

# Digital Measurement, Reporting & Verification (MRV) Framework

Version for Public Comment



**InterWork  
Alliance**

A Global Blockchain  
Business Council Initiative



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# Foreword

The first version of the Digital Measurement, Reporting & Verification Framework was published in late 2021. Since that time, the membership of the InterWork Alliance (IWA) and Global Blockchain Business Council (GBBC) have shared the framework broadly throughout the sustainability ecosystem and put it through its paces to find missing elements, refine definitions, and strive to establish common ground to help unify the way ecological and environmental products like voluntary carbon credits are manufactured or originated.

This document will replace its predecessor in its entirety due to the hard work and collaboration of its contributors. But we are not done. There are still improvements to be made and refinements to be discovered as we all set forth to implement these specifications and commit to returning the lessons learned back for the next version of this specification in the future.

We invite you to join us on this journey to help scale these markets by shoring up its foundations by creating consistent, comparable, interoperable, and hopefully higher quality digital ecological assets to help all of us achieve our personal, organizational, and global goals.

To that end, we would like to share this document with the community to gather feedback and comments which can be taken in by the group, synthesized, and incorporated back into the framework to ensure that we provide robust guidance to the market.

**Please submit any comments or feedback to [iwa@gbbccouncil.org](mailto:iwa@gbbccouncil.org) by August 25th, 2023.**

# Executive Summary

To scale ecological and environmental markets we need to digitize the origination, or manufacturing process, and products. This new digital approach should enable the creation of standardized, comparable, and differentiated products from a wide variety of sources and lower the cost of creating them.

The Digital MRV Framework defines the terminology, roles, process, generic evidence packaging, and attestation that digital MRV solutions should follow to originate these next generation digital assets. The framework defines a generic roles-based process along with an extensible data model to facilitate the reuse of common infrastructure across asset classes and allow customization for the diverse set of activities that can produce these new assets.

The framework can better enable investments in, and generation of, high quality, well-documented ecological assets at scale. This framework defines the variables that enable its application for a wide variety of standards, protocols, and technologies that should be used in combination to create high quality projects and claims, ready for validation and verification.

A harmonized, standardized framework agreed to by market participants will enable investors, buyers, and society to ensure the credibility and integrity of outcomes, particularly in a market operating at scale, while maintaining rigor and the necessary documentation and evidence to indisputably track impacts. Additionally, the framework, when implemented, can ensure that double-counting and double-crediting do not occur – to ensure market integrity.

While this paper is focused on the business aspects of the framework, we have also produced a technical specification that dives deeper into the details for those implementing solutions based on the framework. This specification can be found at:

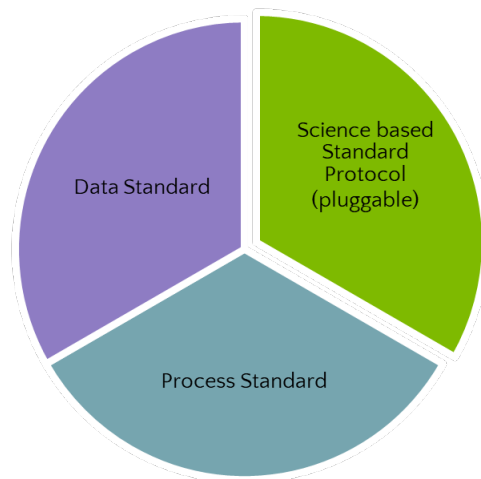
<https://interworkalliance.github.io/TokenTaxonomyFramework/dmrv/spec/index.html>

# Framework

The Digital MRV Framework provides the high-level, implementation-neutral, specification for creating a solution that issues standardized claims into an open ecosystem for validation, verification, and crediting. This framework builds off the published “Voluntary Ecological Markets Overview Version 2” standard<sup>1</sup> from the InterWork Alliance to enhance global agreement on terms, definitions, and basic understanding of the process for creating ecological or environmental assets like carbon credits.

This framework brings Process, Data, and interchangeable science-based Quality Standards together that can operate under a governance framework to facilitate adjustments and ensure diversity, inclusion and a level playing field.

**Figure 1: Governance**



The modular Quality Standard is specific for the type of activity being implemented and the source of beneficial claims. These Quality Standards usually are modular in themselves and combine a “methodology” or “protocol” that is specific for the activity being measured or monitored, a program or process that is generic, and optionally have “best practice” or recommend tools for determining aspects like additionality, etc. Quality Standards define steps to establish a valid project and detail the evidence required and the calculations used to determine the quantity of benefit the project’s activity (e.g., CO<sub>2</sub>e) removed.

<sup>1</sup> <https://gbbccouncil.org/wp-content/uploads/2022/09/Voluntary-Ecological-Markets-Version-2-InterWork-Alliance.pdf>



The Quality Standard a project follows will provide the who, what, where and when for a digital MRV solution to be built. Meaning it specifies what evidence should be collected, from what kind of sources, in what cadence for a reporting period. The Process and Common Data Standard remain the same across Ecological Projects.






Traditionally, Quality Standards have been governed by accredited registries as a portfolio for projects to choose from. However, recent advancements and innovation has led to the development of new “methodologies” and “protocols” by consortia, start-ups, and academia that are accelerating time to market by issuing credits using non-traditional techniques. This is likely a symptom of the traditional registries being a bottleneck for the adoption and governance of new techniques and not being able to keep up with the broader ecosystem. As Quality Standards become digitized and optimized, it is likely that a balance of innovation adoption and conservative management will be achieved.

## Framework Components


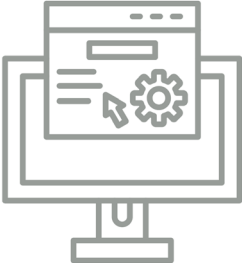



The framework defines components that represent roles, process artifacts, and subsystems that work together to package evidence in a claim that can be independently verified in standard processes. Each of these components provides a placeholder or variable that can be replaced with a specific actor, artifact or subsystem, allowing the framework to be generic and support a wide and diverse set of implementations.



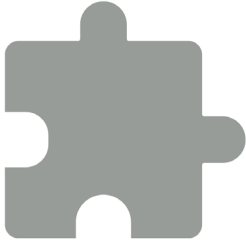


For example, solutions using the framework for soil carbon sequestration through agricultural practices would have different standards and sources of evidence than a direct air capture program, but each solution would create a standard claim that plugs into a standard process.

	<p style="text-align: center;"><b>MRV Network</b></p> <p>A shared set of infrastructure where the Data and Process standards are implemented that provides storage, compute, ledgering, and other capabilities for all participants.</p>
	<p style="text-align: center;"><b>Ecological Project or Program (EP)</b></p> <p>The identity and metadata about a program or project that will be hosting or sponsoring one or more Modular Benefit Project(s). The EP is a way to group multiple modular projects logically to support different business models.</p> <p>For example, an EP can represent a single farm that will want to have a project that makes carbon removal claims and another that will make water claims. Each claim type is associated with a different Quality Standard and will result in different credit types being issued, but are managed by a single organization.</p> <p>Or an EP can represent an organization that will host multiple MBPs in different geographic locations, like solar deployments in different countries or states.</p>

	<p style="text-align: center;"><b>Modular Benefit Project (MBP)</b></p> <p>An Ecological Project/Program (EP) can have multiple MBPs, where each MBP represents the type of ecological claim being issued. This is where the evidence is provided for issuing one or more claims about beneficial impact such as a claim of carbon removal.</p> <p>For example, an EP may want to create claims for carbon removal and water, thus having an MBP for each. An MBP must be validated before it can begin submitting claims for verification.</p>
	<p style="text-align: center;"><b>Accounting &amp; Ecological Claims Registry</b></p> <p>An organization that maintains and governs a portfolio of protocols or methodologies which certifies Validation and Verification Bodies (VVBs) to validate projects and verify their claims based on the protocol or methodology and then issue credits from these validated and verified claims.</p>
	<p style="text-align: center;"><b>Certification Standards Body</b></p> <p>An organization that creates and certifies science-based standards, e.g., protocols and methodologies, for measuring environmental impacts and benefits. This may be an industry consortium, academic partnerships, or a single organization.</p>
	<p style="text-align: center;"><b>Quality Standard</b></p> <p>Requirements for measuring outcomes, based on approved methodologies or protocols, that result in high quality credits being issued. A Quality Standard can encompass a Standard Protocol or Methodology, a crediting program, measurement tools, and certification requirements for a VVB.</p>
	<p style="text-align: center;"><b>Standard Protocol (Methodology)</b></p> <p>A science-based standard, often called a methodology, that is incorporated in a Quality Standard for making a claim like carbon removal. A protocol is specific to the type of activity and can vary based on its location, time, duration, etc. It defines the kind, amount, and frequency of evidence collected from required source(s) and formulae for using the evidence to determine the values of the claim. For example, determining the amount of carbon removal as well as other attributes like durability, additionality, co-benefits, etc</p>



	<p><b>Validation &amp; Verification Body (VVB)</b></p> <p>An organization that is certified to validate and verify claims, based on a standard, to ensure that the protocols and methodologies were followed and that the evidence collected supports the claims. The VVB first Validates the ecological project plan against the Quality Standard being followed; once complete, the claims process can begin.</p>
	<p><b>Verification Platform</b></p> <p>A solution designed to accelerate the verification of claims. Depending on the Quality Standard, it may be able, with appropriate audit requirements, to perform full verification of claims issuance of ecological credits. For other Quality Standards, these platforms or services may automate and prepare findings data that are evaluated by a VVB in order to speed up and support a continuous verification process.</p>
	<p><b>Project Validation</b></p> <p>Before a Modular Benefit Project can begin creating claims for verification, the project must be validated, against the Quality Standard being followed, by a certified VVB. This process can vary, but usually includes several steps and requires the production of documents like a Project Design Document (PDD) and may also include legal documents to be submitted like proof of ownership, title, lease, etc.</p>
	<p><b>Verification Contract</b></p> <p>A “Smart Contract” between the Modular Benefit Project, Standard (registry) and the VVB for the claims process. Here the terms and conditions of the verification process are agreed to and documented. All artifacts in the claim process are linked to this contract. The MBP may choose to switch standards or VVB and create a new contract for verification.</p>
	<p><b>Ecological Claim</b></p> <p>Made by a Modular Benefit Project in accordance with its validated Project Design Document (PDD). The PDD follows the requirements of a quality standard, an applicable methodology, and protocols required to generate the necessary evidence for validation of the claim.</p> <p>A completed claim output is similar to a Monitoring Report, except that it is primarily intended to be machine readable, whereas a Monitoring Report is designed to be human readable. Some solutions may generate both machine and human readable output.</p>

	<p style="text-align: center;"><b>Claim Source</b></p> <p>A registered source of claim data that can be raw source data from a device/sensor or a device/user/application and 3rd party reference data like satellite images or remote sensing. These sources are registered with the Ecological Claim as valid sources of evidence.</p>
	<p style="text-align: center;"><b>Claim Checkpoint</b></p> <p>A submission of prescribed evidence data made towards an ecological claim based on a cadence or schedule required by the standard methodology or protocol being followed. An ecological claim is made of a collection of checkpoints.</p>
	<p style="text-align: center;"><b>MRV Extension</b></p> <p>A Quality Standard can define multiple MRV Extensions that can be attached to the DMRV process and data types to collect context-specific data points from appropriate sources.</p> <p>The components defined are common or generic to allow for maximum re-use, but the framework will need to support Quality Standard (methodology/protocol) extensions to allow for the collection of data that is specific to the Quality Standard being followed. As such, Quality Standards can define MRV Extensions that are specific for their methodology and add them to Modular Benefit Projects, Claims, Checkpoints, etc.</p> <p>These extensions can be versioned and optionally provide documentation so that the extensions get reused by many projects following the same Quality Standard.</p>
	<p style="text-align: center;"><b>Span Data Package (SDP)</b></p> <p>Contains evidence data from one or more registered sources that is used to create a claim checkpoint. Sources may be 1st party, automated, application/device data, or reference data. The SDP is immutably stored, and its cryptographic fingerprint is recorded in the claim checkpoint.</p>
	<p style="text-align: center;"><b>Span Data Package (SDP) Manifest</b></p> <p>A JSON file in the root of the SDP that contains metadata about the contents of the SDP. This includes identifiers like the Ecological Project, the Modular Benefit Project, and the Claim the SDP is for as well as extensible MRV and Quality Standard metadata that is defined by the participants and stored on the MRV network. It can include digital signatures of claim sources.</p>



### Digital MRV Solution

An implementation of this framework that follows a protocol using a combination of technical devices, services, data sources, and applications to automate as much of the claim creation process as possible.

A digital MRV solution is comprised of 2 parts:

- A Digital Measurement and Reporting Solution that an Ecological Project uses to create Ecological Claims by checking evidence in via checkpoints.
- A Verification solution that the VVB uses to verify Ecological Claims created by the Ecological Project via the Digital Measurement and Reporting Solution.

These 2 solutions integrate and communicate with each other using MRV transactions, messages, and events.



### Processed Claim

Once an ecological claim is open for verification, the verifier (VVB) will reserve the Ecological Claim it is verifying and, once complete, will create a processed claim. To support continuous verification, a MBP developer(s) can continue submitting checkpoints throughout the claim period and the VVB can add Checkpoint Results as they are verified. The Processed Claim is finalized with a proposed credit once the claim period is over and the last checkpoint is verified.



### Checkpoint Result

To support continuous verification, a VVB may create a Checkpoint Result for each Checkpoint that is verified. This checkpoint result may contain communications between the VVB and the Ecological Project about the data contained in the checkpoint, such as a request for clarification.



### Ecological Benefit Token: Carbon Removal Unit

An issued digital asset, from a processed claim, that represents one metric tonne of CO<sub>2</sub>e of carbon removal or reduction. These credits are issued by an issuing authority and, once issued, the Processed Claim is finalized. This credit is cryptographically linked to its processed ecological claim sources for full transparency.

# Framework Component Dependencies

Framework components have dependencies or relationships with other components. For example, a Modular Benefit Project (MBP) is dependent on the Standard Protocol chosen in which to base its claims on. The VVB selected must be certified to verify claims for the Standard the MBP is using.

Of note, Carbon Credits and other Ecological Benefit products are used to offset, or remove in this case, carbon to net effective emissions downward. The action of using a credit is commonly referred to as retirement. In this framework, the credit is derived from an ecological claim and its progression through the validation and verification process. As a claim progresses through its lifecycle and moves on to the next stage, it is finalized, which means it is made permanently read-only and linked to its successor.

## The framework dependency map:

### EP -> MBP

The MBP is a child entity of its parent Ecological Project or Program (EP).

### MBP -> Quality Standard

The MBP is bound, or contracted, to follow a standard in which to form and create its ecological claims.

### VVB -> Quality Standard

The VVB must be certified to validate claims for the Quality Standard bound to the MBP.

### Quality Standard -> MRV Extensions

A Quality Standard can define MRV Extensions.

### MBP -> Quality Standard -> Ecological Claim

The Ecological Claim is a child of its parent MBP and is based on the Standard Protocol in the Quality Standard.

### MBP -> VVB -> Quality Standard -> Verification Contract

A Verification Contract has signatories representing the MBP, VVB and Quality Standard participating in the claims process.

### MBP -> Claim Source(s)

Claim sources are registered with the MBP they are providing evidence for. These sources can be devices, applications or reference data.

### MBP -> MRV Extension(s)

MBPs can have one or more attached MRV Extensions

### MBP -> Validations

An MBP will have at least one validation before verification can begin which contains the validation artifacts created between the Ecological Project and the VVB.

### Claim Source -> MRV Extension(s)

A Claim Source can have one or more attached MRV Extensions.

### **Claim Source -> Ecological Claim**

Sources of evidence collected are registered with the Ecological Claim.

### **Claim Checkpoint -> Ecological Claim**

Claim Checkpoints are children of an Ecological Claim which maintains a collection of checkpoints and sources.

### **Claim Sources -> Span Data Package**

Only registered claim sources are allowed to have their data included in the Span Data Package.

### **Span Data Package -> Manifest**

Each SDP contains a manifest.json file in the root of the package that contains metadata about its contents.

### **Span Data Package -> MRV Extension(s)**

A Span Data Package can have one or more attached MRV Extensions.

### **Span Data Package (SDP) -> Claim Checkpoint**

The SDP is the input to create a Claim Checkpoint.

### **Ecological Claim -> VVB**

Once completed, the Ecological Claim is encumbered or locked by the VVB once the verification process begins.

### **Ecological Claim -> MRV Extension(s)**

A Claim can have one or more attached MRV Extensions

### **VVB -> Processed Claim**

Once verification of an Ecological Claim begins, the Processed Claim is created by the VVB and Checkpoint Results are created as Checkpoints are processed. The Processed Claim along with its checkpoint results allow for continuous verification progress to be demonstrated and monitored.

### **Processed Claim -> Ecological Claim**

When the Ecological Claim is open for verification, the Processed Claim is created and the two claim states become cryptographically linked.

### **Processed Claim -> MRV Extension(s)**

A Processed Claim can have one or more attached MRV Extensions

### **Processed Claim -> Standard (Registry)**

The Standard (Registry) is notified when the Processed Claim is finalized.

### **Standard (Registry) -> Carbon Removal Unit**

The Standard (Registry) conducts a final quality check on the Processed Claim and then issues a Carbon Removal Unit and finalizes the Processed Claim.

### **Carbon Removal Unit -> Processed Claim**

The Carbon Removal Unit is cryptographically linked to the finalized Processed Claim.

# Artifact Details

## Ecological Project

The Ecological Project establishes an organizational identity for one or more 'child', or 'sub', Modular Benefit Project(s) and only contains basic organizational information primarily used for identification. Establishing a hierarchical project structure allows for organizational and benefit projects to be arranged logically, enabling many different business scenarios.

## Modular Benefit Project (MBP)

A Modular Benefit Project, is a 'child' of an Ecological Project, and serves as the system of record for the actual type of project work that generates a benefit being measured. It contains information about who the developers or workers are, the project's geographical boundary, its link to a Quality Standard, etc. Modular Benefit Projects are validated and are the source of ecological claims to be verified.

## MBP Sources

Modular Benefit Projects produce claims that contain evidence. In order for the contained evidence's provenance to be established, a 'claim source' must be registered with the MBP. Some examples of claim sources would be:

- A device or sensor that takes measurements
- An application that runs on a mobile device that uses the devices' sensors, GPS, etc., and the authenticated user to collect and submit evidence
- A 'reference' source could be a Factor Library like the US EPA, IPCC, etc. libraries and version
- A 'service' like a geospatial or satellite provider to provide biomass estimates or other remote sensing capabilities.

Because the capabilities of these sources of evidence can vary, the method for establishing an identity for them to register will as well. There are several techniques for identifying a source and various ways to ensure evidence integrity to prove that evidence came from a registered source.

Newer methods for establishing identity and integrity of data will be more thorough and trusted, but we also need to support older, less capable sources of evidence that can be phased out over time in favor of fully identified and validated sources.

For example, newer devices can establish an identity based on Decentralized Identities and Verifiable Credentials<sup>1</sup> and are able to attest to their own evidence, see [Attestation](#). Other devices may be able to support PKI infrastructure<sup>2</sup> and digitally sign their evidence. And in many cases, only a device make, model and serial number are available. In this specification we provide a general framework to support as wide a range of sources and compatibility as possible, while recommending that sources migrate over time to higher trust capabilities.

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1 <https://www.w3.org/TR/vc-data-model/#introduction>

2 <https://www.enisa.europa.eu/topics/incident-response/glossary/public-key-infrastructure-pki#>

## Verification Contract

The Verification Contract is a “Smart Contract” between the MBP (Ecological Project), Standard, and VVB for the creation, verification, and issuance of credits for claims made under the contract. Every artifact created in this process is linked back to the Verification Contract.

The details such as the Standard, Version, and Protocol are all agreed to by the signatories of the contract. An MBP may choose to switch standards or VVBs, which would require a new Verification Contract to be executed and the old contract archived.

Property	Type	Req	Specification
<code>id</code> :	String	M	Unique identifier for the VerificationContract, See § 3.82 <a href="#">Data Type: Id</a> for details.
<code>name</code> :	String	M	The name of the Verification Contract, usually the name of the project - name of the issuing registry.
<code>description</code> :	String	M	A description of the Verification Contract and where special instructions are provided.
<code>signatories</code> : <a href="#">Signatory</a>	Array	M	A collection of signatories, the MBP owner, Issuing Registry, VVB and Verification platform are examples of signatories. See § 3.31 <a href="#">Data Type: Signatory</a> for details.
<code>qualityStandard</code> : <a href="#">QualityStandard</a>	Object	M	The quality standard being used for the verification. See § 3.40 <a href="#">Data Type QualityStandard</a> for details.
<code>mrvRequirements</code> : <a href="#">MRVRequirements</a>	Object	M	The MRV requirements being used for the verification. See § 3.41 <a href="#">Data Type MRVRequirements</a> for details.
<code>agreementDate</code> : <a href="#">Date</a>	Date	M	The date the agreement was signed. See § 3.45 <a href="#">Data Type: Date</a> for details.
<code>estimatedAnnualCredits</code> :	String	O	The quantity of credits that are expected to be generated annually.
<code>mbpld</code> : <a href="#">Id</a>	String	M	The unique identifier for the corresponding MBP. See § 3.82 <a href="#">Data Type: Id</a> for details.
<code>AuditSchedule</code> : <a href="#">AuditSchedule</a>	String	M	The string representation of the audit schedule, see § 3.70 <a href="#">Data Type: AuditSchedule</a> for details.
<code>Audits</code> : <a href="#">Audits</a>	Object	M	The audits that are required for the verification contract. See § 3.30 <a href="#">Data Type: Audits</a> for details.

Figure 2: Properties of a Verification Contract

## MRV Extensions

To allow for the Digital MRV process to be customizable for each Quality Standard (methodology, protocol, tools, etc.) extensions can be defined and attached to Modular Benefit Projects, Claims, etc.

Digital MRV Extensions should be defined by the participants, in the context of a Quality Standard, in the origination/manufacturing process (e.g., Methodology Developer, Issuing Registry, VVB). A Digital MRV extension should have a type, name, version description, and optional documentation, then can contain any structure of data expressed in name/value pairs and does not need to be understood by the network, just by the participants in the process for that protocol or methodology.

MRV Extensions are process or data type context specific and are scoped by their type, meaning they can be defined to be attached to a specific data type, e.g., Modular Benefit Project, Claim Source, Ecological Claim, Checkpoint, Span Data Package, Processed Claim, etc. In doing so they can record context specific data elements that are required for that data type for the Quality Standard being followed. For example, a MBP MRV Extension can apply additional geospatial configuration data to a project, or a Claim Source can record additional identifying metadata to increase its record of provenance.

MRV Extensions should be agreed upon between the project application supplying the evidence and the verification platform and/or VVB in order to streamline and optimize the process. It is expected that the development of standardized MRV Extensions will be adopted and incorporated into solutions digitizing Quality Standards.

See the companion specification for details:

<https://interworkalliance.github.io/TokenTaxonomyFramework/dmrv/spec/index.html>

## Span Data Package

A span data package is a file package (.zip, etc.) that contains data from registered sources that is to be stored as evidence for a claim. It is up to the digital MRV solution as to the actual data format(s) so long as it is agreed to and understood by the parties involved in the verification process.

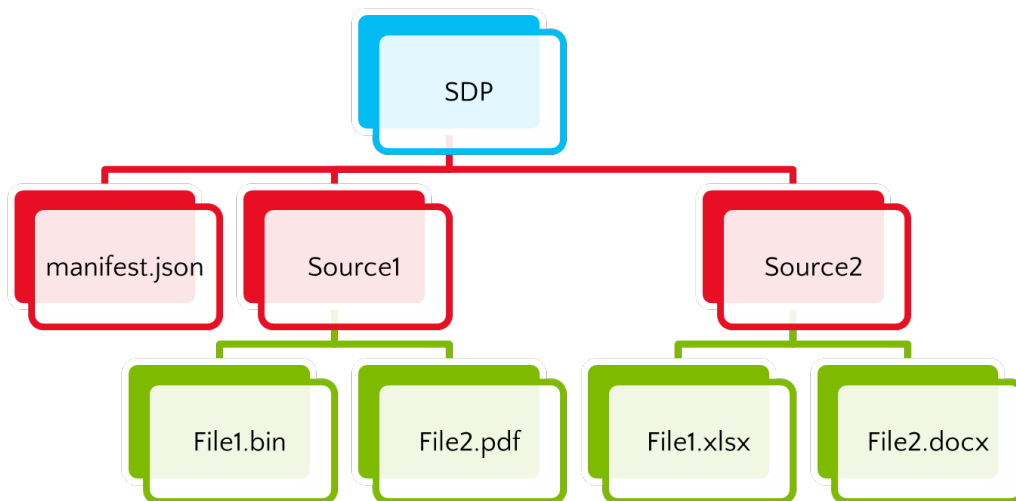
Each SDP has a “manifest.json” file in the root of the package that contains metadata about the files included and the sources the evidence originates from. The manifest.json is extensible to allow for specific extensions for digital MRV solutions and Quality Standards.

Claim sources are registered with the Ecological Claim and provided an Id, this Id is used to validate and verify that the data contained within the SDP is from the registered source. Some sources may be capable of digitally signing their evidence, in which case the source’s public key would be registered with its Id.

Example claim sources that can be registered:

- IoT Sensors
- Reference Data (Satellite, Remote Sensing, etc.)
- In-person application/device/human





**Figure 3: Span Data Package**

The manifest.json file within the SDP file can contain methodology- or protocol-specific attributes or properties that can be defined and values stored. This allows for each protocol or methodology to have a customized digital MRV implementation, yet also co-exist with other digitized protocols or methodologies.

It is expected, but not required, that an implementation would read the manifest.json file and record it in the checkpoint so that it is stored in the ledger and the SDP file can be persisted in an appropriate data store. This allows for the network implementation to support placing DMRV specific data on the ledger, without having to “understand” every Quality Standard it supports.

### **Claim Checkpoint**

Once the digital MRV solution creates an SDP, it will need to submit it to the Ecological Claim as a Claim Checkpoint. The SDP will be securely stored and a cryptographic fingerprint for the SDP acts as a receipt embedded in the checkpoint.

## Ecological Claim

The Ecological Claim is the standard foundation for digital MRV solutions to create and submit a claim on the MRV network. It has metadata about the claim and collections of children entities such as sources, checkpoints, and co-benefits.

The Ecological Claim, once all the prescribed checkpoints are received, is then encumbered, or locked, by the VVB upon notification of finalization of the claim. This prevents an Ecological Claim from being processed by more than one VVB.

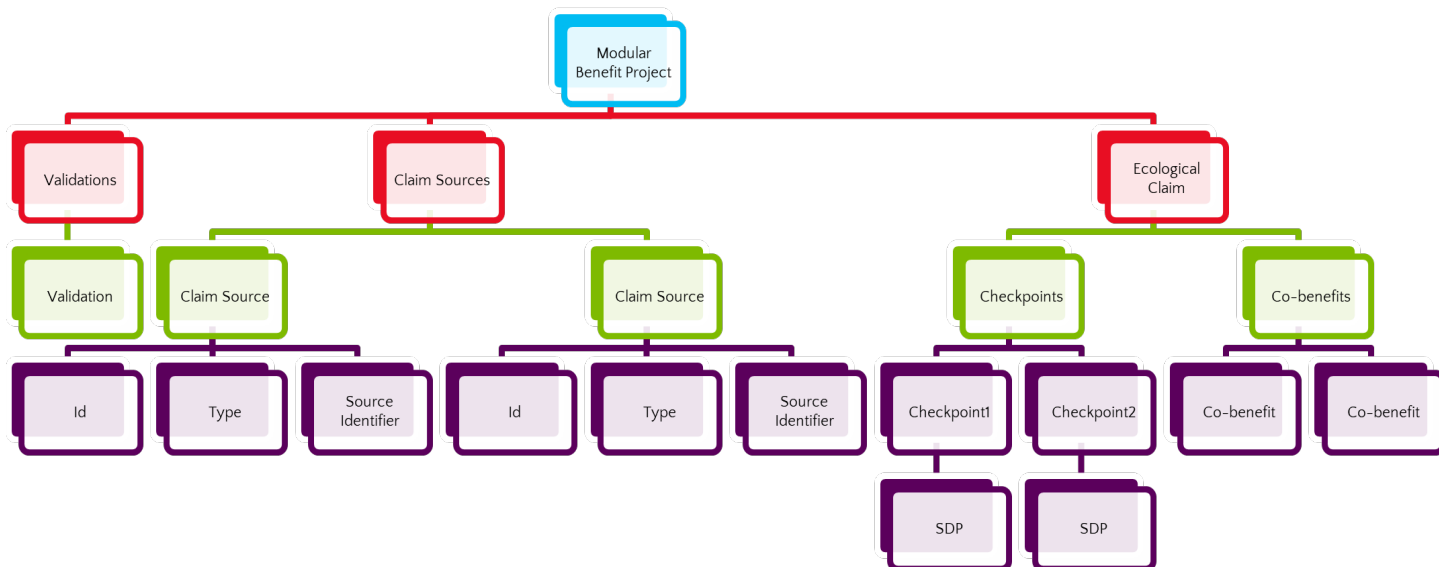


Figure 4: Ecological Claim

## Processed Claim

The processed claim is created by the VVB to record its findings during the validation and verification process. Once the processed claim is completed, the VVB finalizes the Ecological Claim.

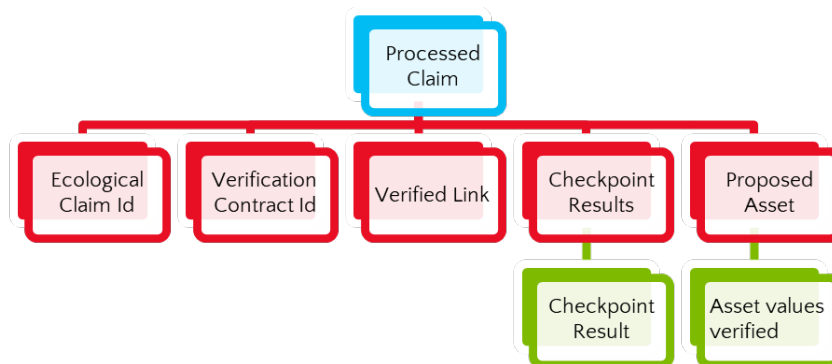


Figure 5: Processed Claim

## Ecological Benefit Token Examples: Carbon Removal Unit

The IWA VEM Overview generically describes a tokenized value representing an ecological benefit token. It provides an example of a carbon reduction/removal unit:

- Carbon Removal or Reduction Unit token (CRU) – is for removals or reductions and is non-fungible with other tokens of any type.

There is another token designed for distribution or markets called a Carbon Reference Token (CRT) that references CRUs; it is not covered in this framework.

The credit that is issued by the standard (registry) upon final verification of a Processed Claim finalizes that Processed Claim. This creates a chain of lineage from the issued credit to its Processed Claim and to the source Ecological Claim.

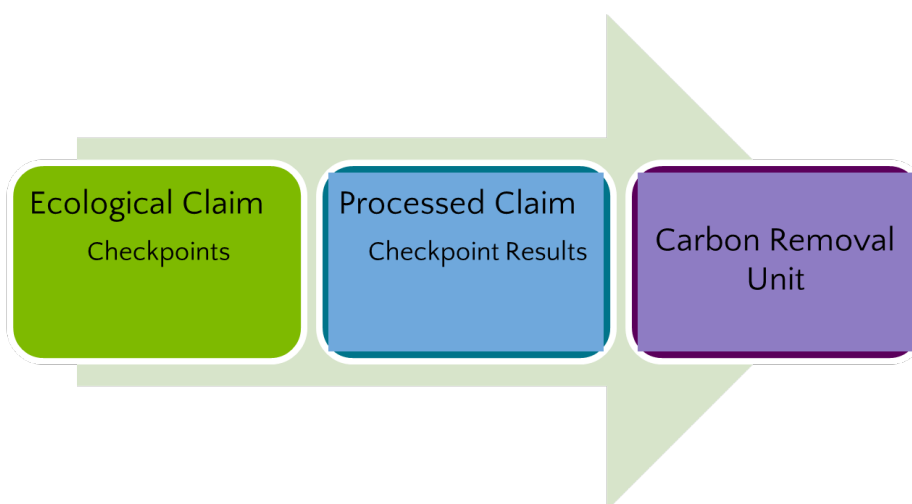


Figure 6: Carbon Removal Unit Generation

# Framework Process Flow

Components in the framework work together following a process that generates artifacts documenting and attesting each step along the way. Participants in this process are actors fulfilling a role in the process, contributing data, verification, and attestation that is cryptographically and immutably recorded by the MRV network.

The MRV network is the system of record for the participants in the process where entities like the Ecological Project, Modular Benefit Project, and Ecological Claims are recorded.

## Project Validation: Step 1

Modular Benefit Projects are required to be validated by a VVB according to the Quality Standard the MBP is following. The validation of an MBP may include multiple steps that usually have associated documentation that is generated or supplied. For example, an MBP will usually be required to produce a Project Design Document, which provides details about the project, what activities are to be conducted, and how evidence about these activities and their results will be collected. Additionally, an MBP may need to produce documents that prove land ownership or a lease to ensure that the MBP is properly licensed by authorities to conduct the activities.

Because the validation process can vary based on the Quality Standard (e.g., one that is for a nature vs. engineering based project type), the process is flexible to allow for Quality Standard-specific validation processes to fit within the generic framework.

Each MBP will have a collection of Validations that establishes the time the validation was performed, when it expires, as well as links to all of the steps that occurred or are in progress with verified links to any documents those steps produce.

## Claims Process: Step 2 - Ecological Claims

1. An Ecological Project, the identity of a source project that can make different types of claims, establishes a Modular Benefit Project for each type of claim the host project will create, e.g., Carbon Removal, Carbon Reduction, water, etc.
2. A Modular Benefit Project selects a Quality Standard from a Standard Registry that matches the activity they will conduct to make a claim, e.g., Direct Air Capture, Soil – Crop Rotation & Covering, Forestry, etc.
  - a. There is a lot of development and refinement needed for Quality Standards for Carbon Removals and Reductions to digitize the protocols.
  - b. There may be scenarios where a Quality Standard is not under management of a Standard Registry, but another organization on the network would support the standard and issue credits for it.
3. The Quality Standard will lay out a “protocol” that prescribes the sources and cadence of evidence that needs to be collected (measured/monitored).
4. Modular Benefit Projects begin creating Ecological Claims based on this protocol.

5. An Ecological Claim is made up of a collection of Checkpoints.
6. A Checkpoint is a submission of evidence as prescribed by the protocol.
  - a. Protocol developers are encouraged to define a regular or event-based cadence for the creation of checkpoints so that claim progress can be tracked downstream.
7. MRV stores the evidence and records its cryptographic fingerprint in the ledger (checkpoints).
8. This process defines the Digital Measurement and Reporting Solution area for MRV.
9. There can potentially be a one-to-many ratio between Quality Standard and Digital Measurement and Reporting Solution, meaning that a DMRV Solution may be able to support multiple types of Quality Standards AND a Quality Standard may be supported by multiple DMRV Solutions.

### Claims Process: Step 3 - Processed Claims

1. An Ecological Claim needs to be verified by a Validation & Verification Body (VVB). A VVB is certified by the Standard Registry that governs the selected Quality Standard for the Ecological Claim.
2. Once an Ecological Claim is open for verification, it will notify the Verification platform (VVB) that it is ready to begin processing.
  - a. The Ecological Claim is “reserved” by the VVB so that it cannot be processed by any other VVB.
  - b. The MBP can continue to submit Checkpoints to the claim for continuous verification.
3. The Verification Platform will verify each of the Ecological Claim’s checkpoints to determine the total benefit – e.g., how many metric tonnes of CO<sub>2</sub>e were removed or replaced. The MRV network provides the chain of custody and cryptographic evidence to authenticity.
4. The verification process will generate a report of its findings in a Processed Claim.
  - a. Once the Processed Claim is created, the Ecological Claim is linked to the Processed Claim and verification can begin.
  - b. Once the reporting period and final checkpoint has been processed, the verifier will attach a proposed credit to be issued that contains the property values that were verified, e.g., total tonnes, co-benefits, etc.
  - c. The Processed Claim is finalized.
5. The Standard Registry that governs the Quality Standard used is notified of the Processed Claim.
6. The Verification solutions can be built and operated by Standard Registries or operated by independent organizations. There will be consolidation of these solutions aligned to the types of Quality Standards being used: e.g., Verification Platforms focused on Forest Carbon, Soil Carbon, etc.
7. These solutions align to the Digital Measurement and Reporting Solutions via the Quality Standard being followed (data formats, data sources, factors, etc.).

## MRV Claims Process: Step 4 – Issuing Credits

1. The Standard Registry will encumber the Processed Claim, to prevent any other registry from issuing credits.
2. The Standard Registry may perform an additional KYC/Compliance check for the Ecological Project to ensure that compliance has been maintained.
3. Credits are issued based on the Processed Claim's findings/proposed credit: e.g., a Carbon Removal Unit equal to 20mtCO<sub>2</sub>e.
  - a. These credits become the property of the Ecological Project
4. Credits may be enlisted in a Long-Term Monitoring solution (e.g., for Nature Based Carbon Removals like Soil and Forestry). This monitoring system can determine deviations in durability or permanence that can result in the revocation and replacement of credits issued.

Following these processes, roles, and solutions, each creating, attesting, and contributing to the artifacts along the way, will create an Ecological Credit that contains a transparent link to its lifecycle data.

## Quality Standard to Digital MRV Mapping

A Digital MRV solution needs to follow a Quality Standard and the methodology or protocol it contains for its implementation. It would be optimal for methodology and protocol developers to be aware of this framework and be able to prescribe evidence collection methods and checkpoint cadence for the building of Ecological Claims.

For example, protocol developers can prescribe:

- A data source: a device, an application or reference data that can provide evidence to support the claim.
  - Specify the data source identity parameters required for the source to be registered to submit valid evidence. Can include device identifiers, application certificate, user identifiers, geolocation and time stamps, reference data URL with data hash, etc.
  - Specify the data format for the evidence a registered source should submit, including if the data should be digitally signed. This can include the data type (i.e., file extensions), meta-data, etc.
  - Specify the cadence which evidence should be included in a Span Data Package for submission as a checkpoint.
- The establishment of a cadence for claim checkpoints for building the Ecological Claim over time. These can be event-based checkpoints (e.g., agricultural events between crop rotations) or time-based (e.g., every day/week/month).

# Attestations

Attestations provide opportunities for context in MRV data. Conceptually, attestations can be the data within the project or the commentary around the project. For project data, “Direct Data Attestations” can come from individuals, project developers, verifiers, and/or directly from devices asserting an event that is represented digitally on the public ledger.

Attestations, metadata, or “Tags” describing digital entities, such as actors, calculations, or their quantifiable outcomes, allow for more context to exist about ecological projects within the market, which inherently have a relationship with credit pricing and can describe overall project effectiveness.

For these “Tags” about the project to have further meaning they need to have an understanding of the real-world activity and the digital data model. This brings to light both “High-Definition” workflow data in digital MRV and its relationship within data models to “Low-Definition” attributes, which form higher order concepts that act as metrics for the market and ecological outcomes. Attributes are formed by providing a relationship of specific schemas, data, and calculations to higher order concepts such as Additionality, Durability, and Leakage, but can span to much broader concepts including co-benefits and SDG-oriented statistics.

The level of granularity, accuracy, and the breadth of information covered, in addition to the consistency of the information, form the basis for reputation of both the project and actors involved in the ecological project. Some examples of attestations surrounding a project can be represented in Tags as described below:

- tags can be created by any actor with a valid DID.
- created tags should be credentialed, i.e. it is clear who and when created or added to a particular tag.
- tags can have cumulative scores, i.e. two people independently creating/assigning the same tag to the same artifact results in both tagging actions recorded (credentialed etc), and the ‘tag score’ is then counted as 2.
- It is possible for users to untag the item, however this action does not remove the record of tagging in the first place it just records the action of untagging (also credentialed), and reduces the score by 1.
- tags should be able to be associated with any identifiable entity/thing/artifact that uses and/or produces, such as:
  - actors, including SRs (i.e. DIDs)
  - schemas
  - policies and policy modules
  - VCs/VPs
  - tokens
  - smart contracts (ie. addresses)
- tags can be created after the (immutable) artifacts are produced, therefore tags are external to artifacts.
- it should be possible to create and/or follow tag ontologies containing the definition or description of tags.
- tag registry[-ies] should be discoverable and usable by automated indexing systems.

## Reputation

For reputation to take effect, based on digital MRV data and attestations, it is suggested to use a credential model that is fully traceable and contextually aware. Although reputation is often thought of in the context of projects, companies, or individuals, reputation should be considered to be extensible to devices, methodologies, or even specific sections of a methodology. This allows for a more complex understanding of a project and substantive details. Although this is often price-focused, reputation can also facilitate discourse on effectiveness of a project or any element or actor involved in a project. There should not need to be a single data model; however, using public ledgers and associated tooling, there should be an opportunity for reputation systems to form based on open standards and access to non-confidential information.

## Confidentiality in Attributes & Asset Generation

The data associated with a project that may be relevant to reputation will likely be limited as we transition to a more digitally native format. However, there are also privacy and confidentiality considerations that may not have been fully considered in the analog format.

To enable confidentiality in MRV data, there are multiple approaches to privacy; however, there are specific requirements to enable this in the requirements of an MRV workflow. The below example is not an endorsement of a specific approach, but shows an example reference based on W3C standards.

## Reference Example

In a reference example for generating Digital Ecological Assets, the Hedera Guardian uses the W3C standards of Decentralized Identifiers (DIDs), Verifiable Credentials (VCs), and Verifiable Presentations (VPs) in order to capture digitally signed documents that are stored on the decentralized InterPlanetary File System (IPFS).

Guardian uses VCs & VPs for a variety of data types - particularly:

- Monitoring, Reporting & Verification (MRV) data capturing the actual carbon reduction, removals, or renewable energy generation.
- The policies that digitize the methodology. In this context of carbon debits & credits, a methodology is a framework document that defines the rules governing the MRV and the criteria for minting tokens corresponding to that MRV.

The current Guardian model publishes MRV data as a VC and creates a corresponding VP, a priori from that VC, and stores the VP on IPFS. The VP (and the VC within) can be retrieved from IPFS at any time and are, by default, unencrypted.

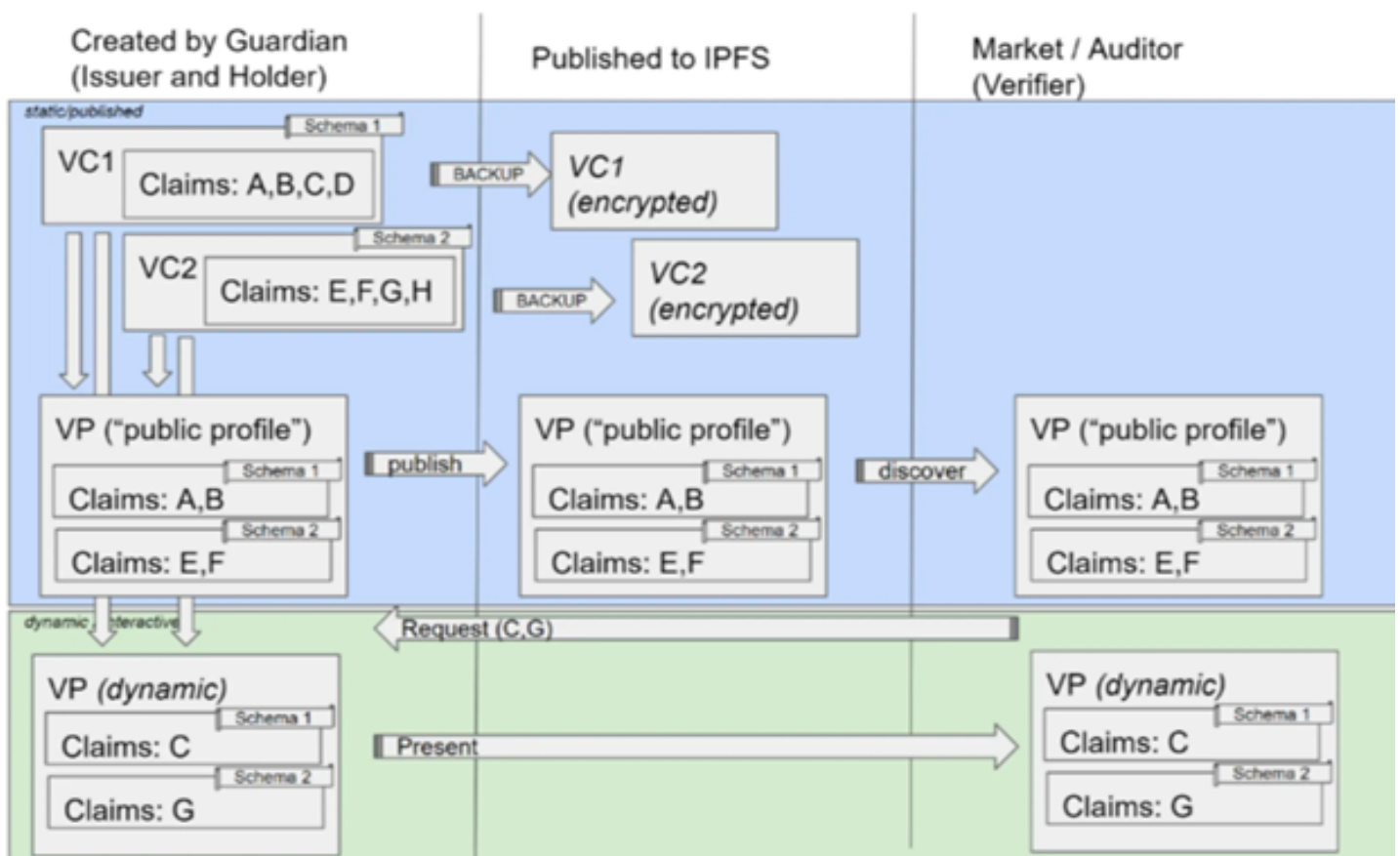
While this default transparency enables easy validation of provenance chains, it may not be acceptable to all enterprises considering using Guardian to track emissions of their manufacturing processes. While a business may recognize the need to be fully transparent about the amount of CO<sub>2</sub> emissions associated with their business processes, they may wish to keep some details of those processes less than fully public to protect associated intellectual property and confidentiality.



Separately, confidentiality may be required to protect an individual's information. For instance, a homeowner that installed solar panels may not want their street address public, but recognize that the approximate location is important for assessing the credibility of energy production.

This sort of confidentiality can be challenging to reconcile with the desired transparency and composability and the fundamental choice of using a public Distributed Ledger Technology (DLT), like Hedera, to track the provenance of Environmental, Social, and Governance (ESG) assets.

Below is an example of attestations with selective disclosure. This model enables delivery of digital MRV generated attributes that include information which may not be publicly disclosed due to confidentiality concerns.



## Co-benefits & Modular Benefits

Today's voluntary carbon credits have "co-benefits" attached that map to one or more of the UN Sustainable Development Goals (SDGs). While these attached co-benefits can provide additional information about the project the credit is sourced from, they are not subject to the same validation and verification requirements of the actual credit that they are attached to.

This is not to say that these co-benefits are without merit, just a recognition that these co-benefits are attributes that cannot stand or be traded on their own. This specification continues to recognize these UN SDG-based co-benefits and enables projects, verifiers, and issuing registries to include them in their processes and attach them to credits issued. We refer to this type of co-benefit to be dependent, meaning the co-benefit is dependent on a credit in order to be traded and cannot be separated from the credit it is dependent on.

There are some co-benefits, and others in development, that are intended to be able to stand on their own and be either bundled with a credit or traded separately. These Independent Co-Benefits should follow the same process as a Modular Benefit Project, meaning they are sourced from the same Ecological Project, but are defined in their own MBP that is mapped to a Quality Standard for the Co-benefit type, and need validation and verification of claims.

Dependent co-benefits are defined within the MBP for the credit they are dependent upon, and Independent co-benefits are defined in their own MBP.



# Moving Forward

Continued collaboration is required to both improve and continuously refine this framework so that it can help establish a common understanding of the Process and Data standards needed to support interchangeable Quality Standards. This modular approach to standardization along with a foundation based on common terms and shared data descriptions should aid in the development of new Quality Standards for a wide range of ecological products in the future.

We welcome and appreciate your feedback on this paper as we work to continue to refine the Digital MRV Framework.

**Please submit any comments or feedback to [iwa@gbbcouncil.org](mailto:iwa@gbbcouncil.org) by August 25th, 2023.**