This requires an update to the VEM Verification Contract Schema with these properties.

- Audit Schedule: Biannual | Annual | 2 | 3 | 4 | 5 year
- Last Audit: Date
- Last Audit Report: Verified Link to the report

## Carbon Reference Token (CRT)

A Carbon Reference Token (CRT) references one or more CRU tokens to represent a specified volume of metric tons of greenhouse gas (GHG) emissions reduced or removed by the underlying CRUs.

The CRT has standard data elements that represent the shared view required by the parties in the carbon market from suppliers, buyers, validation and verification bodies ("VVB"), registries, and exchanges. These standard data elements are based on the recommendations from the ICVCM, with the included CCP property-set. The token specification using the TTF is given in the figure on page 29 .

Every CRT will have the following behaviors and properties:

- Is a fungible token that represents one metric ton of CO2 (tCO2) or 1 tCO2e of reduction or avoidance.
- Is divisible, transferable, encumberable, revokable, delegable, offsetable and mintable with role support.
- Unique identifier (Id): An identifier that is assigned when issued.
- Quantity: The amount of CO2e in tonnes, can have up to 4 decimal place precision.
- Owner: The Id of the account that is the owner of the token.
- Listing Agent Id (optional): If the CRT is listed on a marketplace or exchange.
- Core Carbon Principles (CCP): A set of properties that every CRT will have.
- Climate Labels (optional): Name/value pair of additional climate labels for compatibility.
- Issuer: The Id for the issuing standard registry.
- Retired (optional): True or false for implementations where it is not implicit.
- Offset Applied to Id (optional): A link to an ESG Scorecard or goal that the offset should apply.
- CRUs: A collection of the Ids of the CRUs referenced and encumbered by this token.

# CARBON-REFERENCE-TOKEN

Taxonomy Formula: [tF'{d,t,e,v,g,OSC}+phCCP]

## Token Specification Summary

### Token Classification

| Template Type: | SingleToken | This token has no sub or child tokens. |
|---|---|---|
| **Token Type:** | Fungible | Tokens have interchangeable value with one another, where any quantity of them has the same value as another equal quantity if they are in the same class or series. |
| **Token Unit:** | Fractional | This token can be sub-divided or split into smaller units or parts based on a certain number of decimal places. |
| **Value Type:** | Reference | This token is a receipt or title to a material item, property or right. The token represents a reference to the value, can be owned or used digitally via its token. Sometimes referred to as a digital twin. |
| **Representation Type:** | Unique | Token instances are unique having their own identities and can be individually traced. Each unique token can carry unique properties that cannot be changed in one place and their balances must be summed. These are like bank notes, paper bills and metal coins, they are interchangeable but have unique properties like a serial number. |
| **Supply:** | Infinite | Infinite supply indicates that tokens in the class can be created and removed with no cap and potentially reflect negative supply for certain business cases. |

Draft

*DRAFT - This is a token based on the recommendations from the Integrity Council for Scaling Voluntary Carbon Markets (ICVCM) for creating a Carbon Reference Token and its extended attributes. It is a Unique Fractional Fungible token, with up to 4 decimal places, Offsetable Supply Control with Revoke and Replacement, and the Core Carbon Principles property-set. It is a token where 1 token equals 1*

## Using CRT

CRTs can be held for their value or spent to offset reported emissions in either a voluntary or a regulated market. When an owner offsets using a CRT, they may retire the whole token or choose to decouple the CRUs from the CRT, retire a select number of them, and then re-compose a new CRT with the unspent CRUs. Any retirement can be applied towards an ESG Goal or another target and is retired or burned and cannot be offset again. See ESG Scorecard.

## Issues with CRT

Narrowing the list of attributes to cover most demand signals may cause limitations when it comes to value variables including:

- Year scale for Global Warming Potential (GWP) for calculating GHG CO2e:
    - 100yr GWP vs. 20yr GWP for methane (CH4) that has greater warming potential in the 20yr vs. 100yr GWP.

### *Additionality*

Additionality, for carbon reduction, is whether it would have happened without the existence of the project. This is a complicated and controversial topic—relying on logic that can be difficult to prove in either direction.

- There is not a single, clear market agreement for how to calculate the baseline against which a project's impact gets measured. Project developers can misuse baselines, resulting in inflated credit values. Baselines against which removals are estimated must be set conservatively to minimize risk of over-crediting.

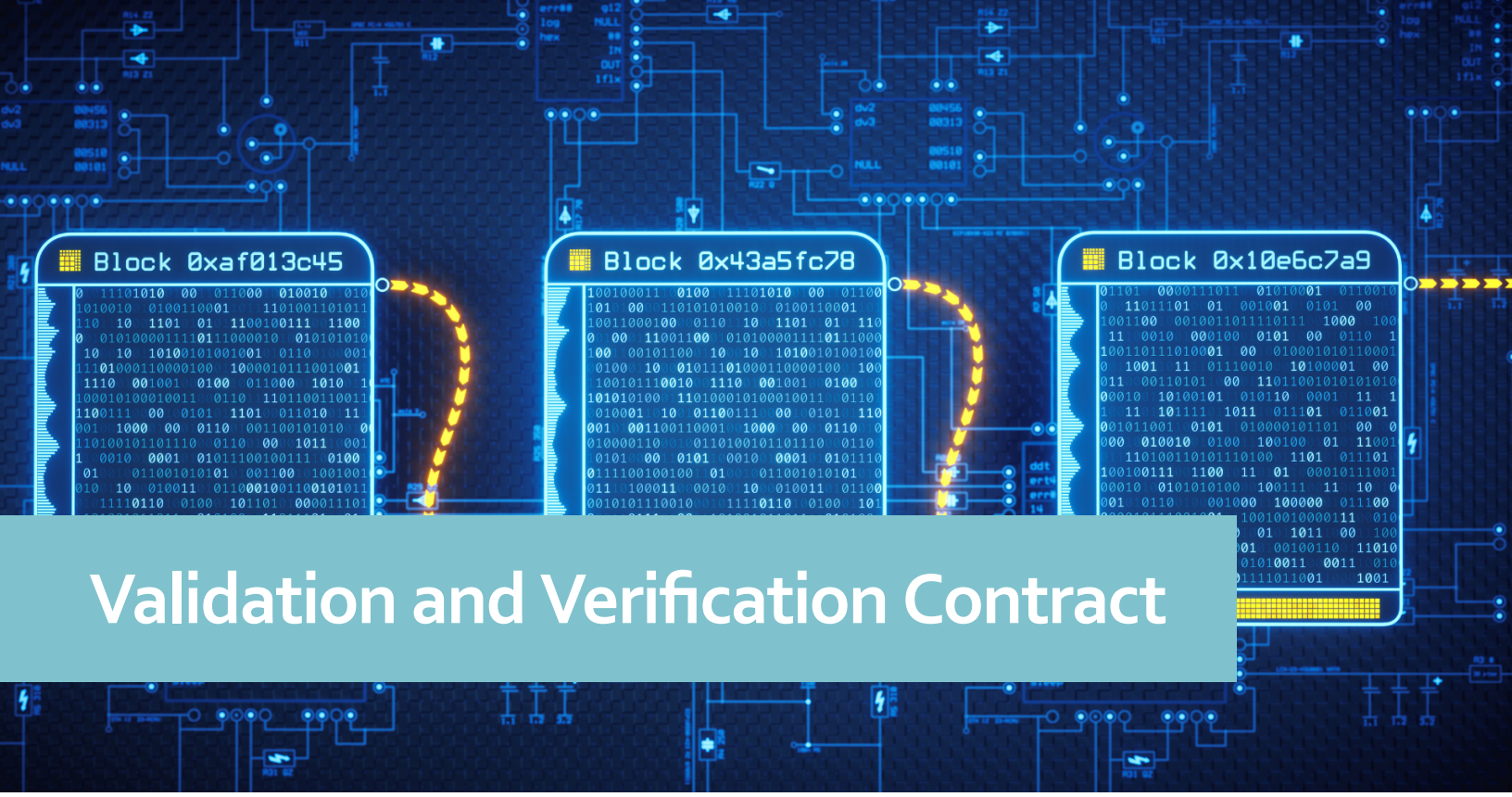
- No best practice, or common authoritative standards body guiding best practices, exists to guide decisions on how carbon finance and corporate procurement of credits contribute to additionality. Some projects have received criticism because payments for carbon credits are only a percentage of the entire project funding stack or because landowners don't know that the project is generating carbon credits.

### *Baseline*

Establishing an accurate and fair baseline to measure progress, like reductions measurement requires a baseline level to be established. Historically, establishing a baseline has been troublesome for validation of claims.

### *Leakage*

Some projects inadvertently shift emissions from one geographic area to another area that is not counted in the project claim. Activity leakage occurs when an activity is displaced from one geographic area to another. Market leakage occurs when a project reduces the supply of a specific product, but market demand encourages others to provide that product instead. For example, carbon removal might be achieved in one area by letting trees grow longer but may indirectly result in trees being cut elsewhere to satisfy timber market demands. To improve leakage determinations, registries should develop stronger science-based benchmarks for leakage that are informed by research.




# Validation and Verification Contract

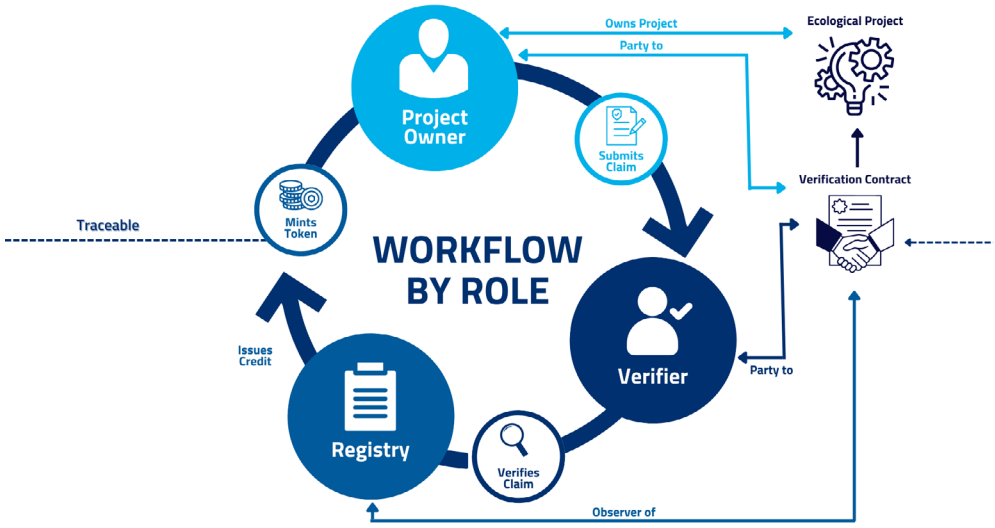
A Validation and Verification Contract is a multi-party contract between an Ecological Project owner, a VVB of the type of benefit claims that the project will be creating, and the governing registry of the quality standard. Because benefit claims should map to a quality standard developed by a registry, the VVB must be authorized to perform the verification by the registry.

## Key Points

There are a few key details regarding the parties involved in the verification process:

- Each Ecological Project (EP) can have multiple Modular Benefit Projects (MBP), where each MBP creates claims based on a selected quality standard. Only one MBP can create claims of a specific type per EP. For example: an Ecological Project can have a MBP for Carbon Reductions and another for Carbon Removals.
- The Verification Contract is established at the MBP level as it is the source of claims to be verified.
- There can be different VVBs for different MBPs in each EP.
- EPs can switch VVBs between claims from its MBP.
- MBP Claims are based on the selected quality standard from a registry, thus the registry is an observer in the verification process. There are standards where the verification and registry roles can be handled by the same entity, but, in this case, through independent departments within the organization.

### Workflow Diagram



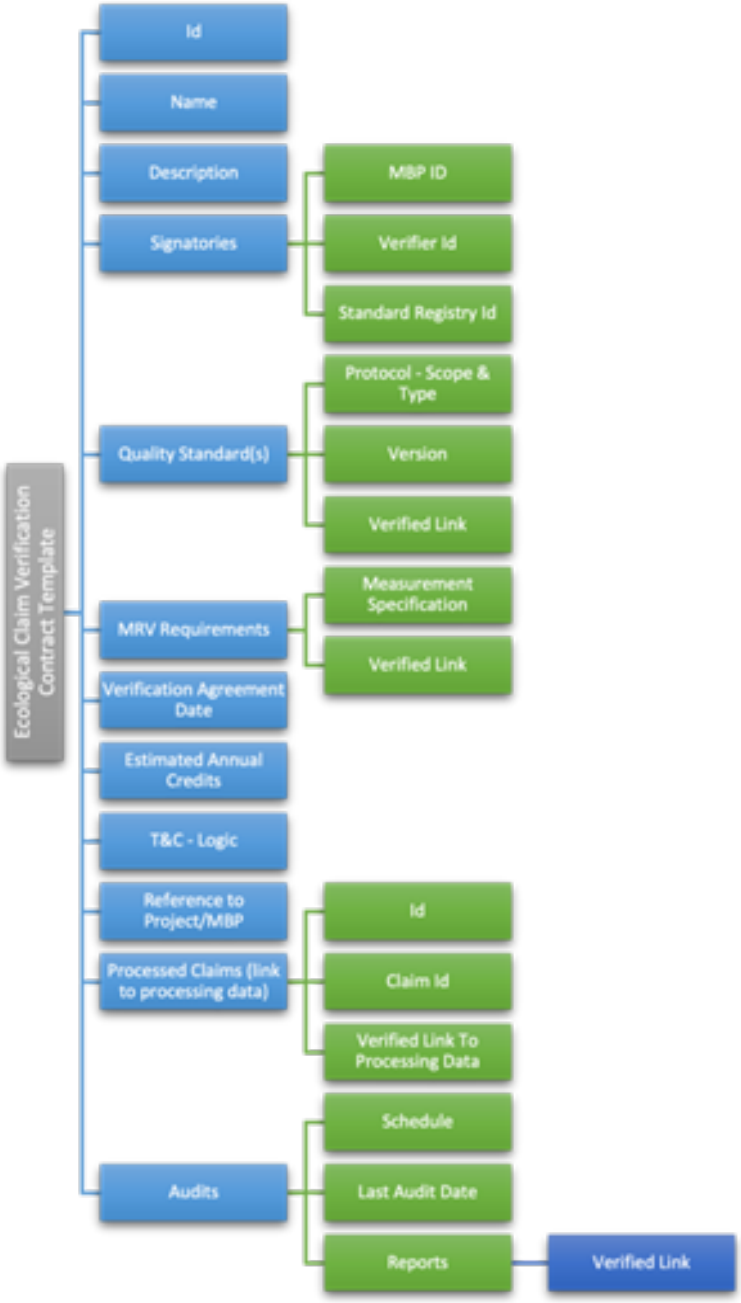

## Properties

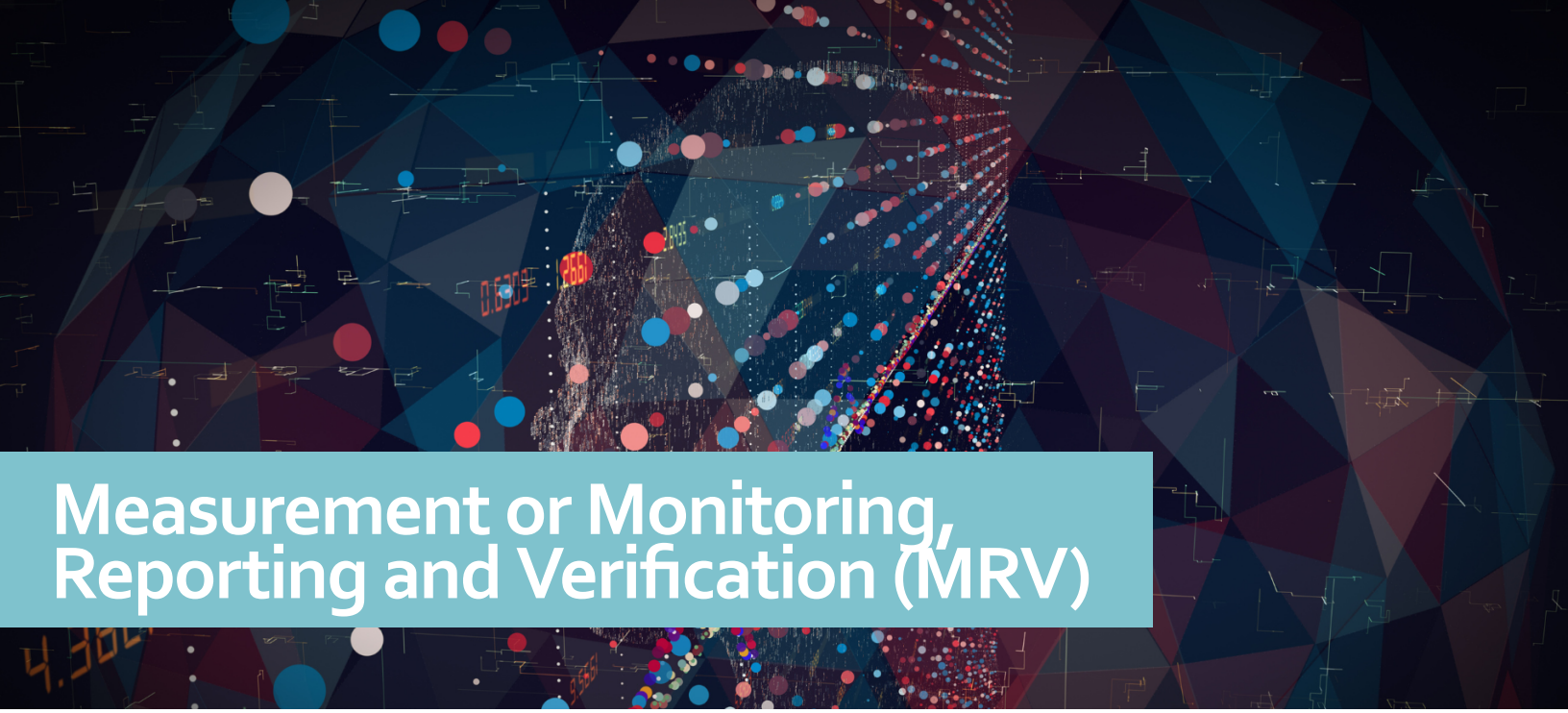
Each Verification Contract contains the following:

- Unique identifier (Id): That is issued and is independent of the “name” of the contract. The Id is used to reference the contract and link it to its processed claims and credits issued from it.
- Name: A name, recommended, but not required, to be unique.
- Description: A brief description of the contract.
- Signatories: Have Id(s) of the EP owner, VVB, and Standard Registry.
- Quality Standard:
  - Methodology or Protocol
  - Version
  - Verified Link: Link to the published standard.
- MRV Requirements (Measurement, Reporting and Verification)
  - Measurement Specification
  - Verified Link: Link to the detailed measurement spec.
  - MRV Attributes: See MRV Characteristics
- Agreement Date
- Estimated Annual Credits

- T&C - Logic
- Reference to Ecological Project/MBP
- Processed Claims:
  - A Processed Claim contains:
    - Id: A unique, independent Id for the processed claim.
    - Claim Id: Reference to the source claim.
    - Verified Link: Link to the verification data.
- Audits:
  - Audit Schedule: Biannual | Annual | 2/3/4/5 Year
  - Last Audit: Date
  - Reports
    - Last Audit Report: Verified Link to the report

## Verification Contract





# Measurement or Monitoring, Reporting and Verification (MRV)

Measurement means scaling of emissions, reductions, or other results and estimating based on measure-related data. Reporting indicates the recording and submission of data and detailed analysis. Verification refers to the assessment of the emissions, reductions, and other data that is measured and reported. MRV requires the following six characteristics: transparency, comparability, reliability, usefulness, timeliness, and completeness.

Data acquisition, handling, processing, and storage across various phases of the MRV process should enable a greater degree of standardization, digitization, and automation.

## *Principles*

The application of the following guiding principles helps build confidence and trust in the MRV system. The guiding principles that underpin the Digitalized MRV System are the same as those that have been cited in the international standards: ISO-14064, IPCC Guidelines, CDM Project Standard, The Gold Standard and Verra: Verified Carbon Standard (VCS), and could be summarized as per the following characteristics:

- Relevance: To select the greenhouse gas (GHG) sources, GHG sinks, GHG reservoirs, data, methodologies, and all other information that is appropriate to the needs of the intended user.
- Completeness: To include all relevant GHG sources and sinks, and information to support compliance with all requirements.
- Consistency: To enable meaningful comparisons in project activity-related information.
- Accuracy and Conservativeness: To reduce bias and uncertainties as far as it is practical/cost-effective, or otherwise use conservative assumptions, values, and procedures to ensure that GHG emission reductions or net anthropogenic GHG removals are not overestimated.
- Transparency: Disclose sufficient and appropriate project activity-related information in a truthful manner to allow intended users to make decisions with reasonable confidence. However, proprietary, or confidential, information should not be disclosed without the written consent of the provider of the information, except as required by national law.

## *Quality Standards*

A clear understanding of the key data that is required to be measured and monitored, the standard, and the associated methodology for calculating the environmental impact to be adopted, are essential to perform consistent and accurate reporting that could be compared and transparently verified. Together, these define the Quality Standard to be followed by the MRV process.

- Standard represents the key data required to be measured, monitored, and reported which is the basis for submitting a claim based on the data.

- Methodology or Protocol represents the technique or method used to collect, validate, and verify the data the standard requires to submit a claim and have a claim verified.

In compliance markets, the annual procedure for MRV, together with all the associated processes, is known as the ETS compliance cycle. In voluntary markets, standards can be adapted to more accurate and timely data collection to increase the frequency of the MRV process.

## *MRV Characteristics*

Having a set of properties that can be used to quickly determine characteristics of the MRV process used to generate the credit can be used in conjunction with other property-sets like durability to determine quality and value of a credit.

- Suppliers that use high precision measurements and do not rely on factored estimations.

- Robust evidence data collection from multiple sources

- Counterfactuals:
    - Overestimation often takes place at the level of the project design by using inappropriate counterfactuals. The largest misrepresentations in this regard come from overestimated or poorly specified baseline scenarios.
    - The “parameters not monitored”, which typically includes emission factors, is also prone to misrepresentation.

Determining what attributes/properties of a credit can reflect a credit’s MRV supply chain without buyers “glazing over” granular details is covered in the verification process. This taskforce is recommending these properties as a starting place for MRV Characteristics, known as a Property-Set, for the verification contract of the token to be issued.

## *MRV-Characteristics Property-Set*

- MRV Precision: Low - Estimated via Modeling | High - Direct Measurement, Recording and Verification

- Data Sources: A collection of Data Sources which each contain:
    - Id: A unique identifier for the data source
    - Description: A summary description of the data source and its capabilities
    - Verified Link: A link to the data source specifications

The key measures for new MRV architectures for ecological projects like carbon removal should be based on precision, transparency, governance, scalability, and efficiency.

## *MRV Framework*

The IWA's Sustainability Working group, under which this taskforce operates, accepted a member contribution from Microsoft and some of its partners as a companion to this VEM overview. The Digital MRV framework document was published after version 1 of this document and dives into details about how digitization of measurement, reporting and verification can be generalized and applied to a wide range of ecological assets.

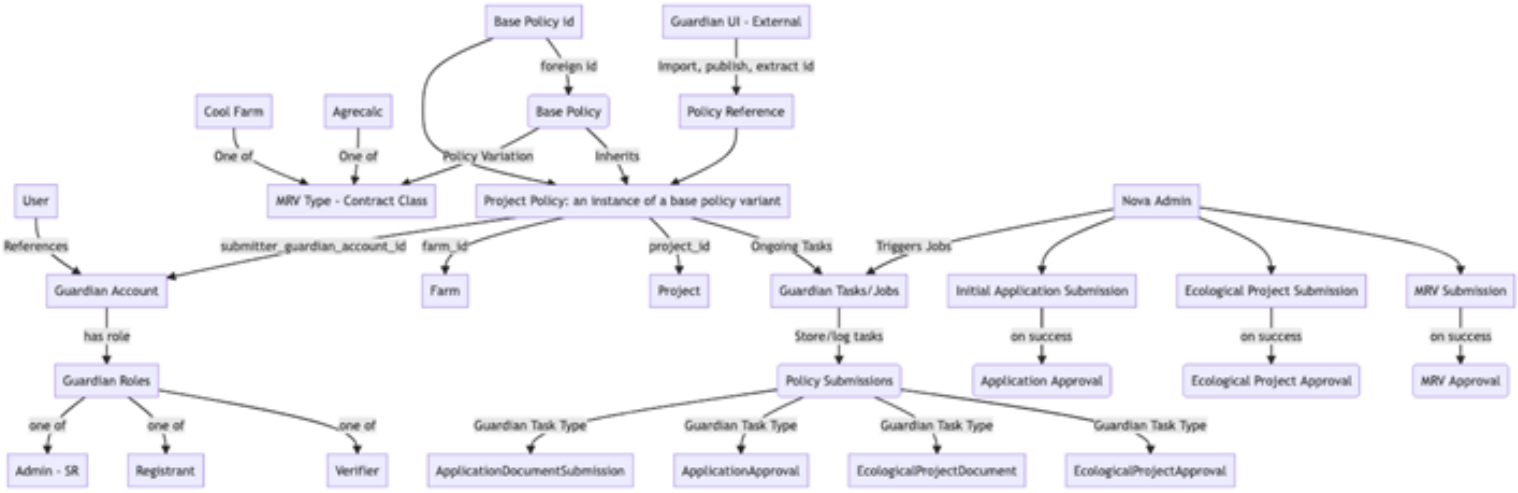
The contribution made is a version 1.0 from a narrower set of participants and a work in progress. This taskforce will continue the evolution of the framework in much the same way by broadening feedback and participation. The Digital MRV Framework can be found here.

## *Combining CCPs, CRUs, & MRV - DOVU Implementation Example*

DOVU has leveraged the IWA VEM specification for the carbon token lifecycle by delivering an auditable process, focused on MRV and capturing proofs in the audit trail tied to individual actors that have been validated and verified. These actors have unique keys, which they use to sign every transaction following W3C Decentralized Identifier (DID), Verifiable Credential (VC), and Verifiable Presentation (VP) standards and linking them to a native Token using the Hedera Hashgraph public DLT and Hedera's Guardian, an open source reference implementation of the IWA's Voluntary Ecological Markets Standards.

While the IWA and the participants of the taskforce do not endorse or prescribe DOVU or Hedera specifically, it is important to the group that a reference implementation is included to show how all of the pieces work together. You can find more information about the DOVU use case in the Appendix.

**DOVU Implementation Example**



# Establishing Voluntary Demand – Emissions and Reporting

*In July 2022 the GBBC launched the  Carbon Emissions Token Taskforce to help further define processes and standards around tokenizing carbon emissions to better track emissions through supply chains. Carbon Emissions Tokens, and corresponding actions will be further explored and defined by the Taskforce throughout the second half of 2022.*

Most organizations participating in the voluntary market are setting goals and reporting their carbon emissions. The VEM will not attempt to define a level of detailed carbon accounting, but rather follow developing standards like the Greenhouse Gas Protocol and simply record a summary of Scope 1, 2 and emission goals, forecasts, and reporting. Netting of owned credits to offset reported emissions will result in effective emissions to track progress for participants in the voluntary market. See the figure on page 38 for a breakdown of emissions scoping.

## Lifecycle - Establishing Voluntary Demand

This taskforce initially focused on organizational voluntary emissions goals, reporting, and applying offsets to match effective emissions with targeted goals. Calculating emissions follows the Greenhouse Gas Protocol and records emissions quantity, scope, and category for the reporting organization. To send a demand signal, an organization's sustainability goals, forecasting, buyer preferences, and reporting should be established for tracking their progress as well as providing valuable guidance to suppliers.

Below, we provide some introductory material as to the direction the taskforce focusing on emissions is leading, these are in the early stages of development, but provide a good overview of how these efforts fit together.

# Emissions

Jurisdictions (countries), organizations (companies) and the scientific community each use different, incompatible methods to determine greenhouse-gas emissions. The results of these methods cannot easily be compared or combined to work together which results in information on emissions across the spectrum being inconsistent, incomplete and unreliable.

By tokenizing emissions in the same manner as we propose tokenizing credits, it is a step towards establishing an integrated global system of greenhouse-gas "ledgers" that can balance the books of emissions and removals across the planet.

There is an adjacent taskforce in the IWA's Sustainability Working Group that has just begun focusing on this task. Below is a brief introduction to that work.

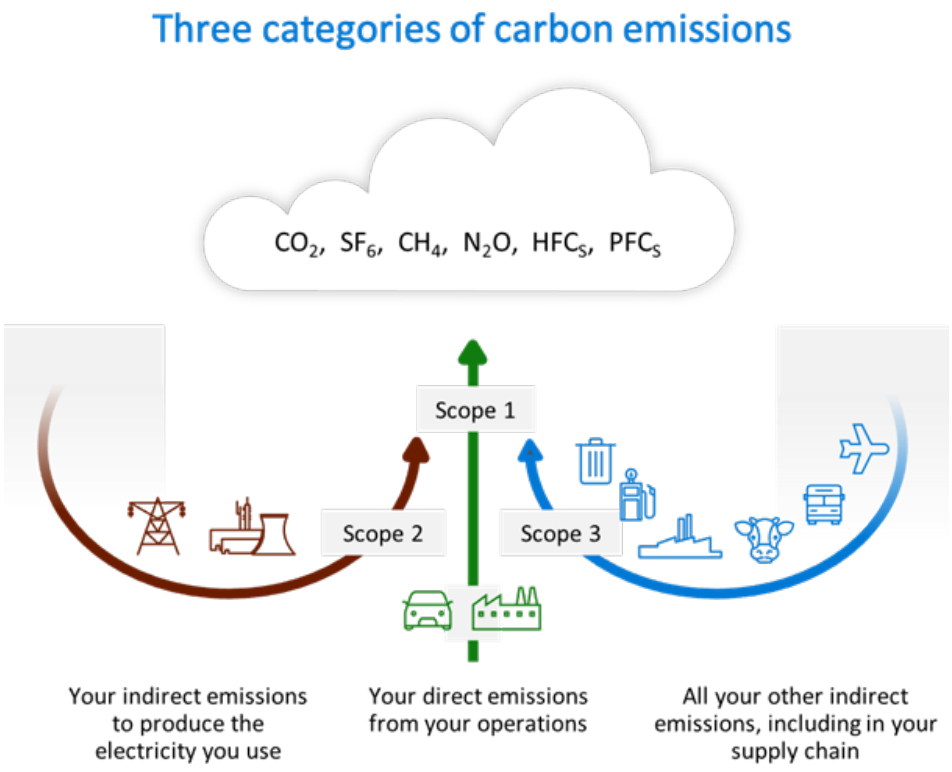
## *Carbon Emissions Token (CET)*

Reporting GHG/Carbon emissions following the GHG Protocol follows a standardized accounting methodology for calculating the actual emissions an organization directly and indirectly emits.

The CET represents a specified volume of metric tons of greenhouse gas (GHG) emissions and should be able to distinguish GHG Protocol (GGP) Scope and Category of the emissions reported.

To understand how carbon is spread across a supply chain and to effectively begin targeting reductions where they are the largest, it is important to be able track and trace the emissions across the entire supply chain. The GGP does this by scoping and categorizing emissions.

From Greenhouse Gas Protocol



At a high level, one participant's scope 1 emissions become other participant's scope 2 for direct energy consumption. Scope 3 emissions flow upstream and need to be calculated, which is a complex process that involves estimations at best with a bit of guesswork thrown in. If full track-and-trace for scope 1 & 2 emissions can be captured by enough participants in a supply chain, it should be able to be overloaded with trade flows between the supply chain to produce a more straightforward and accurate calculation.

One additional aspect for CETs is their offsetting with CRTs and allowing that offset to cascade through the emissions reporting within a supply chain. Any implementation of offsets should ensure that an offset cannot be spent or applied twice for scope 1 emissions, it DOES want to ensure that any offset that decreases a downstream participant's emissions also decreases proportionately for the upstream consumers calculating their scope 3 emissions.

Using both a CET to account for emissions and CRTs or CRUs to account for an offset/reduction allows for this behavior in any implementation.

# Voluntary Reporting, Progress Tracking, and Demand Signals

## Environmental, Social, and Governance (ESG) Contract

Participating organizations in the voluntary market should record their emissions goals and report their audited results alongside to get an accurate gauge of demand for offsets. Currently, the pledges an organization makes in most jurisdictions are largely marketing exercises in the spirit of Environmental, Social, and Governance (ESG) criteria for socially conscious investors.

An organization can record its ESG pledge, using a regular reporting cadence, for achieving a targeted ESG goal of carbon neutrality or negativity and then report their actual emissions in the same location. This would provide a baseline for the supply of offsets needed to achieve this ESG goal.

Further, if this organization were to purchase offsets from the marketplace and apply/spend/consume them to lower their reported emissions to an effective rate that met their cadence goal, this would remove the applied offsets from the supply and complete the lifecycle of the offset.

An organization that participates in the voluntary market establishes a contract between itself and an auditing participant for each reporting cycle (cadence). The figure on page 42 presents a simple example of what an ESG scorecard might look like in practice.

### *ESG Scorecard*

- Establishment of a voluntary reporting network where participants can register their ESG goals, report their actual emissions, as well as apply offsets to achieve an effective emissions report demonstrating progress towards their goals.

- Enable track-and-trace for GGP Scope 1 & 2 emissions used in the calculation of Scope 3 emissions.
- Standardize on a token or digital asset representation for emissions.

The ESG Scorecard is for:

- Buyers looking to offset, which they do so for various reasons: brand protection, valuation/stock price, and compliance are a few.
- Establishing emissions goals and reporting progress.
- Sending demand signals about product preferences.
- Having a verified record of goals, emissions and offsetting activity for investors concerned about ESG (Environmental, Social & Governance) criteria.
- Providing accurate and trusted (governance) data to firms evaluating corporate progress and actions.
- Having a standard voluntary progress tracker to state goals, record actual emissions, and offset against.
    - Emissions reporting – recommendation to start with coarse goals and actual emissions. Structure to allow for more granular reporting to follow as the process matures.
    - Offsetting details should come from transactions and provide the granular detail available from standards in supply creation.

The contract is a simple ESG scorecard for a participant to record their established pledge (net zero, net negative, etc.) and track progress (goals, forecast, actual, effective). The contract can also include an auditor or registry for different reporting periods. The contract provides the following key capabilities:

- Signal demand and buyer preferences.
- Apply offsets  to the scorecard when retiring the offset.
- Complete the lifecycle of the offset credit.
- Should be able to be private with conditional access.
- In the future it can be used to provide verification for 3rd parties evaluating the participant's ESG score and used for more detailed emissions reporting.

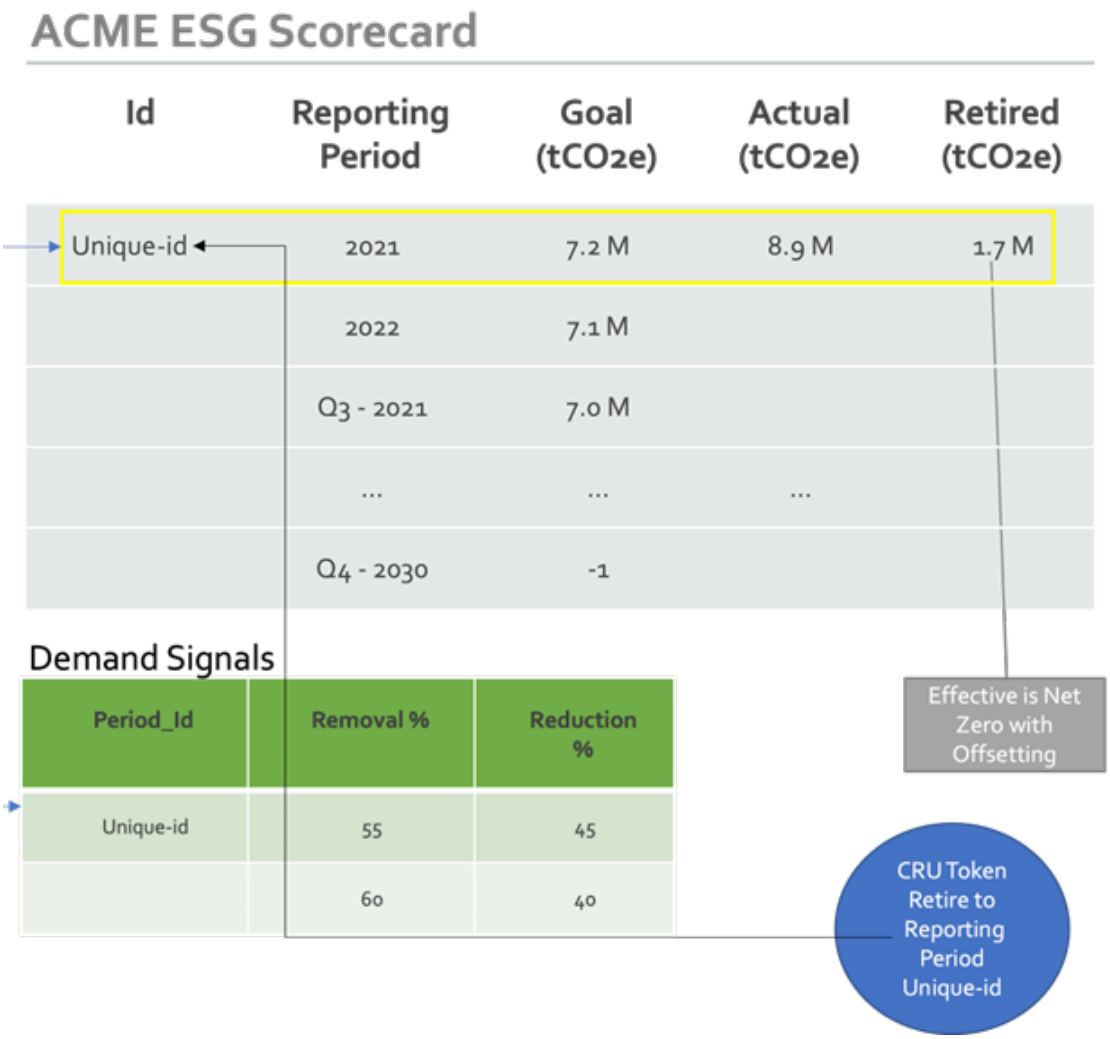
### *Properties*

The ESG Scorecard contract contains these initial properties and functions:

- Company Name
- ESG Milestone:
    - Id: Unique identifier for the milestone
    - Name: Example name Carbon Neutral by 2030

- Description: A description of the milestone
- Reporting Periods
    - Reporting Date Range: Start and end date of the reporting period
    - Goal: Quantity for the period
    - Actual: Measured results from the period
        - Links to CET Tokens or other reports
    - Retired Assets
        - Links to CRT or CRU tokens retired to net down emissions. When a token is retired to offset or remove towards an ESG Reporting period, the retirement request should pass in the Id of the scorecard entry it offsets.

## ESG Scorecard Example



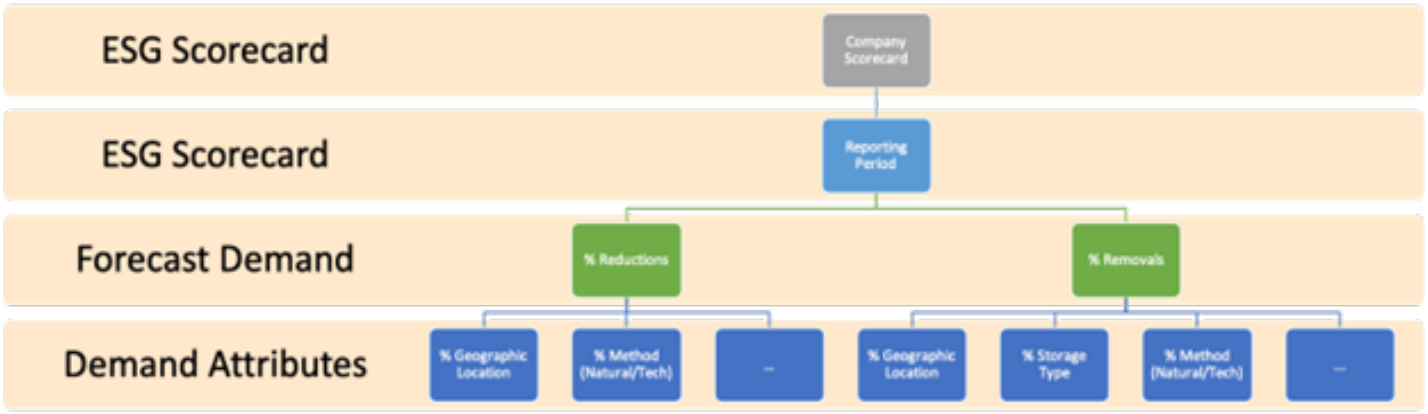
## *Demand Signals*

To establish a clear demand signal to suppliers, a more detailed forecast for the type of offsetting the buyer will engage in can provide details about removals vs. reductions. Then, in each offset preference, the demand signal can be filtered further via technique (nature vs. technical), storage (biosphere vs. geosphere), geography, etc.

Determining the list of attributes to cover most demand signal preferences may run into limits. It is yet to be determined whether variables like GWP would be important for buyers, for example:

- Year scale for Global Warming Potential (GWP) for calculating GHG CO2e:
    - 100yr GWP vs. 20yr GWP for methane (CH4) that has greater warming potential in the 20yr vs. 100yr GWP.

**Demand Signal by Reporting Period Example**




## *Example ESG Scorecard Contract with Future Emissions Goals*

Here an organization (the reporting organization in the figures below) creates a new ESG Scorecard Contract, publishing their future GHG Emissions goals by a certain date and adding a reporting entry placeholder for each reporting date up to the future emission goal.

For example, if an organization's goal is to be carbon negative by 2030, they would publish that goal for the final quarter of 2029 having an emissions report of -1. Then they would add an entry for each reporting period (quarterly, bi-annually, or annually), recording their progress toward their goal for that period.

If their current quarterly emissions report is 10,000 and they have 38 reporting periods (quarters) until their goal, they can simply establish their period goal by reducing emissions by 264 for each period to achieve a negative emission goal.

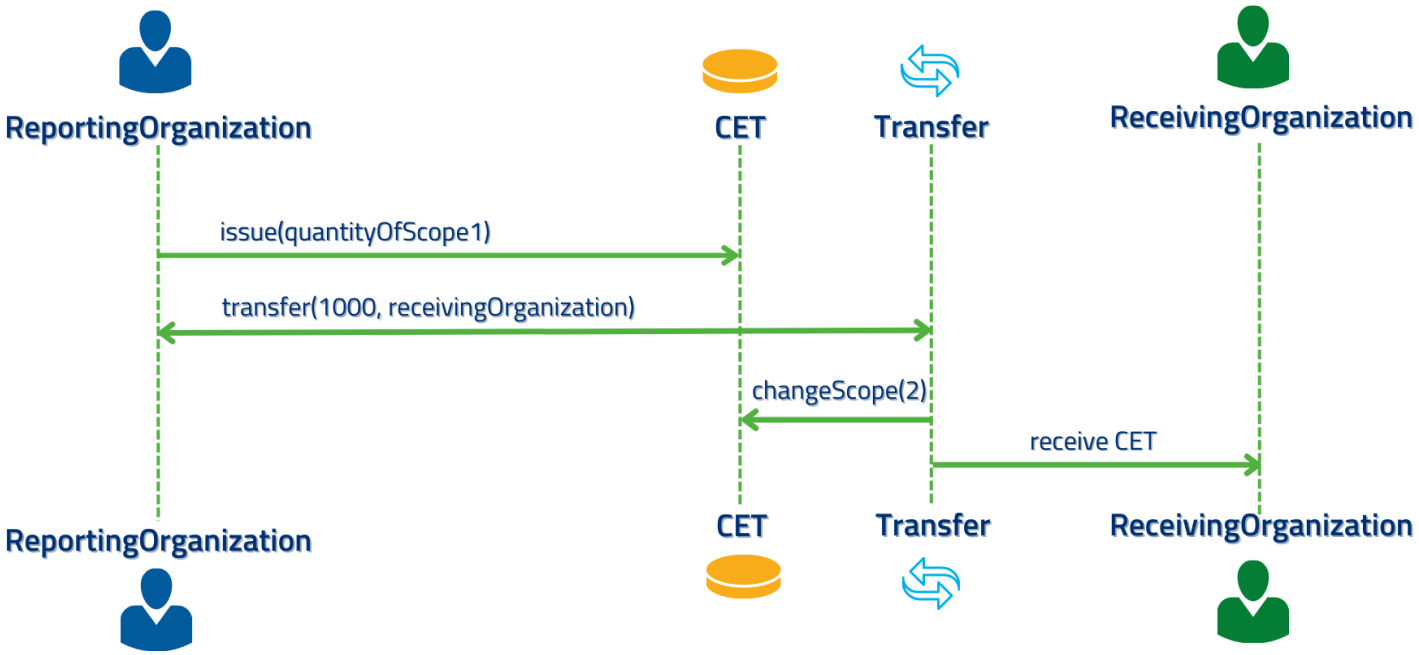
**10,000/38 = ~264 subtract 264 from each period's emission goal.**

# (FUTURE) Reporting and Allocated Transfer of Emissions

Participants report their emissions using CETs (Carbon Emission Tokens) and may transfer ownership of CETs through their supply chain which changes their GGP Scope and Category. CETs are issued by GHG sources like power utilities and organizations that emit GHG through their direct operations; CETs are issued as Scope 1.

When a CET is transferred in the supply chain from Scope 1 (direct generation) to another participant, like a power company's consumer, a quantity of CETs is transferred to the consumer and set to Scope 2. If the participant's power provider does not issue CETs, the participant can issue CETs directly as Scope 2 emissions. Scope 3 emissions are more difficult to calculate until the entire supply chain is reporting its Scope 1 & 2 emissions and correctly performing allocated transfers of CET upstream. To accommodate the accounting and calculation of Scope 3 emissions in the meantime, Scope 3 emissions can be recorded in the period report.

Transfer CET Sequence



# Auditing Emissions

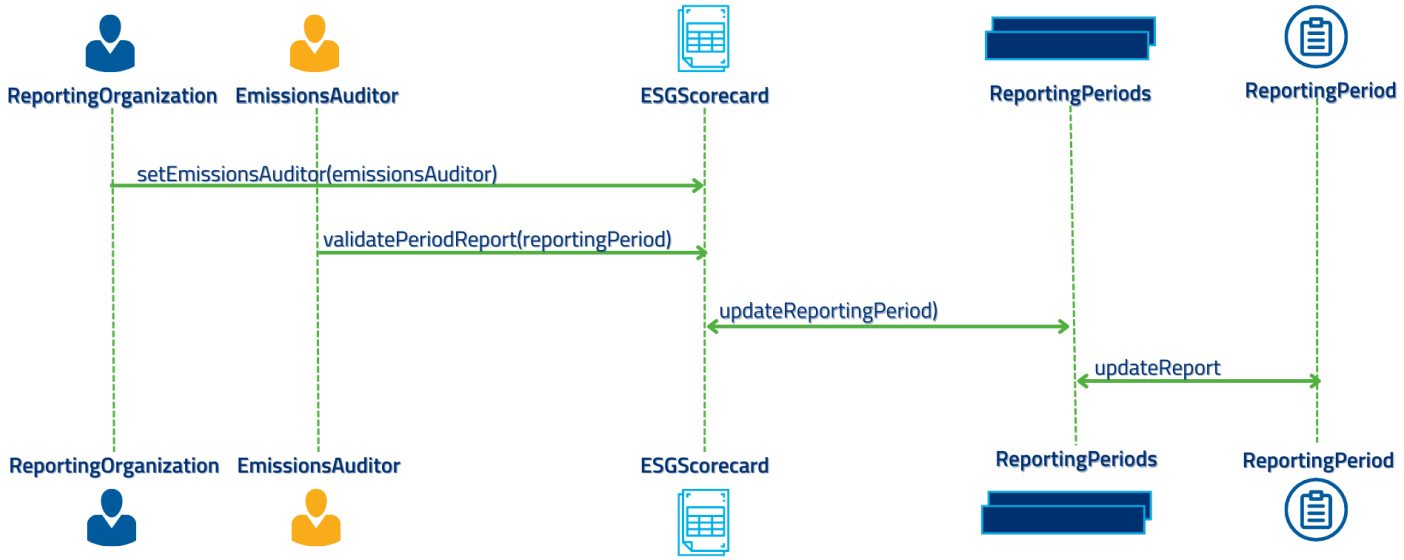
An organization reporting its emissions will select an auditor for its reporting period and record its emissions "side by side" with its period goal. The period goal is recorded as a number entry, but actual emissions are reported using CET (Carbon Emission Token) sums for the reporting period.

Because CETs have a lifecycle and transfer in a carbon supply chain between GHG sources and consumers, in the future the same CET will transfer between owners until it reaches its destination. For example, a power utility company's Scope 1 emissions become its customer's Scope 2 emissions which can become another organization's Scope 3 emissions in a supply chain. This is covered in more detail in the above section on CET.

However, until a critical mass of participants reporting emissions that can be "track-and-traced" through the supply chain is hit, Scope 3 emissions calculations should be reported using one of several methodologies being developed in the market.

The role of the auditor is to ensure that the issued and owned CETs for the reporting organization match their audit results, correct any discrepancies, and then sign off on the period's report.

### Audit ESG Scorecard Sequence



# Lifecycle – Buying and Trading Contracts

Participants in the voluntary market will want to list, trade, offset, etc., these EPs and have a common understanding of the rules that the market will set.

- Establish standardized contracts for applying or spending credits by emissions reporters retiring them so they cannot be applied again or resold once consumed.
- Establish standard reference contracts, spot, forward, and futures for either OTC or exchange-based trades.

This section covers contracts that span across emissions and credits, like a Delivery vs. Payment contract for trading offsets for another established value (money). The VEM will align with the recommendations issued by the ICVCM operating committee to shape the drafts for each of the below contract types.

## Standard Reference Contracts

Due to the nature of the underlying physically-settled "asset," contracts can be fungible or non-fungible. The marketplace has evolved to establish a contract layer of eligibility criteria. Reference tokens for offsets or removals from EPs that meet such criteria can be physically delivered on a spot basis via standardized reference contracts.

To-Be-Defined Market Types:

- Spot: Typically, spot markets physically settle an asset and cash on the same day of transaction. However, different spot markets may vary (e.g., ranging from hourly or T+2 delivery).

- Forward: OTC contracts between two parties agreeing on terms of a contract for future delivery or settlement (typically within 24 months).

- Futures: Derivative financial instruments that derive their value from the underlying asset. Typically, exchange boilerplate listed contracts can be traded for up to 24 months (most futures exchanges are in North America, UK, and Asia).

## Buyer Preference for Offsets

Buyers in a voluntary marketplace can send a demand signal through their ESG Scorecard, but will also need to be able to search for, and trade, credits based on their properties. Buyer preference can be based on a classification filter, e.g.:

- Reduction vs. Removal
- Natural vs. Technological
- Co-benefit Types
- Source Geography
- Vintage
- Durability
- Methodology
- Etc.

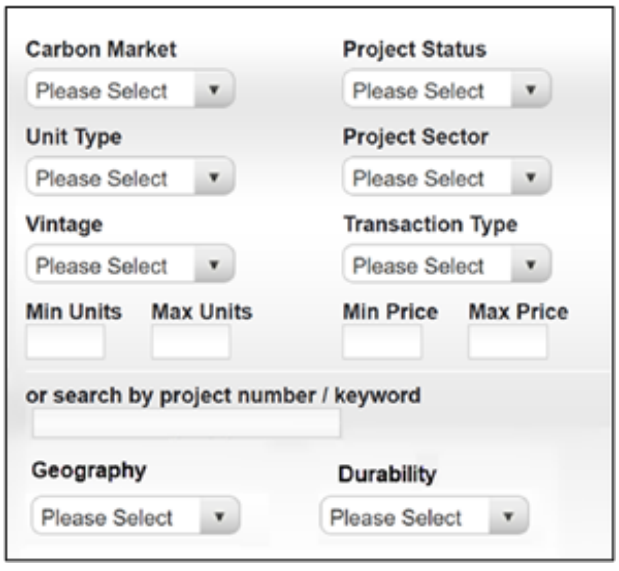
However, through the derivatives instruments (spot/forwards/futures), there would be a readily available market to bring the sellers and buyers of the offers together.

## Voluntary Buyer Use Cases

As a voluntary market can offer both types of carbon credits (CRUs and CRTs), an implementation should have searchable parameters. For example, a standard reference contract can be fungible with other credits in the same class or can be non-fungible custom contracts that can differ in value and be bundled together based on various attributes.

Using the specifications for Ecological Projects, Carbon Removal Tokens, and Verification Contracts, buyers should be able to build queries to find products based on their buyer preferences.

**Interface for Selecting Buyer Preferences Example**



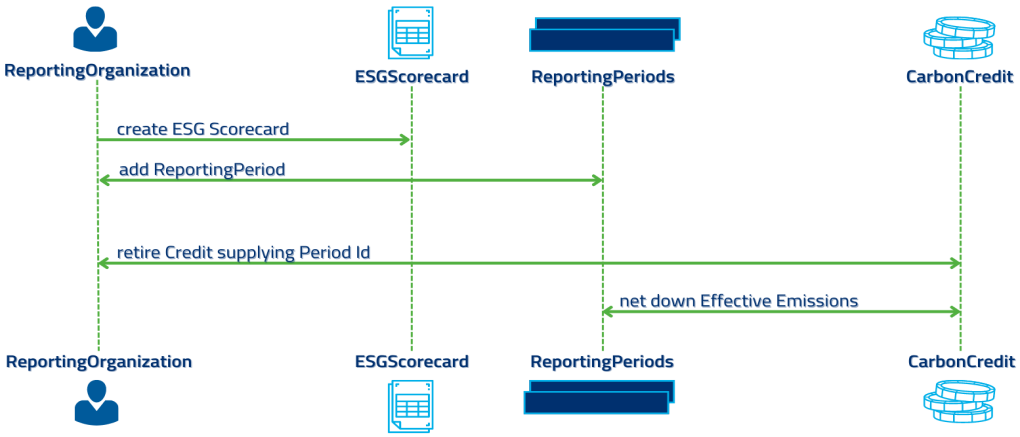
# Lifecycle – Offsetting Emissions to Determine Effective Emissions

Once a participant owns a credit they wish to use as an offset against their emissions, they can spend/retire their credit tokens towards their ESG Goals.

Participants can purchase carbon offsets and apply them against their reported period's actual emissions to achieve their goal for the period. When an offset is applied to reduce actual emissions, the offset is spent and cannot be reused or sold and generates a lower effective emissions balance.

Carbon Reference Tokens (CRTs) represent credits that can be used to offset or decrease (netting) a reporting organization's effective emissions for the reporting period. Effective balances for a period can be calculated from the ledger based on the actual CET transferred or issued in the period for the organization minus the CRTs or CRUs it spends in the period.

### Retiring Credit toward ESG Scorecard Goal Sequence




Once track-and-trace capabilities are realized, the applied offsets should cascade in the supply chain and be reflected upstream in a reduction of Scope 3 reported emissions.

# Summary

This overview of the Voluntary Ecological Markets is just the beginning. The IWA and the Sustainability Working Group continue to revise and refine the specifications outlined in this document. The specifications for the main entities: Ecological Project, Ecological Claim, Carbon Reference Tokens (CRTs) and Carbon Removal Unit (CRU) tokens, and the ESG Scorecard will get more detailed and refined with implementation feedback moving towards released standards that can support implementation certifications.

Future work on a standard, open MRV framework, based on ISO 14064-1:2018, that integrates natively with the specifications identified in this document will help accelerate innovation in the creation of verified supply from diverse ecosystems.

IWA members will also be driving thought leadership across various channels to evangelize and influence using the IWA working group documentation and specifications to connect with organizations that are aligned and driving standardization. To this point,  version 1.0 of this documentation was used to inform the GBBC's GSMI 2.0. Launched in October 2020, the Global Standards Mapping Initiative (GSMI) is an industry-led effort to map and assess the blockchain and digital asset landscape in three distinct areas:

1. Technical standards
2. Legislation and guidance released by sovereign and international bodies
3. Industry best practices and blockchain consortia

Version 2.0 of the GSMI included a Green Economy & Sustainability section, led by IWA and Digital Asset, to integrate with other key subject matter experts through a working group. The outcomes of that working group will inform a Green Economy fact card that will accompany this year's release of GSMI 3.0.

For more information on GSMI see GSMI - Global Blockchain Business Council

InterWork Alliance
A Global Blockchain Business Council Initiative

# Annex

Here in the Annex we are providing links to underlying framework artifacts. The specifications outlined in this document are fully defined as token specifications using the Token Taxonomy Framework.

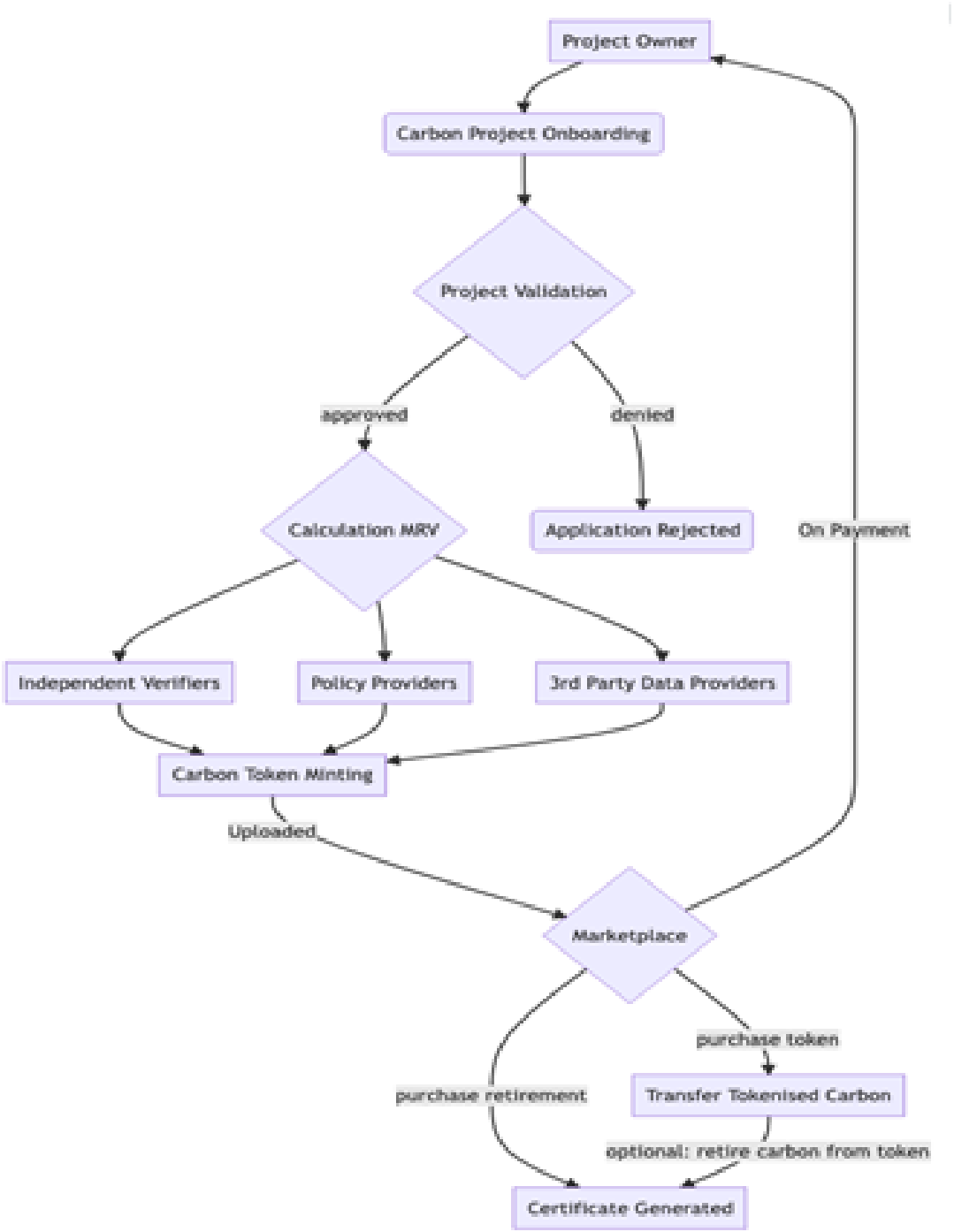
The token specifications for the entities defined in the VEM Overview:

- Ecological Project
  - Framework Artifacts
  - OpenXML Specification
- Ecological Claim
  - Framework Artifacts
  - OpenXML Specification
- Processed Claim
  - Framework Artifacts
  - OpenXML Specification
- Carbon Reference Token (CRT) Token
  - Framework Artifacts
  - OpenXML Specification
- Carbon Reduction/Removal Unit (CRU) Token
  - Framework Artifacts
  - OpenXML Specification
- Carbon Emission Token (CET)
  - Framework Artifacts
  - OpenXML Specification
- Common Types
  - Framework Artifacts

# Appendix - DOVU Use Case

The first step towards compliance was building a system to support manual attestations for an MRV. To mitigate the risk of manually attested data, DOVU supports attestation from multiple sources, as well as verification of the manual data by a 3rd party verifier. In addition, in order to reduce the risk of actors carrying the risk of manual data, DOVU is building a collateral mechanism that would be tied to these actors to serve for insurance purposes.

### DOVU Project Example



### *Actors:*

Standard Registry / Root Authority - Dovu.
MRV supplier - 3rd party policy creator, ex. Cool Farm.
Originator - Dovu.
Primary source - The farmer
Secondary Sources - External verifier.
Guardian.

### *Flow:*

A simplified flow  would see a farm owner contact DOVU. As part of the onboarding process, this initial application will get evaluated. At this point, DOVU will create an Ecological project and ask the farm owner to provide data and documents such as proof of land ownership. Next, an MRV will be created and attached to the farm application. Once MRV data has been collected, a 3rd party verifier will evaluate the data and signoff where appropriate. All of these steps are publicly auditable through IPFS, with connecting proofs of schema-based VC data. After the MRV data has been signed off, the CRT tokens are minted using the Guardian.

### *Guardian:*

This diagram expands on the basic flow and incorporates basic Guardian functionality. The Guardian controls data flow related to every stage of an ecological project.

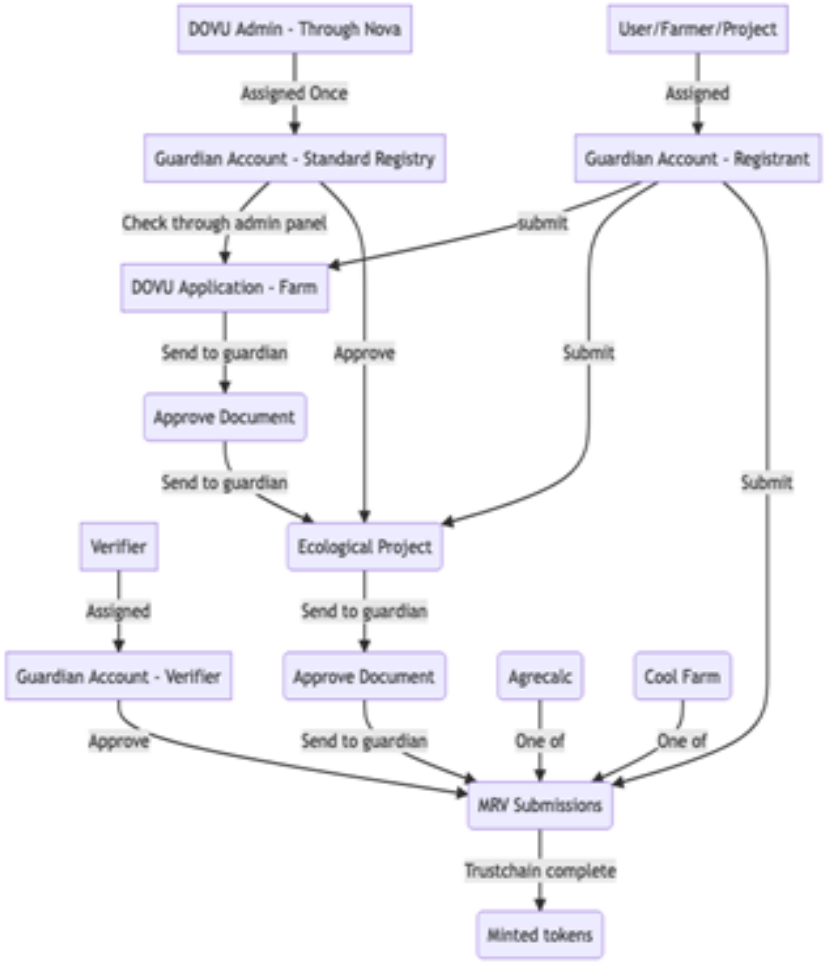
These data flows are recorded on the ledger and signed off by verified actors. Ultimately, this data will be fully transparent and available to see once the carbon tokens are minted and listed on our marketplace.

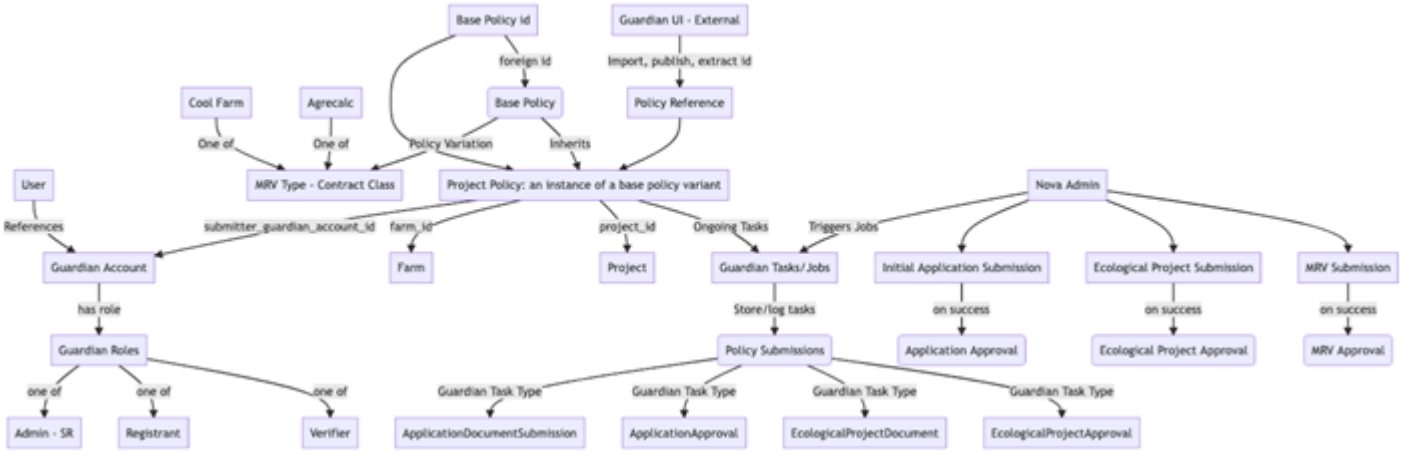
### *Architecture:*

A given MRV protocol is used in a policy that is set by a standards registry. That standard registry could be anyone from a state actor to a voluntary registry, or a new type of standard being set up. The standard registry also defines what is a CRU, and as part of that lists the different types of measurements that are set up and approved.

DOVU utilizes a number of different preset policy templates that end in different resulting MRV methodologies, such as Agrecalc or Cool Farm Tool; this could easily be replaced by Verra, Gold Standard, or other methodology toolsets. MRVs are methodologies which are external to DOVU and are open source. New policy templates can be generated for any additional third-party MRV service per market demands.

Once a project starts working with DOVU we assign a specific policy which inherits a given template, all submitted VP data streams through the Guardian, recorded through IPFS and signed off through DIDs resulting in the minting of a tokenized carbon credit.

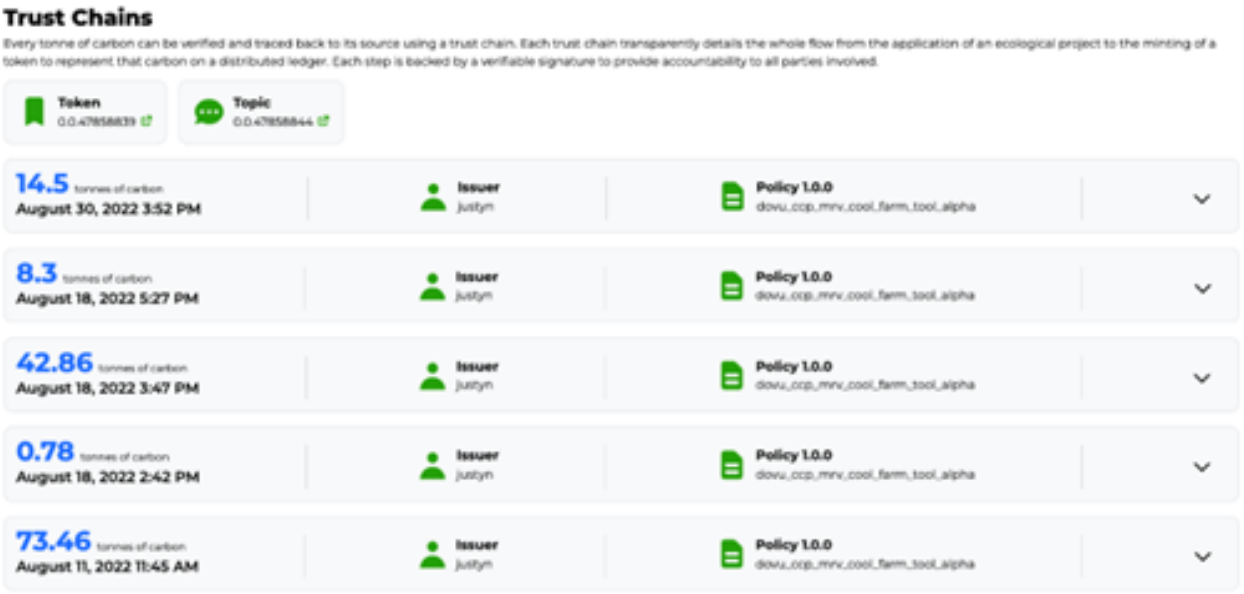

DOVU Admin - Through Nova
User/Farmer/Project
Assigned Once
Assigned
Guardian Account - Standard Registry
Guardian Account - Registrant
Check through admin panel
submit
DOVU Application - Farm
Send to guardian
Approve
Submit
Approve Document
Send to guardian
Submit
Verifier
Ecological Project
Assigned
Send to guardian
Guardian Account - Verifier
Approve Document
Agrecalc
Cool Farm
Approve
Send to guardian
One of
One of
MRV Submissions
Trustchain complete
Minted tokens


Base Policy Id
Guardian UI - External
foreign id
Import, publish, extract id
Cool Farm
Agrecalc
Base Policy
Policy Reference
One of
One of
Policy Variation
Inherits
User
MRV Type - Contract Class
Project Policy: an instance of a base policy variant
Nova Admin
References
submitter_guardian_account_id
farm_id
project_id
Ongoing Tasks
Triggers Jobs
Guardian Account
Farm
Project
Guardian Tasks/Jobs
Initial Application Submission
Ecological Project Submission
MRV Submission
has role
Store/log tasks
on success
on success
on success
Guardian Roles
Policy Submissions
Application Approval
Ecological Project Approval
MRV Approval
one of
one of
one of
Guardian Task Type
Guardian Task Type
Guardian Task Type
Guardian Task Type
Admin - SR
Registrant
Verifier
ApplicationDocumentSubmission
ApplicationApproval
EcologicalProjectDocument
EcologicalProjectApproval

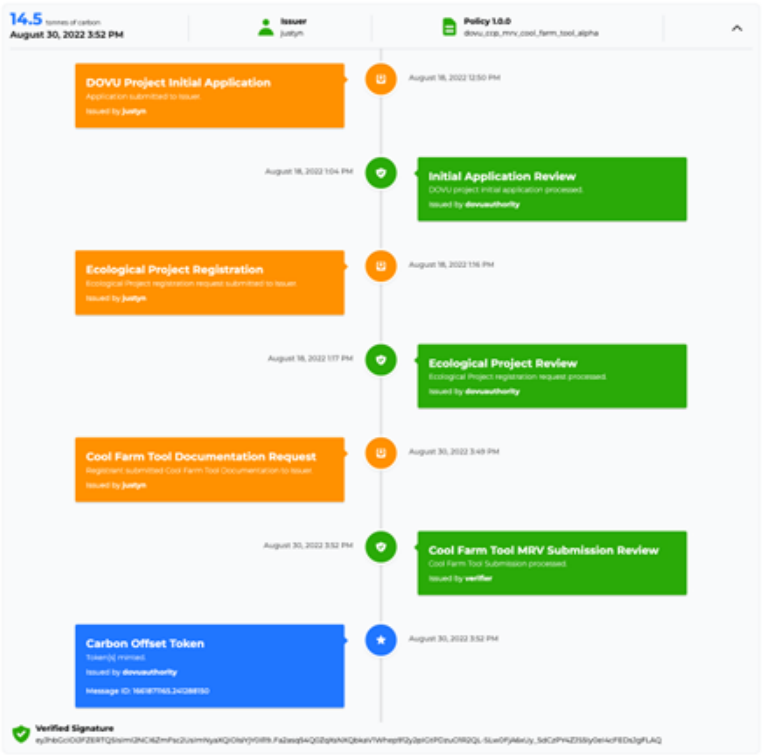
These credits are minted as CRT, with the aim of transitioning into NFTs with the CRU specification. Our tokens are divisible because we use the CCP specification, as fractional NFT capability is brought to Hedera we will be able to transition to the CRU model. We only mint carbon that is verifiably additional or proves removal instead of avoidance or lesser methods. We are working on implementation of reversibility, revocation, and life time audit capabilities of the system.

## *MRV Flow Example:*

Overview of an ecological project's carbon audit trail, showing multiple trust chains related. Each trust chain represents minted carbon or additionality over time.




The trust chains above can be expanded and show all events related to the token creation, from the initial carbon project onboarding, through the MRV and verification, all the way to the minting. All data reaches consensus through Hedera and is stored on IPFS via Filecoin.



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