



Climate
Warehouse

Simulation III

TECHNICAL GUIDE

July, 2022

OBJECTIVE: Co-innovating a bottom-up system to transparently track the transfer of Mitigation Outcomes (MOs)

Iterative stakeholder consultation on the design of the Warehouse include:

REGISTRY INTEGRATION

Developing data structures to aggregate and harmonize data from heterogeneous registries.

- Determining prerequisites and minimal requirements for peer-to-peer integration between partner registry systems;
- Harmonizing of heterogeneous data formats;
- Synchronizing and surfacing of registry information in the Warehouse;
- Testing the feasibility of blockchain and smart contracts.

TRANSFER OF MOs

Developing functions to enable the surfacing and tracking of MOs while safeguarding environmental integrity.

- Developing robust accounting procedures and highlighting double-counting risks;
- Supporting the information flow to conduct corresponding adjustments in the involved registries;
- Enabling matching of buyers and sellers of MOs through dashboard filter functions;
- Providing a transfer reporting summary function to facilitate the national reporting of transfers.

CO-INNOVATION

Learning between all actors involved in the simulation.

- Understanding potential barriers to participation;
- Iterative design improvements based on participant feedback;
- Capacity building on the use and benefits of this architecture;
- Exploring of Warehouse governance considerations to achieve bottom-up ownership.

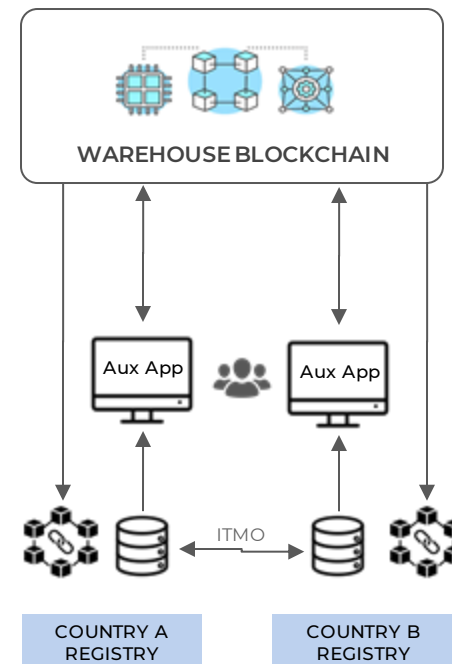


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The Simulation will flow through three key steps:



1. USER STORIES — These are the features and capabilities of the warehouse. Includes:

- a. REVIEW — Review and manage the data on your projects
- b. EXPLORE — Projects, Units, and Transfers
- c. TEST — Add Qualifications, Break unit blocks, status projects and units, transfer units



2. SCENARIOS — Put the user stories together and try them out with partners, to test what information the data warehouse will show and how information should be captured. Learn how analytics could find double counting scenarios within the shared data sets.



3. FEEDBACK — This is an agile design approach involving participants, giving feedback to features and mapping out different options about a common feature. Simulation scripts will include questions to think about and answer to facilitate the feedback process.

EXPECTED IT REQUIREMENTS FROM PARTICIPANTS

OVERVIEW

Participants have a variety of options for engaging with the Climate Warehouse. For participants that choose to run the Climate Warehouse on their own local machine, the high-level installation steps are shown below.

For observers and participants that choose to run the Climate Warehouse through a hosted machine, the installation steps will be completed for you.

This breakdown illustrates the high-level steps required to locally install the Climate Warehouse:

PROCESS STAGE	DETAILS	DIFFICULTY	TIME
1. Download/Install Software	Download Chia, Climate Warehouse, and Aux App	Low	0-5 mins
2. Chia Setup/Open Port 31310	Create Chia wallet and start services; open network port	Medium/High	1-2 hours
3. Sync Blockchain	Synchronize your Chia application with the blockchain	Low	3-10 days
4. Run Climate Warehouse	Run Climate Warehouse and allow sync	Low	5-10 mins
5. Run Aux App	Open and run Aux App	Low	0-5 mins

Note on costs. Participants may have to anticipate external costs associated to their involvement in the simulation if they wish to host a node locally, depending on the in-house technical support they have. These costs would include sourcing external IT help to implement the IT efforts required for integration (mentioned above), though the setup has been designed so that the WBG team supports all advanced technical steps.

TYPE OF PARTICIPANTS IN THE CLIMATE WAREHOUSE SIMULATIONS:



Hosted Node Participants

Have Read+Write access to their own node, read access to other nodes



Local Install participants

Read+Write access to their own node, read access to other nodes



Observers

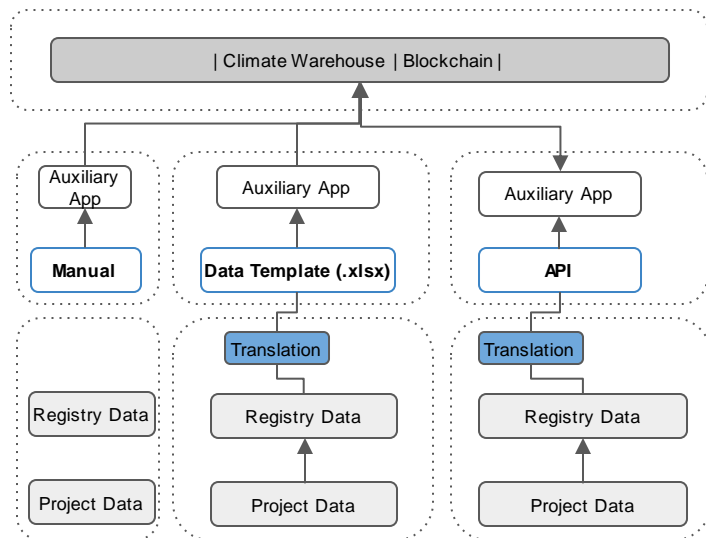
Read-only access ([link](#))

1. SOURCE REGISTRY DATA INTEGRATION

PREPARING AND TRANSLATING YOUR REGISTRY DATA FOR UPLOAD

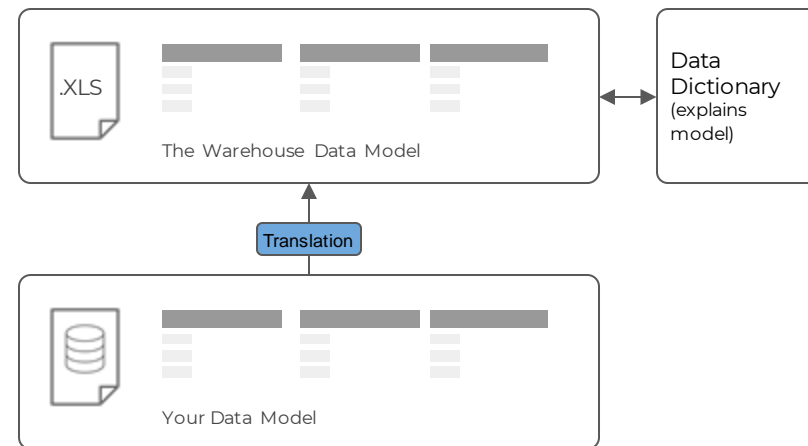
There are three ways to upload your data into the Climate Warehouse Auxiliary App:

1. **Manual Upload** - using the Aux App formats to manually input project and unit information
2. **Data Template** - using the provided Excel document, with a predefined data model, to load your data and then upload that .XLSX using the Aux App.
3. **APIs** – submit data using APIs, documentation available



DATA MODEL TRANSLATIONS

The Climate Warehouse has a predefined and encompassing Data Model, laid out in the Data Dictionary. You will have to translate from the data model in your registry to the warehouse data models, so as to have data homogeneity during the simulations. This implies a manual and human assessed translation between both models. This data model translation is performed either by 1) manually uploading data through the Aux App (already in the Warehouse data model), 2) writing a translation script within excel, or 3) creating a middleware for the source data and then pushing the data through the API.



2. AUXILIARY APP & NODE SETUP



AUX APP REQUIREMENTS



STANDARD WINDOWS/MAC APP

The Aux App runs as a standard application in Windows and Mac OS. This software does not require any pre-requisites to be installed and will simply run after you have downloaded and installed the Climate Warehouse Aux App.

Users must have permissions to install the app locally.



CHIA BLOCKCHAIN REQUIREMENTS



Chia Setup

Participants who locally run the Climate Warehouse will need to download and install Chia software (hosted instances will have Chia pre-installed). Once installed, participants will need to start Chia services (node, wallet, & datalayer) to use the blockchain for the Climate Warehouse.

Details for starting Chia services can be found at: [Climate Warehouse Github Repo](#)



Minimum Specs

In order to properly run Chia, you will need to have a machine with specs at or above that of a Raspberry Pi 4:

- Quad core 1.5Ghz CPU (must be 64 bit)
- 4 GB Ram
- Python 3.7-3.9
- ~75gb disk space

Expected Timelines:

Chia Setup: 1-2 weeks (depending on blockchain svcnc time)

EXPECTED TIME REQUIREMENTS FROM PARTICIPANTS

Test Scenario	Scenario Description	Time Commitment
Install Climate Warehouse	Install the necessary software to run Climate Warehouse on a local machine	2-4 hours; requires call with testing support team
Access Climate Warehouse	Access a cloud instance of Climate Warehouse with pre-installed software	5-10 minutes
Create Organization	Create your organization within the Climate Warehouse	5-10 minutes
Create Project(s)	Create projects within the Climate Warehouse, either through manual entry, excel upload, or API calls	30-120 minutes
Create Unit(s)	Create units associated to specific projects through manual entry, excel upload, or API calls	30-120 minutes
Report on Climate Warehouse Data	Generate reports using Climate Warehouse data by either downloading a static excel file, or by accessing a mirrored database	10-60 minutes
Unit lifecycle	Simulate the unit lifecycle by issuing, splitting, transferring, and eventually retiring the unit	30-90 minutes
Subscribe to other Organizations	Subscribe/unsubscribe to other organizations that are participating in the Climate Warehouse	5-15 minutes
Track audit history	Use the audit function within the Climate Warehouse to see audit history for selected organizations	10-30 minutes
Total		~4-11.5 hours

EXPECTED TESTING AREAS FOR PARTICIPANTS

1

Installation – Testing that is solely focused on installing and running the prerequisite software to run the Climate Warehouse

Tester Profile – Person who would be managing the software in the production state. This person wants to know how to properly install and maintain the Climate Warehouse software

Importance – Allows the person managing the software in the future to be confident in what is needed from an infrastructure perspective and how to manage new releases of Climate Warehouse software

2

User Interface (UI) – Testing that is centered around entering, manipulating, or viewing data within the Climate Warehouse UI

Tester Profile – Anyone who is curious about what the Climate Warehouse displays, or anyone who will be replicating data in the Climate Warehouse using the UI. We recommend most participants test this area.

Importance – The Climate Warehouse UI is the visual representation of the power of the Climate Warehouse. It is imperative that the UI works well for everyone involved with the Climate Warehouse.

3

API – Testing the Climate Warehouse API endpoints to understand how they are structured with the intent to integrate own registry with CW APIs

Tester Profile – Technically sophisticated registries that intend to integrate with the Climate Warehouse to automatically update Climate Warehouse based on registry transactions.

Importance – Understanding the API endpoints will allow testers to think about how they build the automated integration between their registry and the Climate Warehouse.

4

Mirrored Database – Testing the ability to perform SQL queries using a traditional MySQL database

Tester Profile – Any person who has previous SQL experience and is comfortable performing database functions to manipulate data in a specific manner

Importance – Testing the mirrored database will allow users to understand how they can use traditional tools to create dashboards (like for double counting) while still using the decentralized blockchain

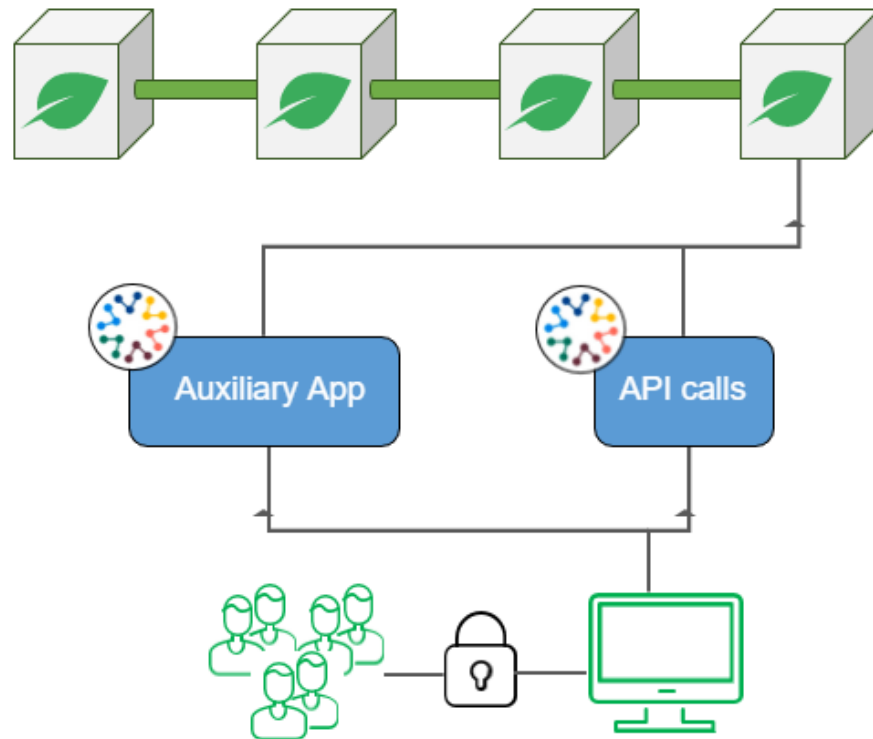
5

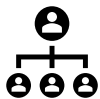
Excel Import/Export – Testing the excel upload/download features

Tester Profile – Any registry personnel that will have the data expertise to update the Climate Warehouse using data file uploads.

Importance – This testing area is important for registries that choose to integrate using file transfer instead of using the API or Auxiliary App.

- The Climate Warehouse is built on top of the Chia public blockchain. This means any data submitted through the Climate Warehouse becomes an **immutable record in the public blockchain**.
- The way data is written to the Climate Warehouse is through using either the **Auxiliary App (frontend UI)** or **through API calls**
- Organizations will host a **node*** which **can write data to the blockchain**. Organizations can choose to permission access to the node so different users within the org have different write/read access.
- The data that is stored on this node is all the blockchain hashes that verify the blockchain is correct and up to date.





Organization Data

The organization ID (a public key) is the unique identifier across the Climate Warehouse. Organizations will use their private key to access their node and update data.

Data within the Climate Warehouse is tied to an organization ID.



Project Data

Project data sits below the organization layer. Organizations will post project data they host, such as project names, types, owners, status, etc.

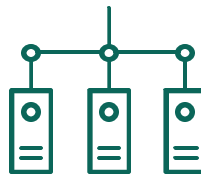
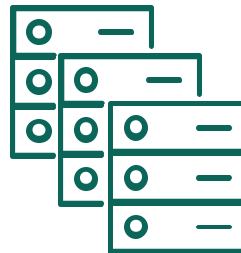
Each project gets assigned a unique project ID.



Carbon Credit (Units) Data

Units' data is connected to specific projects through the project ID. This is where organizations will input information denoting the issuances, amount, status, etc. for carbon credit units.

All IDs created by the Climate Warehouse are **globally unique**, meaning no single ID created will be created again. Organizations will not have two IDs that are the same, for any Climate Warehouse ID field.



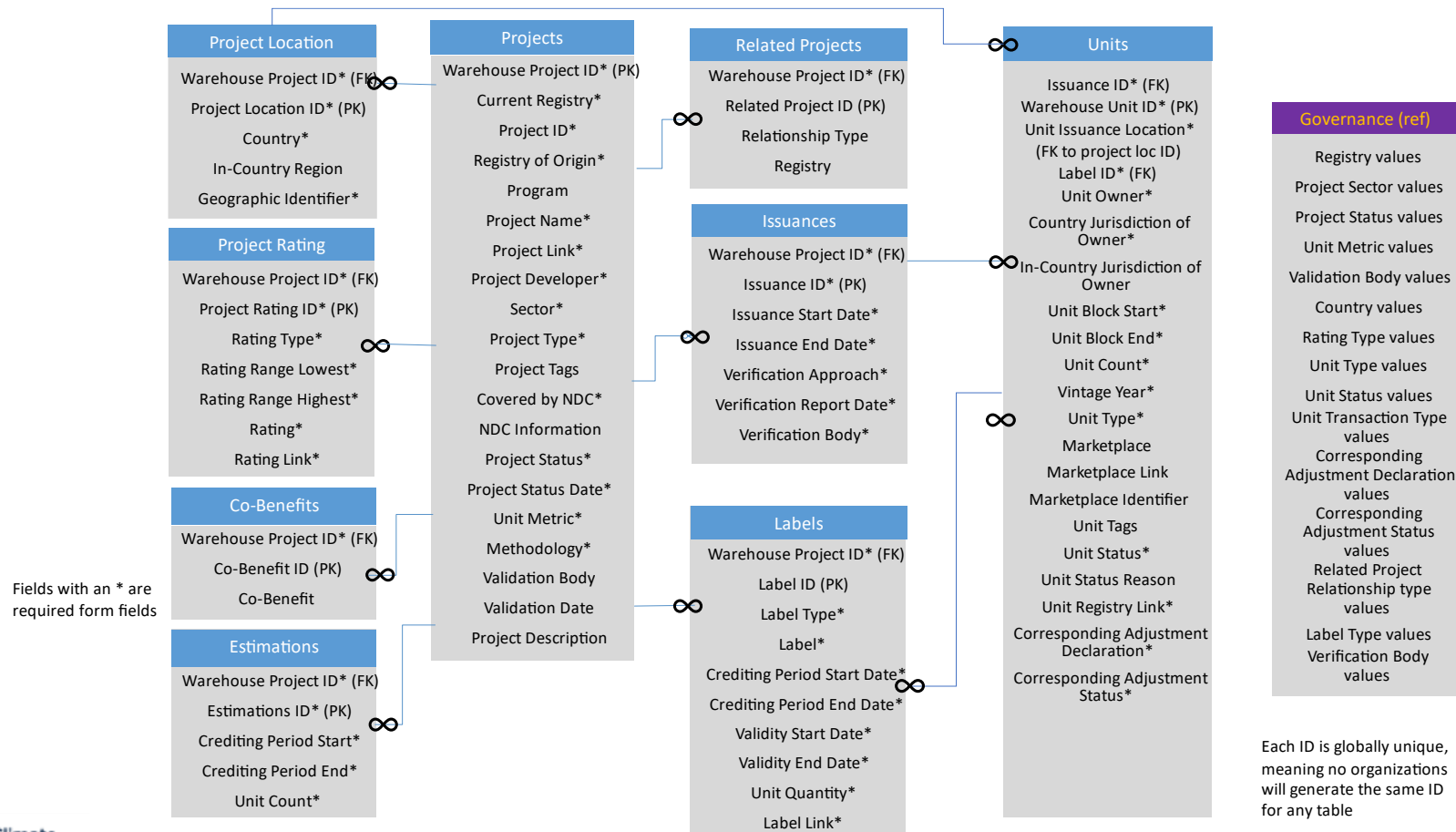
Governance

In an effort to standardize the way the world views and understand carbon projects and their associated data, a governance body will maintain the values in certain data fields.

This will not be restrictive but will rather make reporting easier.

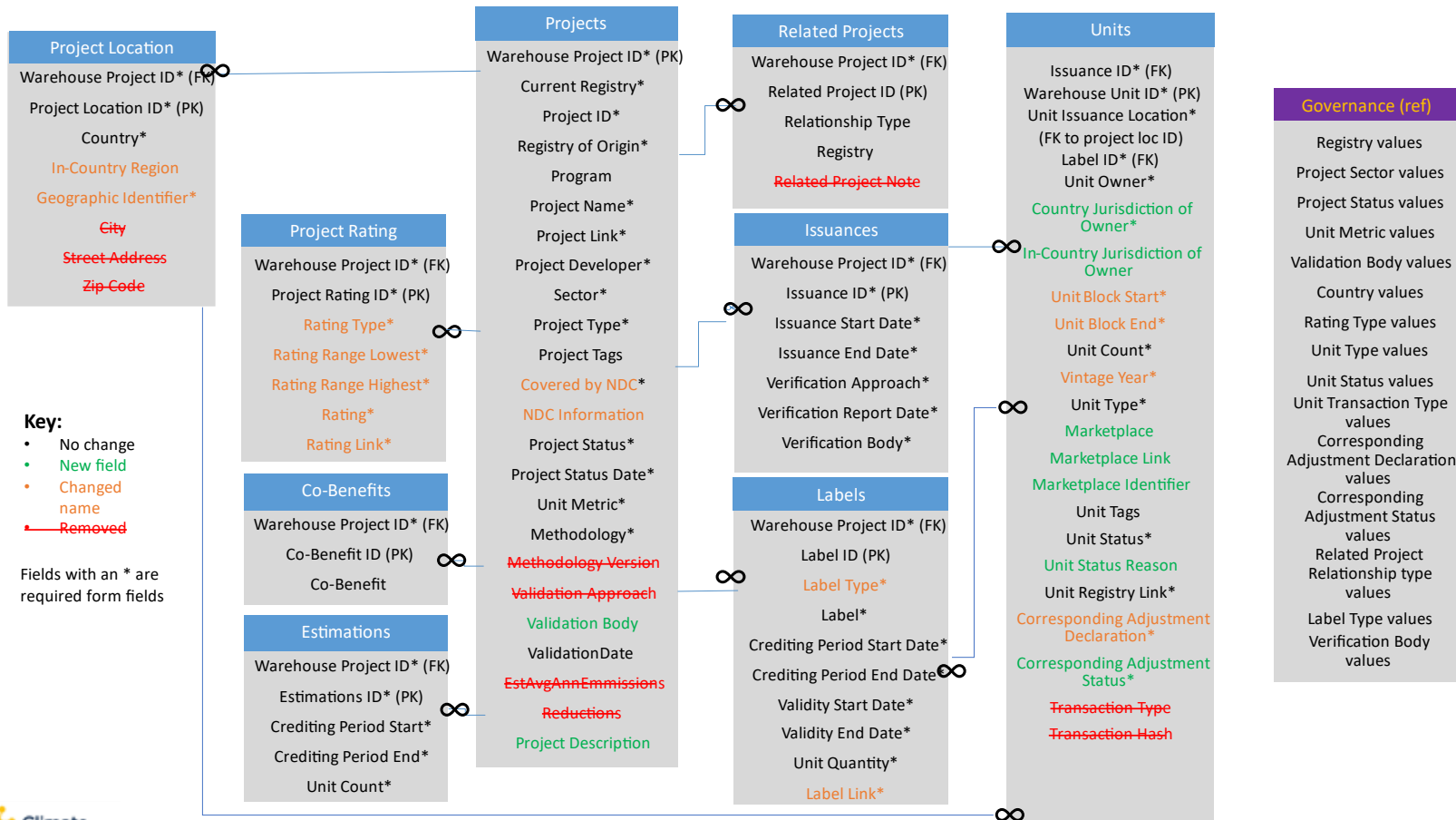
DATA MODEL

This data model is an extended version of the one used in the Climate Warehouse simulation phase II, and provides the essential elements of the data needed to support analysis of double counting issues.

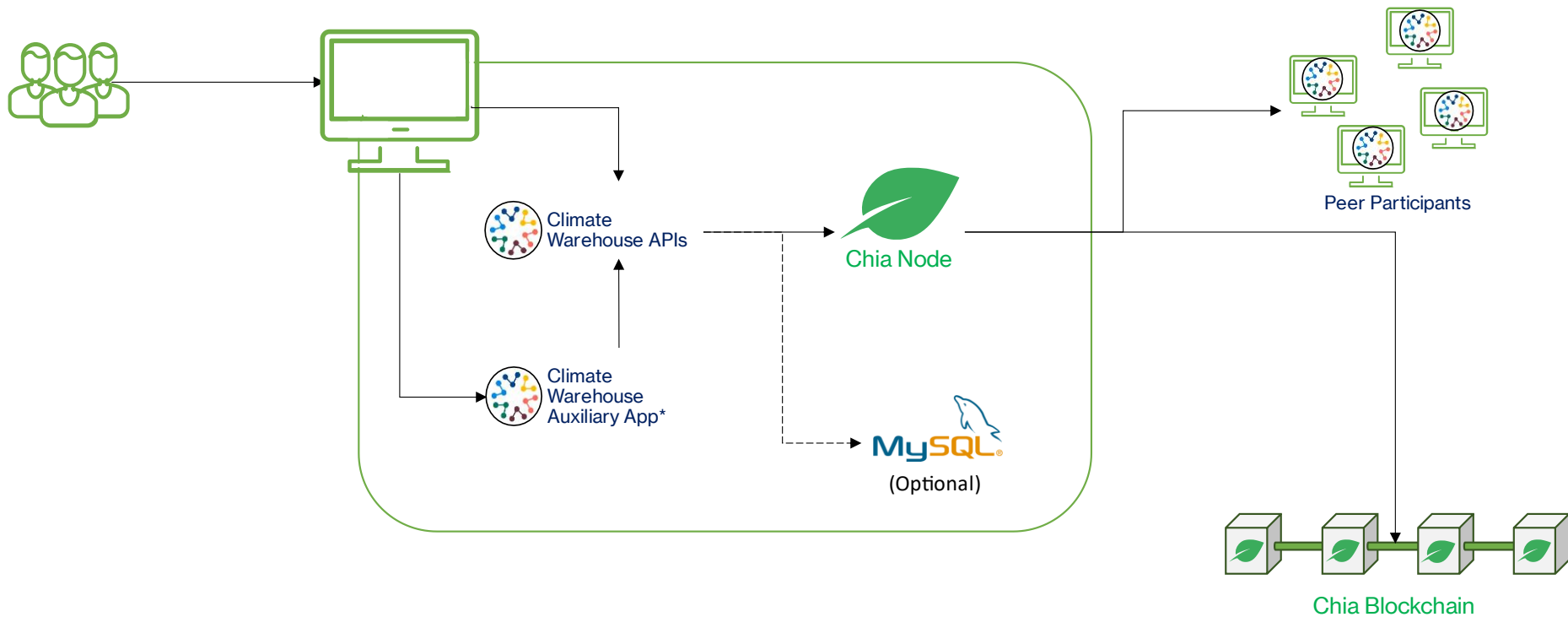


DATA MODEL

This data model is an extended version of the one used in the Climate Warehouse simulation phase II, and provides the essential elements of the data needed to support analysis of double counting issues.



Local Deployment



LOCAL INSTALLATION OF CLIMATE WAREHOUSE

- 1) Download Chia – select the link below corresponding to your OS
 - 1) Windows: <https://download.chia.net/dev/ChiaSetup-1.3.4698-b4e6064b.exe>
 - 2) Mac (Apple chip): <https://download.chia.net/dev/Chia-1.3.4.dev698-b4e6064b-arm64.dmg>
 - 3) Mac (Intel chip): <https://download.chia.net/dev/Chia-1.3.4.dev698-b4e6064b.dmg>
- 2) Run Chia – upon clicking the application, you should be presented with a UI screen asking for an existing wallet or to create a new one; Create a new wallet
- 3) Allow the Chia node to fully sync to the blockchain (**note: this is expected to take days to complete**)
 - 1) *You may continue on to steps 4, 5, and 6, but must wait until the node fully syncs before continuing*
- 4) Open port 31310, 8444, and 8575 on your network; this will allow Chia services to run properly and communicate with the Climate Warehouse
- 5) Download Climate Warehouse - <https://github.com/Chia-Network/climate-warehouse/releases/> - select the latest release and the version for your OS
 - 1) Unzip the package and place it into a new folder you create called 'app'
- 6) Download Aux App - <https://github.com/Chia-Network/climate-warehouse-ui/releases/> - select the latest release and the version for your OS
- 7) Open CLI (Command Prompt, Powershell, or Terminal depending on OS)
 - 1) On windows; cd to C:\Users\[username]\AppData\Local\chia-blockchain\app-[version]\resource\app.asar.unpacked\daemon
 - 2) On mac; cd to /Applications/Chia.app/Contents/Resources/app.asar.unpacked/daemon
- 8) Run command 'chia start data' to start datalayer services
- 9) Open the folder with the Climate Warehouse executable, double-click the .exe file to launch the Climate Warehouse
- 10) Launch the Climate Warehouse Aux App by double clicking the icon from your directory

LOCAL INSTALLATION SCREENSHOTS

CLI Commands: Full Node Synced

```
Microsoft Windows [Version 10.0.17763.2686]
(c) 2018 Microsoft Corporation. All rights reserved.

D:\Users\>cd AppData\Local\chia-blockchain\app-1.2.12753\resources\app.asar.unpacked\daemon

D:\Users>AppData\Local\chia-blockchain\app-1.2.12753\resources\app.asar.unpacked\daemon xchia start node
Daemon not started yet
Starting daemon
chia_full_node: started


D:\Users>AppData\Local\chia-blockchain\app-1.2.12753\resources\app.asar.unpacked\daemon xchia show -s
Network: mainnet Port: 8444 Rpc Port: 8555
Current Blockchain Status: Full Node Synced
Peak: Hash: febd537b5da9044a53efdd3b98c8a30daac23eddc1ef5e738a951262ce42bfc1
Time: Sun Mar 13 2022 16:04:28 Eastern Daylight Time Height: 1689900
Estimated network space: 28.706 EiB
Current difficulty: 2552
Current VDF sub_slot_iters: 135266304
Total iterations since the start of the blockchain: 6608562868307

Height: | Hash:
1689900 | febd537b5da9044a53efdd3b98c8a30daac23eddc1ef5e738a951262ce42bfc1
1689899 | 83f99d0801171f2b1bad17a3d2eca150b155d5cdc3fe35785185ee09347d11f
1689898 | b3bce1f72e097afbf5f341252962c64eb8a6b7bc7eca4f4948655ab99cd5f1e
1689897 | 67469e0c0bae8e25ef6d72918fcedc77446791b9e266246eb85f3cf347
1689896 | df30812d1ea48936b174c61401018efa7ed43ec0cab187aaa482eb0b5d8de8ed
1689895 | 24c088084b1161fa0ecfe29130cdf4fc654c3a90e61f1b291bd9e4d195d9c
```

Running Climate Warehouse:

```
D:\Users\mahendra\app\climate-warehouse.exe
ons.where object is empty. Did you forget to use options.where?
climate-warehouse:dataylayer:persistence Root for b8c11f2b10d710706241e66cd55bb151f009ced347bba0e37101692e74ede88 {
  confirmed: true,
  hash: '0xf5f86189cd3442a2d79f76a4368adc522e09f06764164bca6f5720f5d18091561',
  success: true,
  timestamp: 1647169179
} +19ms
Waiting for Updates - climate-warehouse:task:organizations Subscribing to default organizations +10
climate-warehouse:task:picklists Syncing Picklist Values +2ms
climate-warehouse:task:organizations Syncing subscribed organizations +3ms
(sequelize) Warning: Model attributes (subscribed) passed into finder method options of model organization, but the opti
ons.where object is empty. Did you forget to use options.where?
climate-warehouse:dataylayer:persistence Root for b8c11f2b10d710706241e66cd55bb151f009ced347bba0e37101692e74ede88 {
  confirmed: true,
  hash: '0xf5f86189cd3442a2d79f76a4368adc522e09f06764164bca6f5720f5d18091561',
  success: true,
  timestamp: 1647169179
} +58ms
Waiting for Updates - climate-warehouse:task:organizations Subscribing to default organizations +10
climate-warehouse:task:picklists Syncing Picklist Values +2ms
climate-warehouse:task:organizations Syncing subscribed organizations +3ms
(sequelize) Warning: Model attributes (subscribed) passed into finder method options of model organization, but the opti
ons.where object is empty. Did you forget to use options.where?
climate-warehouse:dataylayer:persistence Root for b8c11f2b10d710706241e66cd55bb151f009ced347bba0e37101692e74ede88 {
  confirmed: true,
  hash: '0xf5f86189cd3442a2d79f76a4368adc522e09f06764164bca6f5720f5d18091561',
  success: true,
  timestamp: 1647169179
} +25ms
Waiting for Updates +
```

Running Aux App:

 Climate Warehouse

[Connect](#) [ENGLISH](#)

WAREHOUSE

Projects List

Units List

REGISTRY

My Projects

My Units

Create Organization

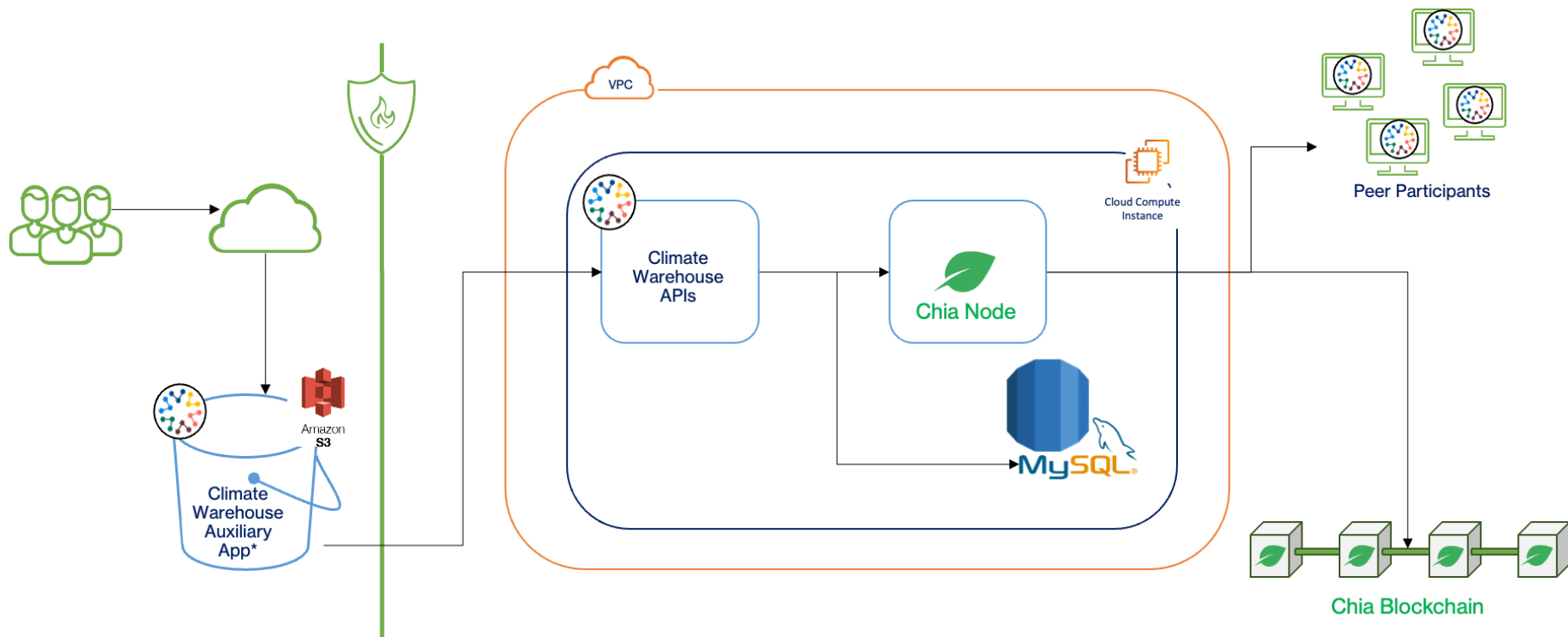
Search

All organizations

COMMITTED

Current Registry	Project Id	Project Name	Project Developer	Sector	Project Type	Project Tags	Covered By NDC	Project Status	Unit Metric	Validation Body
UNFCCC	10186-P1-00...	Accelerating ...	Rural Electrica...	Energy distrib...	Energy dema...	--	Inside NDC	Registered	tCO2e	TUV Nord Cer...
Verra	2458	Guoluo Grass...	Qinghai Guang...	Agriculture F...	Improved For...	--	Unknown	Registered	tCO2e	TUV Nord Cer...
UNFCCC	6055	Teesta Stage...	Lanco Teesta Hy...	Energy (rene...	Energy dema...	--	Outside NDC	Registered	tCO2e	EPIC Sustana...

Cloud Deployment



Note: The above is illustrative and the same can be deployed using other cloud providers

HOSTED INSTANCE OF CLIMATE WAREHOUSE

- 1) Go to <https://app.climatewarehouse.chia.net/>
- 2) Click the 'Connect' button at the top right hand corner of the webpage
- 3) Enter details into the fields as directed by the email that was sent to your inbox

The screenshot displays the Climate Warehouse application interface. On the left, a blue sidebar contains the 'WAREHOUSE' logo and navigation links for 'Projects List' and 'Units List'. The main content area features a search bar, a dropdown for 'All organizations', and a table of committed projects. A modal dialog titled 'Log in to remote node' is open, prompting the user to enter a server address and an API key. The modal includes a 'Cancel' button and a 'Connect' button.

Climate Warehouse Connect ENGLISH

WAREHOUSE

Projects List

Units List

Search

COMMITTED

Current Registry	Project Id	Project Name	Project Developer	Sector	Project Type	Project Tags	Covered By NDC	Project Status	Unit Metric	Validation Body
UNFCCC	4513	Lake Turkana ...				Africa, Renew...	Inside NDC	Registered	tCO2e	China Quality ...
UNFCCC	10186-P1-00...	Accelerating ...				--	Inside NDC	Registered	tCO2e	TÜV Nord Cer...
Verra	2458	Guoluo Grass...				--	Unknown	Registered	tCO2e	TÜV Nord Cer...
UNFCCC	6055	Teesta Stage...				--	Outside NDC	Registered	tCO2e	EPIC Sustaina...

Log in to remote node

*Server address

Add a valid server address

*Api key

Add a valid Api key

v0.1.21

FULL API CAPABILITIES

Participants may choose to integrate to the Climate Warehouse using APIs. All the auxiliary app functions can be performed using APIs and documentation for API uses and examples can be found on [Github](#).

organizations

Functionality: Use GET, POST, and PUT to list, create, and update organizations

GET Options: None

GET Examples

List all subscribed organizations

```

// Request
curl --location --request GET 'localhost:31318/v1/organizations' --header 'Content-Type: application/json'

// Response
{
  "77641db780adc6c74f1ff357804e26a799e4a09157f426aac588963a39bdb2d9": {
    "orgId": "77641db780adc6c74f1ff357804e26a799e4a09157f426aac588963a39bdb2d9",
    "name": "Org Test",
    "icon": "https://climate-warehouse.s3.us-west-2.amazonaws.com/public/orgs/me.svg",
    "isHome": true,
    "subscribed": true
  }
}

```

POST Options:

Key	Type	Description
name	String	(Required) Name of the organization to be created
icon	String	(Required) URL of the icon to be used for this organization

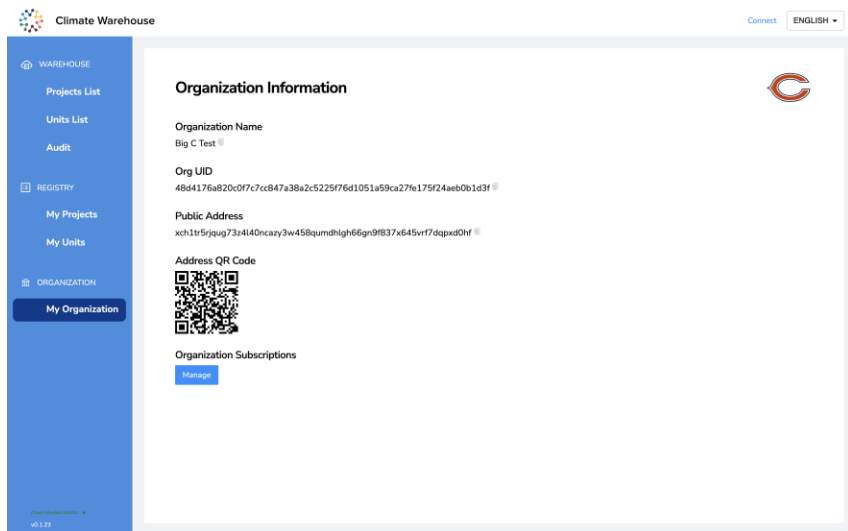
DOWNLOAD/IMPORT API COLLECTIONS

Participants can go to the public Github repository [here](#) to find API collections. Download them into your local or hosted instance and upload the JSON files into postman.

The screenshot shows the Postman application interface. On the left, a sidebar lists collections, including 'Projects API'. The main area displays the 'GET /projects' endpoint. Below the endpoint, there's a table for 'Query Params' with columns 'KEY' and 'VALUE'. The 'KEY' column contains 'key' and the 'VALUE' column contains 'Value'. The 'DESCRIPTION' column contains 'Description'. Below the table, there's a 'Body' section with a 'JSON' tab selected, showing a detailed JSON response for the GET request. The response includes fields like 'orgId', 'name', 'icon', 'isHome', 'subscribed', and a list of 'relatedProjects'.

EXPLORE YOUR ORGANIZATION

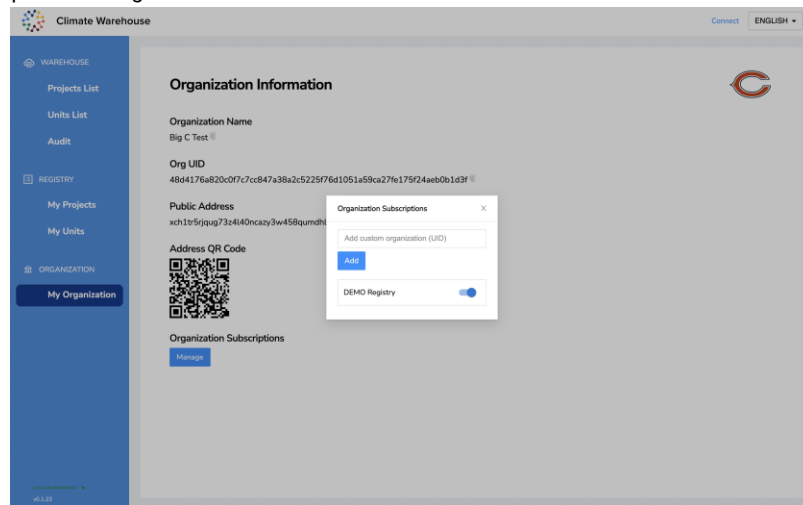
Users can look at details about their organization by clicking the 'My Organization' from the lefthand menu bar. This will display your details about your organization including the name, icon, and Org Uid.



CONNECT TO OTHER ORGANIZATIONS

Using the same 'My Organizations' page, users can manage their organizations subscriptions – which other organizations they prefer to "listen" to (which other organizations data will display in the Climate Warehouse app).

Click the 'Manage' button to be able to add a new organization, or simply use the slider next to each organization to instruct the Climate Warehouse to stop or start listening to a particular organizations data.



MY REGISTRY AND WAREHOUSE FUNCTIONS

The Auxiliary App contains all of the basic registry functions. The data is subdivided in the menu to show Projects List and Units List from the Warehouse (all projects and units of organizations in the governance list), and My Projects and My Units from the participant's registry (Registry). Registry functions can only be performed in the Registry section (My Projects, My Units).

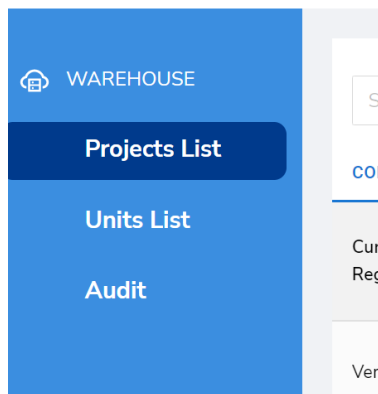
REGISTRY FUNCTIONS SUPPORTED BY THE AUXILIARY APP:

Project Functions:

- Add or edit project information, including related projects and rating information
- Change the status of a project
- Add labels, authorizations or other types of qualifications to a project
- Create new issuances for a project
- Full text search on all Projects fields



Climate Warehouse



Unit Functions:

- Issue units to the project
- Edit unit information, including status information for unit blocks
- Assign labels, authorizations or other types of qualifications to units associated with the project
- Split unit blocks
- Record the transfer of unit blocks to outside registry systems
- Copy into My Registry unit block information transferred to the registry
- Full text search on all Units fields

Other Functions:

- Import Data Template
- Download excel data for registry and warehouse views
- View Audit History in-app

USER INTERFACE & FEATURES

EXPLORE PROJECTS & UNITS

You can explore the different climate projects uploaded by you and other participants to the warehouse; allowing to show how one meta-registry can pool trusted data from multiple different registries.

The screenshot shows the 'Climate Warehouse' interface with a sidebar on the left containing 'WAREHOUSE', 'Projects List', and 'Units List'. The main area displays a table of committed projects. The table has columns for Current Registry, Project Id, Project Name, Project Developer, Sector, Project Type, Project Tags, Covered By NDC, Project Status, Unit Metric, and Validation Body. Three projects are listed: UNFCCC 10186-P1-002, Verra 2458, and UNFCCC 6055.

Current Registry	Project Id	Project Name	Project Developer	Sector	Project Type	Project Tags	Covered By NDC	Project Status	Unit Metric	Validation Body
UNFCCC	10186-P1-002	Accelerating ...	Rural Electrifica...	Energy distrib...	Energy dema...	--	Inside NDC	Registered	ICQ2e	TÜV Nord Cer...
Verra	2458	Guolu Grass...	Qinghai Guang...	Agriculture F...	Improved For...	--	Unknown	Registered	ICQ2e	TÜV Nord Cer...
UNFCCC	6055	Teesta Stage...	Lanco Teesta Hy...	Energy (rene...	Energy dema...	--	Outside NDC	Registered	ICQ2e	EPIC Sustaina...

DEEP DIVE INTO PROJECT AND UNIT INFO

View in-depth project or unit details by clicking on a project or unit record and looking through the various information associated with the record. The Climate Warehouse features the ability to place tags onto project and unit records in order to capture information that your registry deems necessary, but may not exist as an explicit field.

The screenshot shows the 'Project Detailed View' interface. It includes a sidebar with 'Projects List' and 'Units List'. The main area displays detailed information for a project, including Project Name, Project Developer, Project Link, Sector, Project Status, Covered By NDC, NDC Information, Current Registry, Registry of Origin, and Unit Metric. The project details are organized into sections with expandable/collapsible icons.

Project Name: Accelerating Electrification through Grid Extension and 10186-P1-0002-CP1 off-grid electrification in Rural Areas of Uganda CPA 2

Project Developer: Rural Electrification Agency Uganda

Project Link: https://sdm.unfccc.int/programme/activities/sea_dby/ICQ89Y1J0PQOZANQBYR133KHJWVZ/view

Sector: Energy distribution

Project Status: Registered

Covered By NDC: Inside NDC

NDC Information: NDC information listed on website

Current Registry: UNFCCC

Registry of Origin: UNFCCC

Unit Metric: ICQ2e

AUDIT TABLES – REVIEW ORGANIZATIONS HISTORY

The Climate Warehouse features an in-app 'Audit' function. This feature allows a user to select any organization they are connected to and can see all of the Climate Warehouse history for that organization.

This means that you can see what data was added (deleted), when it happened, and the blockchain root hash which corresponds to the change that was submitted.

Climate Warehouse

Connect ENGLISH

WAREHOUSE

Projects List

Units List

Audit

REGISTRY

My Projects

My Units

ORGANIZATION

My Organization

DEMO Registry

Org UID: 98c11f2b104710706241e66cd55bb151f009ced347bbab0c37101692e74ede88

Table	Timestamp	QI	Type	Root Hash
issuances	2022-03-13 08:06:05		INSERT	0x1035c7e4e5d8ba023b181795298ab5a9185549d99209821f98105989a3e8799e
issuances	2022-03-13 08:06:05		DELETE	0x1035c7e4e5d8ba023b181795298ab5a9185549d99209821f98105989a3e8799e
project.locations	2022-03-13 07:56:53		INSERT	0x1e9d5d669780bd6ea9bd2522d0690004248831d0316943dec30c895624c03c63
issuances	2022-03-13 07:56:53		INSERT	0x1e9d5d669780bd6ea9bd2522d0690004248831d0316943dec30c895624c03c63
project.locations	2022-03-13 07:56:53		DELETE	0x1e9d5d669780bd6ea9bd2522d0690004248831d0316943dec30c895624c03c63
project	2022-03-13 07:56:53		INSERT	0x1e9d5d669780bd6ea9bd2522d0690004248831d0316943dec30c895624c03c63
project	2022-03-13 07:56:53		DELETE	0x1e9d5d669780bd6ea9bd2522d0690004248831d0316943dec30c895624c03c63
issuances	2022-03-13 07:56:53		DELETE	0x1e9d5d669780bd6ea9bd2522d0690004248831d0316943dec30c895624c03c63
project.locations	2022-03-13 07:53:03		INSERT	0x09ab24345864a1599b4b448ba4a9926315443ced246e8a5e273410a345f8a11c0
project	2022-03-13 07:53:03		INSERT	0x09ab24345864a1599b4b448ba4a9926315443ced246e8a5e273410a345f8a11c0
project	2022-03-13 07:42:02		DELETE	0x976518726aaf82b64b6e7bcb0654aaf477bc722e2af7e11773b46096bdfc2
project	2022-03-13 07:15:48		INSERT	0xd4656c94bd937d6dd7ae3062b5c78cab06053abeb81e030b7927676f490d
project	2022-03-13 07:15:48		INSERT	0xd4656c94bd937d6dd7ae3062b5c78cab06053abeb81e030b7927676f490d

DEEP DIVE INTO AUDIT RECORDS

Users are able to click into any record and view important details that were submitted in that transaction record.

Items that appear in green text is data additions that were added in that transaction. Items in red text is data deletions that occurred in that transaction.

Audit

Table	Timestamp	Type
issuances	2022-03-13 07:56:53	INSERT
Root Hash	0x1e9d5d669780bd6ea9bd2522d0690004248831d0316943dec30c895624c03c63	
End Date	2020-12-31T22:09:50.000Z	Start Date
Verification Body	TUV Nord Cert GmbH	Verification Report Date
Org Uid	98c11f2b104710706241e66cd55bb151f009ced347bbab0c37101692e74ede88	Warehouse Project Id
		Verification Approach
		Id
		Project Id

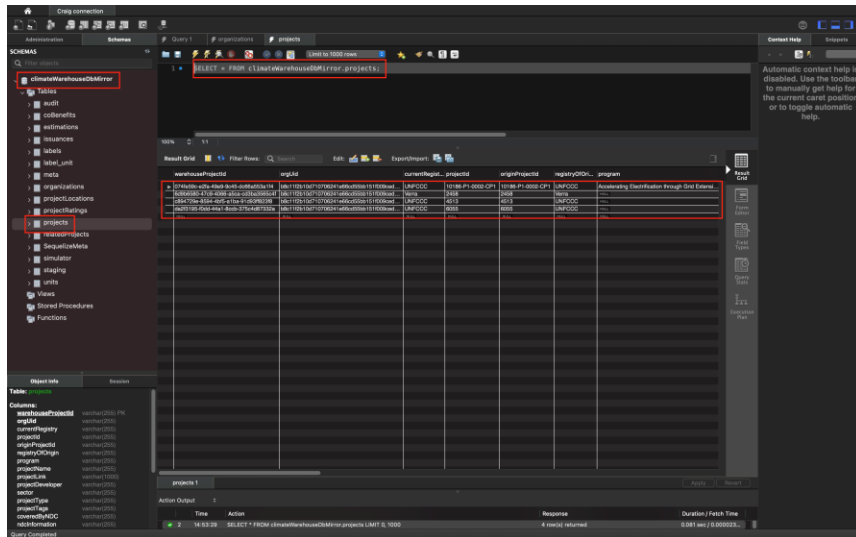
Audit

Table	Timestamp	Type
issuances	2022-03-13 08:06:05	DELETE
Root Hash	0x1035c7e4e5d8ba023b181795298ab5a9185549d99209821f98105989a3e8799e	
Start Date	2017-05-04T23:03:57.000Z	End Date
Verification Report Date	2019-08-27T23:05:18.000Z	Verification Body
Org Uid	98c11f2b104710706241e66cd55bb151f009ced347bbab0c37101692e74ede88	Warehouse Project Id
		Verification Approach
		Id
		Project Id

MIRRORED DATABASE

An important feature of the Climate Warehouse is the mirrored database. The Climate Warehouse data is mirrored into a traditional SQL database and allows permissioned users to access.

Testing the mirrored database will allow users to understand how they can use traditional tools to create dashboards (like for double counting) while still using the decentralized blockchain.



TRACKING TRANSFERS – SIMULATION III

The Climate Warehouse features the ability to reflect transfers of both projects and units between registries.

See below for an illustration of how two registries may track transfers of data during Simulation. In production this tracking of a transfer will happen in a single blockchain “transaction” (data upload) signed by both parties, rather than two blockchain “transactions” submitted by both parties.

Registry A			Registry B		
Projects			Projects		
Project ABC	Units	Status	Project BBB	Units	Status
Project CDC	ABC1000-ABC5000	Held	Project QQC	BBB10-BBB100	Held
Project XYZ	CDC2720-CDC3860	Held	Project TTT	QQQ1010-QQQ2045	Held
	XYZ10-XYZ200	Held		TTT4328-TTT6728	Held

Both registry A and registry B are participating in the Climate Warehouse.

Both registries maintain their own tables of project and unit data.

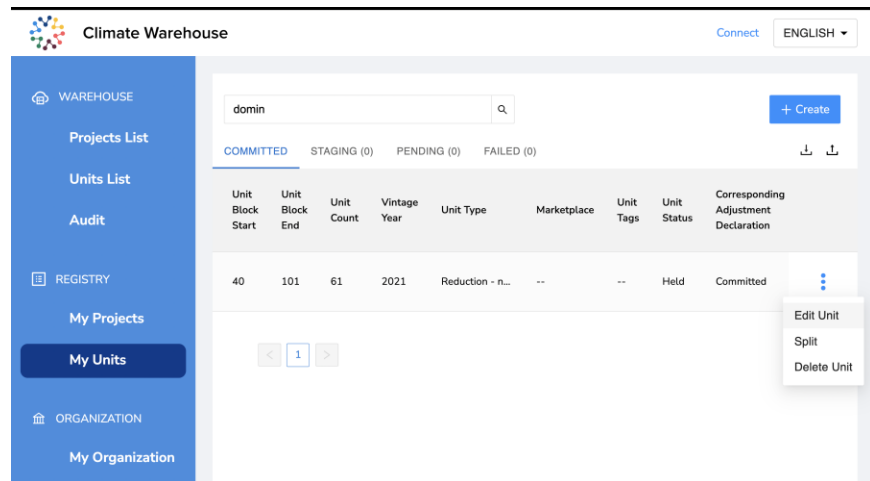
Registry A			Registry B		
Projects			Projects		
Project ABC	Units	Status	Project BBB	Units	Status
Project CDC	ABC1000-ABC5000	Held	Project QQC	BBB10-BBB100	Held
Project XYZ	CDC2720-CDC3860	Held	Project TTT	QQQ1010-QQQ2045	Held
	XYZ10-XYZ200	Transferred		TTT4328-TTT6728	Held
				XYZ10-XYZ200	Held

Let's assume Registry A intends to transfer unit block XYZ10-XYZ200 to Registry B.

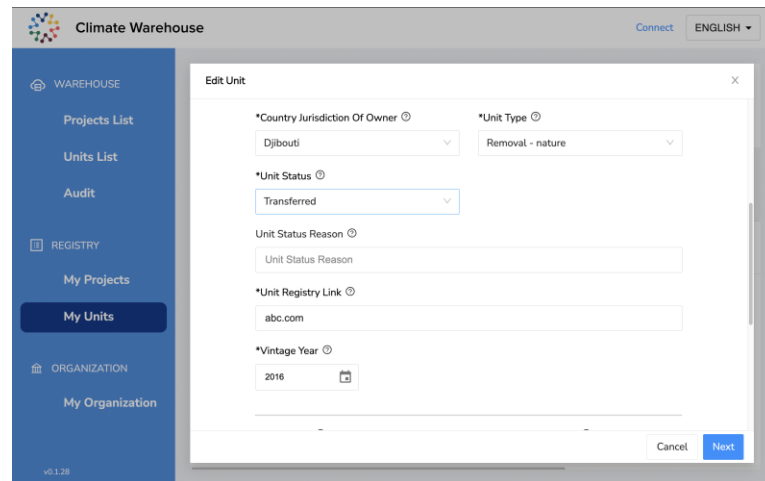
Registry A would update the unit status in their Climate Warehouse to 'transferred' while Registry B would add a new unit and make the status 'held' in their Climate Warehouse.

TRANSFERS— SIMULATION SCREENSHOTS

Below shows screenshots of how both registries will **reflect** a transfer of data in the Climate Warehouse. Please note – the actual transfer will occur outside of the Climate Warehouse, and the below is how the Climate Warehouse will reflect the change that has occurred in the registries.



Project(s) and/or unit(s) will be edited

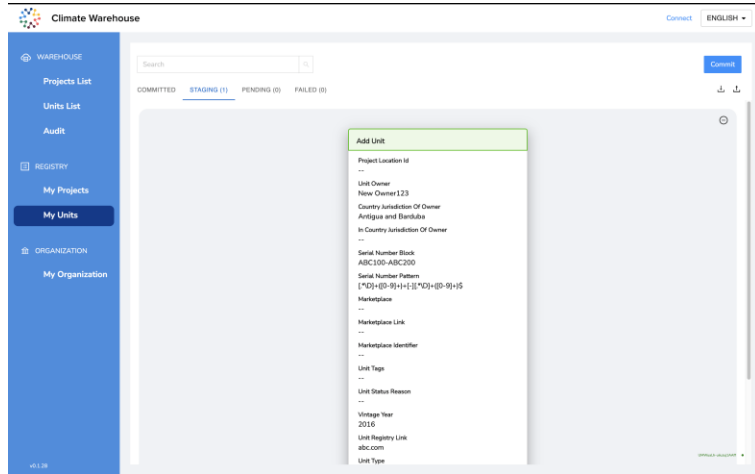


Project(s) and/or unit(s) will be marked as transferred

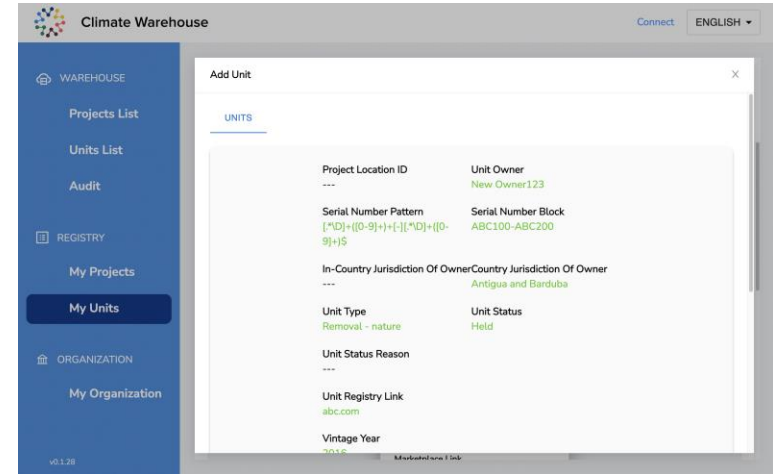
COMMITTED	STAGING (1)	PENDING (0)	FAILED (0)
	<div>Click here to view details. ❌</div> <div>Marketplace Identifier</div> <div>Click here to view details. ❌</div> <div>Unit Tags</div> <div>Click here to view details. ❌</div> <div>Unit Status</div> <div>Held ❌</div> <div>Unit Status Reason</div>		<div>-- ✅</div> <div>Marketplace Identifier</div> <div>-- ✅</div> <div>Unit Tags</div> <div>-- ✅</div> <div>Unit Status</div> <div>Transferred ✅</div> <div>Unit Status Reason</div>

Registry A will commit the change to the blockchain

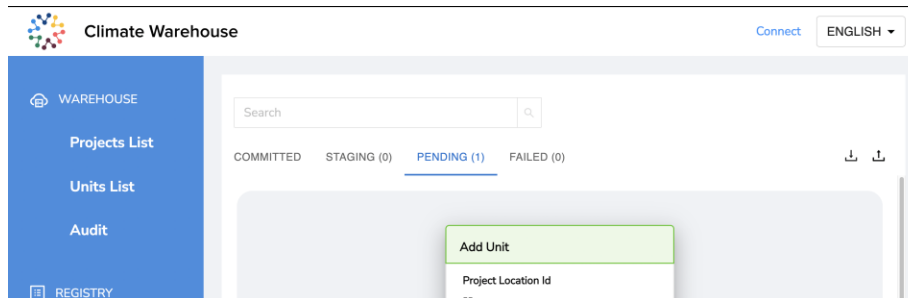
TRANSFERS— SIMULATION SCREENSHOTS



Registry B will add the project(s) and/or unit(s) to their list



Registry B will be sure to mark the new owner and the unit status as "Held"



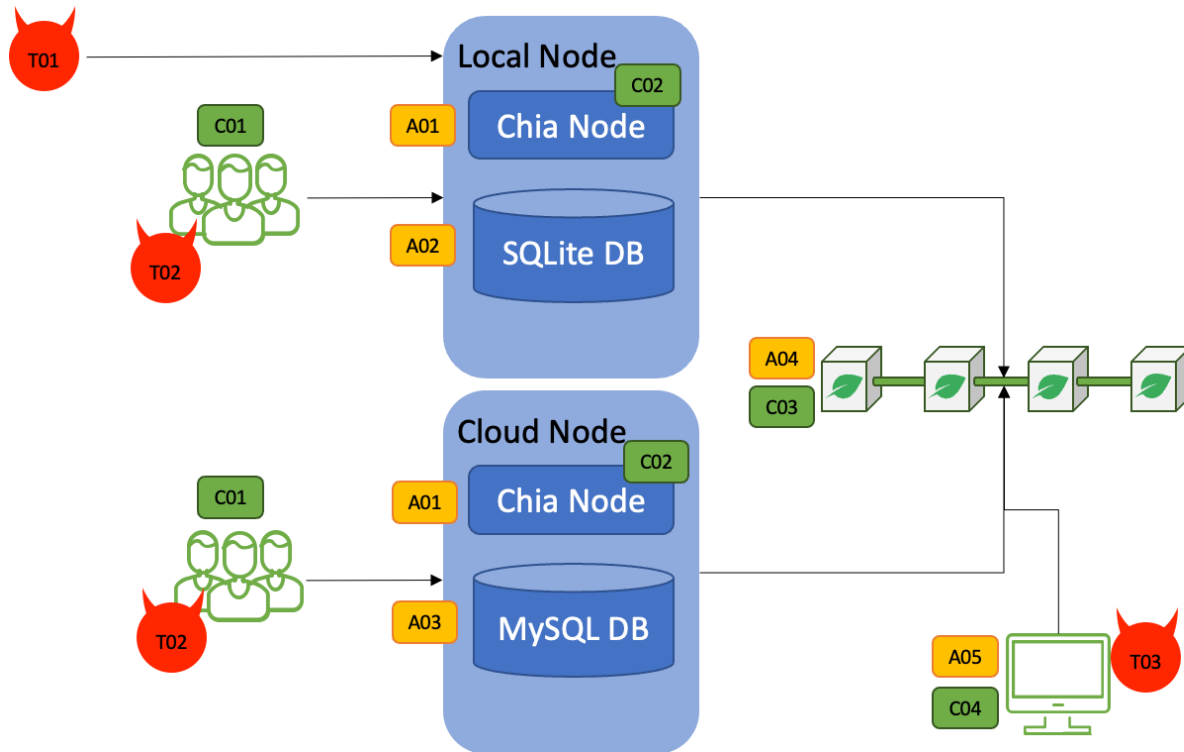
Registry B will commit the change to the blockchain

APPENDIX

- Threat Model (29)
- Testing on a public blockchain considerations (34)
- Climate Warehouse Governance Node (40)
- Double Counting Measures (43)
- Information on Chia Network (49)

High-level Overview – Threat Model

THREAT MODEL I HIGH-LEVEL OVERVIEW



Assets:

A01 – Chia node
A02 – Local data store (SQLite)
A03 – Cloud data store (MySQL)
A04 – Chia public blockchain
A05 – Blockchain nodes

Threats:

T01 – Unauthorized external user
T02 – Unauthorized internal user
T03 – Chia blockchain node(s)

Controls:

C01 – Organizational Access Management
C02 – Wallet passphrase or mnemonic seed
C03 – Immutable blockchain
C04 – 225,000 nodes; 30 exbibytes of storage

Node threats:

These are threats that could compromise a single node. This could mean that the climate data data an organization owns could be manipulated.

Examples of node attacks:

1. Cloud credentials stolen – with a cloud instance of the Climate Warehouse, if the credentials to access the VPC are compromised, an external (or internal) malicious actor could access the DB storage of climate data
2. Wallet credentials stolen – Chia protects all nodes by default with a mnemonic seed, or a user set passphrase. If these were to be compromised, an external (or internal) malicious actor could access the organizations instance of Climate Warehouse, and therefore all associated data
3. Internal user hacked – if an internal user gets hacked (email accessed), it is possible the hacker can masquerade as the internal user and access the organizations Climate Warehouse maliciously
4. OSS code tampering – because Climate Warehouse (and Chia) are open-source, a node can change the code and run their new malicious code within their own node

Public blockchain threats:

These are threats that could *theoretically* compromise the efficiency and/or validity of the blockchain.

Examples of blockchain attacks:

1. Dust storm – malicious user attempts to overload the blockchain with thousands of tiny transactions that fills up the blockchain which may result in delays for legitimate data to pass into blocks
2. Majority attack – one malicious user (or group of users) controls over 51% of the blockchain storage space



THREAT MODEL – CONTROLS FOR NODE THREATS

Threat

Control

1 Cloud credentials stolen

This control relies mostly on the organization managing the cloud environment. Cloud credentials are provisioned correctly and have appropriate safeguards to prevent theft and/or misuse. If a malicious actor obtains cloud credentials, they will most likely have access to Climate Warehouse keys. For this reason, we have onboarding instructions to explain the importance of safeguarding cloud credentials.

2 Wallet credentials stolen

By default, Chia enforces mnemonic seed to access a Chia node. This security measure is nearly impossible for a hacker to guess. However, if the mnemonic seed were written on paper and somehow stolen, then a hacker could gain access to the wallet. For this reason, we have onboarding instructions to explain the importance of safeguarding wallet credentials.

3 User hacked

This control resides within the organization participating in the Climate Warehouse. If a user of an organization gets hacked (email phished, social engineered, etc.), that hacker could potentially get access to the orgs Climate Warehouse node. The way to prevent org users from being hacked is by promoting security measures within the organization.

4 OSS code tampering

Climate Warehouse, Chia node, and Chia datalyer code can all be tampered with as all code is released as open-source. If a malicious user were to tamper with the code, they could run a node with that new code. The Chia blockchain is robust enough to reject any data submitted from a tampered node. It would take over half the network running the tampered code to submit blockchain data that is accepted.

Threat

Control

5 Dust storm

A dust storm simply delays legitimate data from making it to blocks. At a certain point, fees may be charged for transactions in order to prioritize them into blocks, which would make the dust storm financially ineffective.

This is a possible circumstance, but one that corrects itself based on the design of Chia blockchain fees.

6 Majority attack

This attack can only succeed when 51% of the storage space allocated to the Chia blockchain is managed by one malicious actor. Because the Chia blockchain has ~250,000 nodes and 30+ exbibytes of storage allocated to ensuring the blockchain is correct, it is **extremely** difficult (physically and financially) to take over half of the network.

Most Decentralized

Each validator node independently validates each transaction in a Nakamoto blockchain. In a robust public blockchain like Chia, it takes corrupting 51% of the validator nodes to corrupt the data. The Chia network includes over 250,000 nodes today. It would be nearly impossible to corrupt over 125,000 validator nodes.

For Comparison...

Chia Network	250,000 nodes
Bitcoin	65,000 nodes
Ethereum	5,500 nodes

Testing on a Public Blockchain

Mainnet

- Currency is XCH
- ~30 EiB of dedicated storage
- Global, publicly accessible
- Stable and well-tested

- Uses same consensus mechanism – Proof of Space and Time
- Leverages the same peer-to-peer protocols
- Currently has no fees to commit data to the blockchain

Testnet

- Currency is TXCH
- ~150 TiB of dedicated storage
- Global, publicly accessible
- Used to test new Chia code
- Used to test new smart contracts

Mainnet Benefits

- Mainnet is robust and is NOT used for testing new blockchain code
- More storage and nodes allocated to mainnet than testnet
- Mainnet provides an environment set-up that is closer production stage

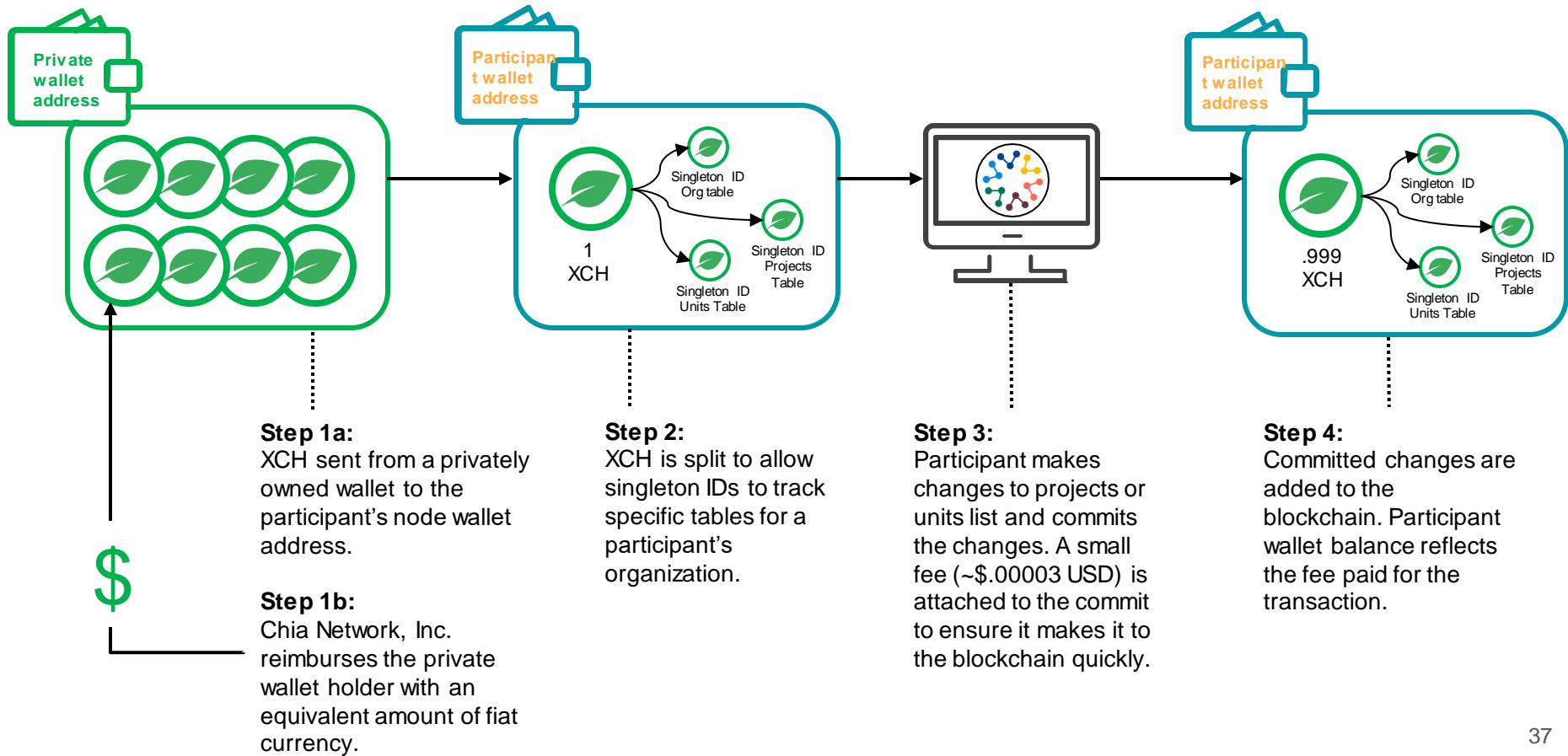
Mainnet Concerns

- Mainnet uses XCH which has real value*, whereas testnet uses TXCH which does not have value
*~\$.00003 USD

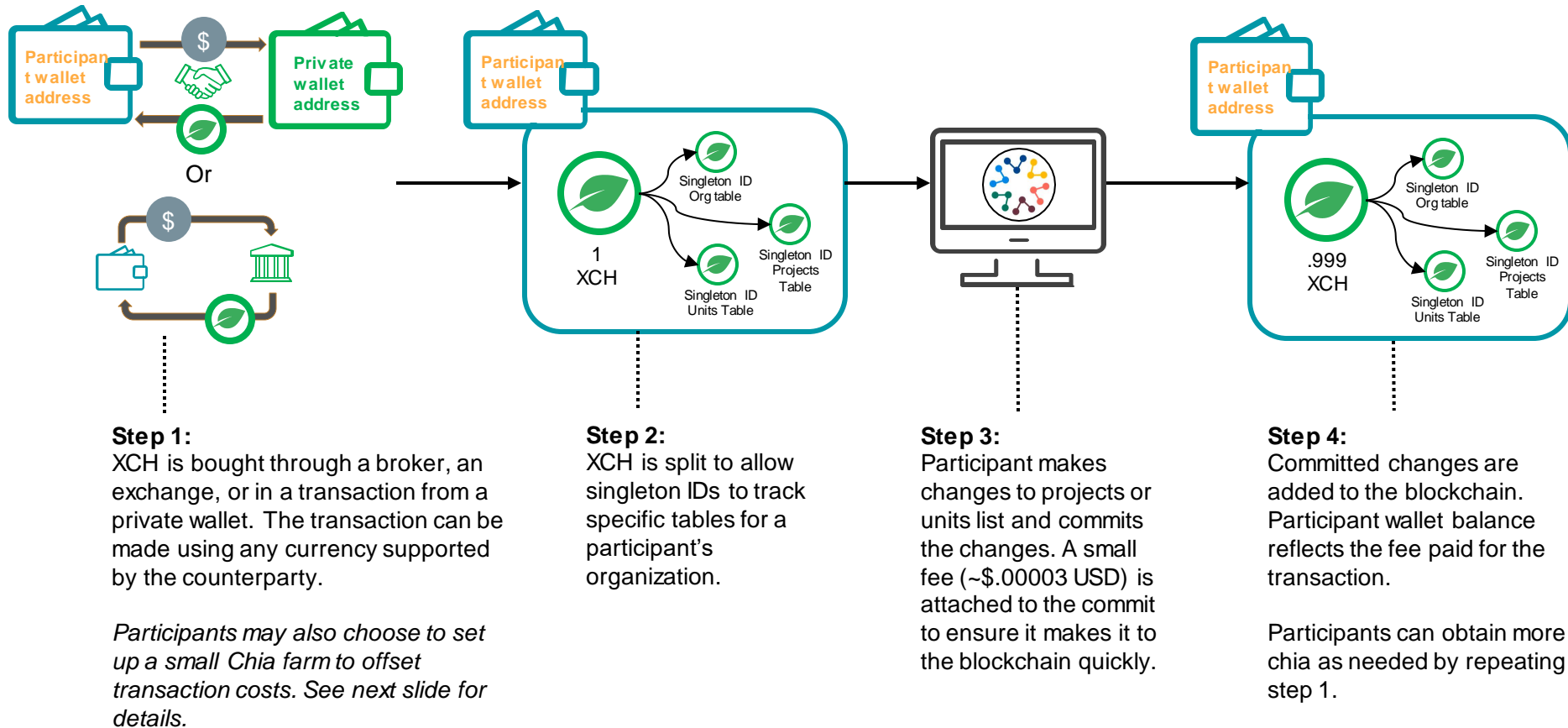
Testers should understand that the blockchain is immutable. The steps below will minimize the visibility of test data errors.

- 1 Organizations are able to stage their data and review it prior to sending it to the blockchain.
- 2 If a mistake is made, organizations can correct those mistakes. The mistake will still exist in the blockchain audit history, but the corrected data will be shown in the Climate Warehouse.
- 3 Organizations can choose when they want to publicly announce their data to be observed. Only once announced will the public observe the published data.
- 4 An organization can abandon one dataset and announce a new dataset ID for observers to follow. Only observers that know to look for the old dataset will be able to see it.

TESTING ON A PUBLIC BLOCKCHAIN – HOW CHIA WILL BE USED IN THE CLIMATE WAREHOUSE

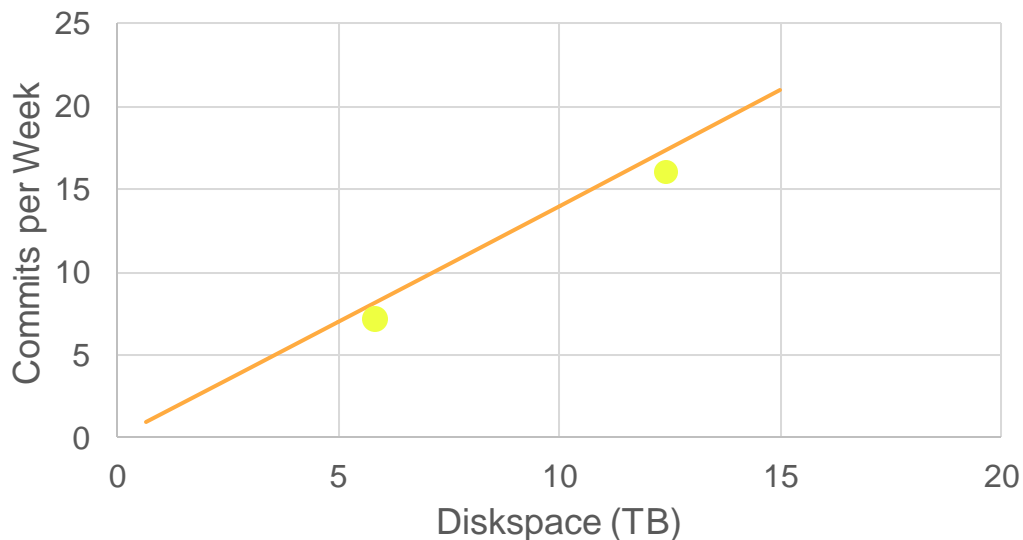


TESTING ON A PUBLIC BLOCKCHAIN – HOW CHIA WILL BE USED IN THE CLIMATE WAREHOUSE



Participants can opt to farm their own XCH by using the same node they use to run the Climate Warehouse. Participants will need to allocate adequate disk space to generate Chia plots. The below graph shows how much disk space (X) will yield how many weekly commits (Y).

Farming XCH for Climate Warehouse Commits



Key Insights:

A 5tb drive, which is currently priced at ~\$100 USD, yields enough XCH to enable daily commits to the Climate Warehouse.

A 10tb drive, currently priced at ~\$180 USD, yields enough XCH to enable twice daily commits.

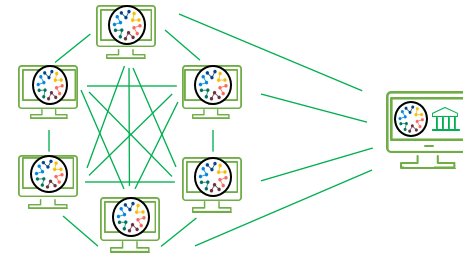
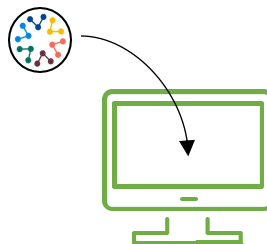
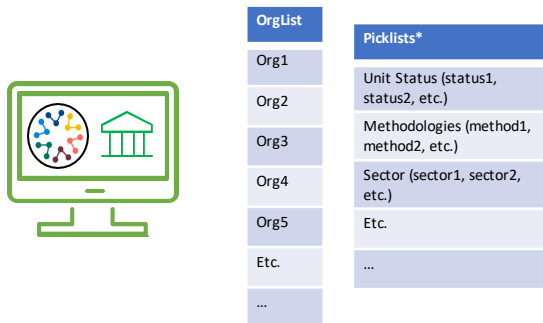
With a small one-time expense, participants can engage with the Climate Warehouse almost indefinitely.

Assumptions:

1. Current fee for CW transaction remains sufficient (.000001 XCH)
2. Pool fees remain approximately the same (1%)
3. Total space allocated to Chia farming stays approximately the same

Climate Warehouse Governance Node

Explainer: Climate Warehouse Governance Node



The *Governance Node* of the Climate Warehouse is the node that controls two tables in the DataLayer that all other participating nodes will use:

Organization List – this table lists the default set of organizations (sovereign registries and independent standards) to which each new node in the Climate Warehouse will automatically subscribe.

Pick Lists – this table lists the set of valid options for certain fields in the Climate Warehouse. This is meant to help standardize the data that is shown in the Climate Warehouse.

Note: some fields allow users to manually enter an option not listed in a picklist

When a new node downloads and installs the Climate Warehouse, it automatically subscribes to the tables provided by the governance node.

Subscribing to the tables downloads a copy of that data to the local computer and then keeps the local copy current with any changes made by the publisher of that data table.

Additionally, subscribing to a table also downloads the entire audit history for that table.

The participants then also subscribe to the tables published by all the organizations listed in the governance node's organization table.

Each participant can choose to unsubscribe from any organization and may subscribe to organizations not on the list provided by the governance node.

Users of each node then view and audit all of the data to which their node is subscribed.

Governance Node – Full Set of Picklists

Picklists
Registries
Project Sectors
Project Types
Covered by NDC
NDC Status
Unit Metrics
Methodologies
Validation Bodies
Countries
Project Rating Types
Unit Types
Unit Statuses
Corresponding Adjustment Declarations
Corresponding Adjustment Statuses
Label Types

Double Counting Measures

There are multiple types of Double Counting risks present in carbon markets.

Double counting risks have always existed within the carbon markets. Market mechanisms and independent standards have measures to detect and avoid double counting within and outside their project and unit registries.

The Climate Warehouse, as a meta-data layer, provides new methods to detect instances of double counting and reduce double counting risks.

Main types of Double Counting:

Double Issuance

More than one unit is issued for the same reductions/removals, e.g. a project is registered in more than one mechanism/standard and pursues issuance in both.

Double Use

The same unit is counted more than once, e.g. a unit is sold to another party and also retired/canceled for reporting purposes (carbon neutrality, compliance, etc.)

Double Claiming

The same Reduction/removals is claimed by more than one party, e.g. by the host country and the project developer.

The Climate Warehouse has built-in a sample method to screen against Double Issuance.

- The Climate Warehouse acts as a meta-data layer bringing together project and unit information across different registries.
- Under the Paris Agreement, Parties will each need to report progress towards meeting their NDC and details on any Cooperative Approaches engaged in with other Parties.
- There is an opportunity for 3rd party organizations to use the data in the Climate Warehouse to develop new, innovative methods to detect instances of double counting, flag units or projects with higher or lower double counting risks, and overall increase the transparency and efficiency of the market.
- The in-built demonstration of screening against double counting focuses on flagging potential for occurrence of Double Issuance.
- A simple algorithm is detailed on the next slide showing the process of the double issuance screening.
- The algorithm will flag the risk of a unit for Double Issuance, not actual Double Issuance occurrences, and display flagged units in the UI.

Test Algorithm for Double Issuance Screening

A simple algorithm was developed to flag potential for double issuance risk for units in the Climate Warehouse.

The algorithm to detect Double Issuance is shown below. Units that meet each of the criteria below are flagged as having the potential for Double Issuance risk. This will be shown in a dedicated User Interface in the Climate Warehouse.

1. Screen for Units issued during the same time period

The algorithm initially detects units issued during for same time period. This is defined as any Units with a monitoring period that overlaps by even one day to ensure all potential instances are detected.

2. Screen for Issued Units from Projects in the same Sector

The algorithm uses sector as the next criteria, and while this is very broad, it avoids missing double issuance cases from different methodologies covering the same project type.

The 3rd step covers further screens units from the same sector by geographic area. This is initially defined as the same country for the project from which issuance occurred, as more detailed geographic information is not guaranteed for each project.

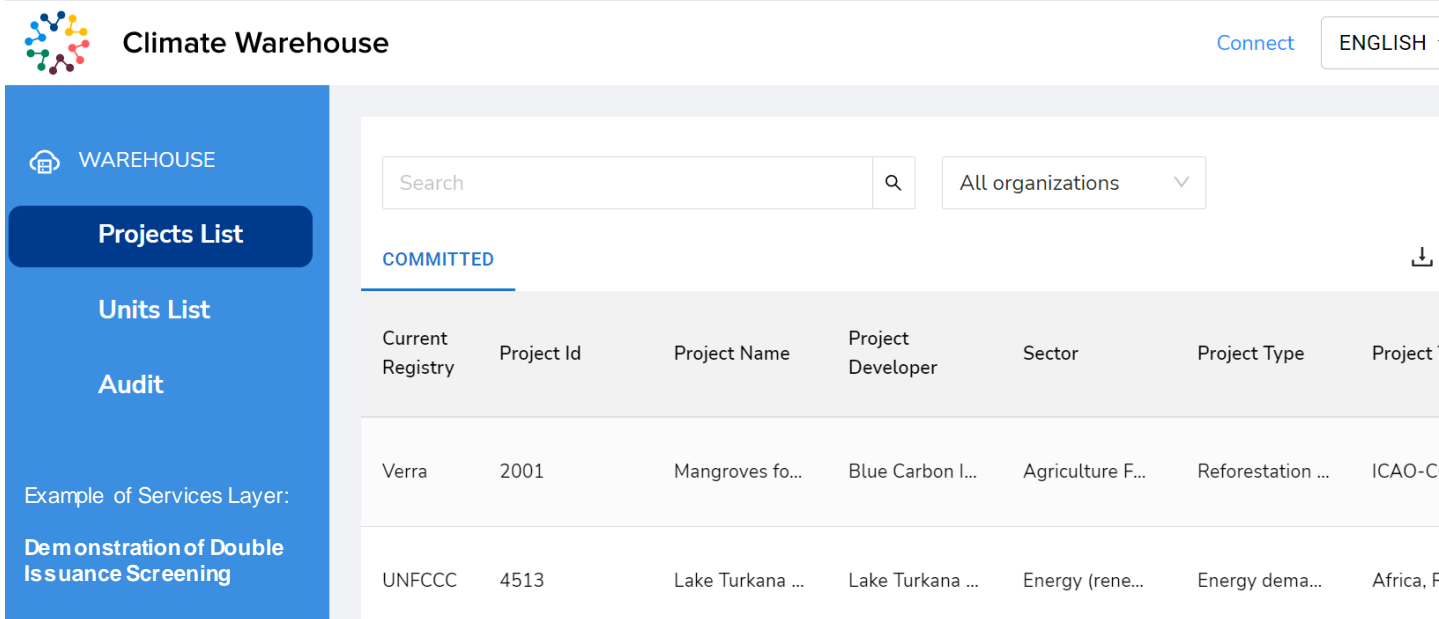
3. Further screen for Units in the same geographic area

The final step is to remove any units flagged in the earlier steps that are issued by the same registry. This is because the registries have internal mechanisms to detect doubled issuance and the focus of the algorithm is to screen across registries.

4. Further screen for Units issued from different registries

How Double Issuance is shown in the Observer Node

- The Climate Warehouse is an open shared data repository that reflects data and transfers from registries using a standardized data model. Once the CW is operational, public and private sector market players can provide services leveraging the data in the Climate Warehouse.
- For example, market players can define the criteria and design the algorithm to identify double conflict instances. For testing purposes, we have included a demonstration of double issuance in the user interface/auxiliary application of the Climate Warehouse prototype



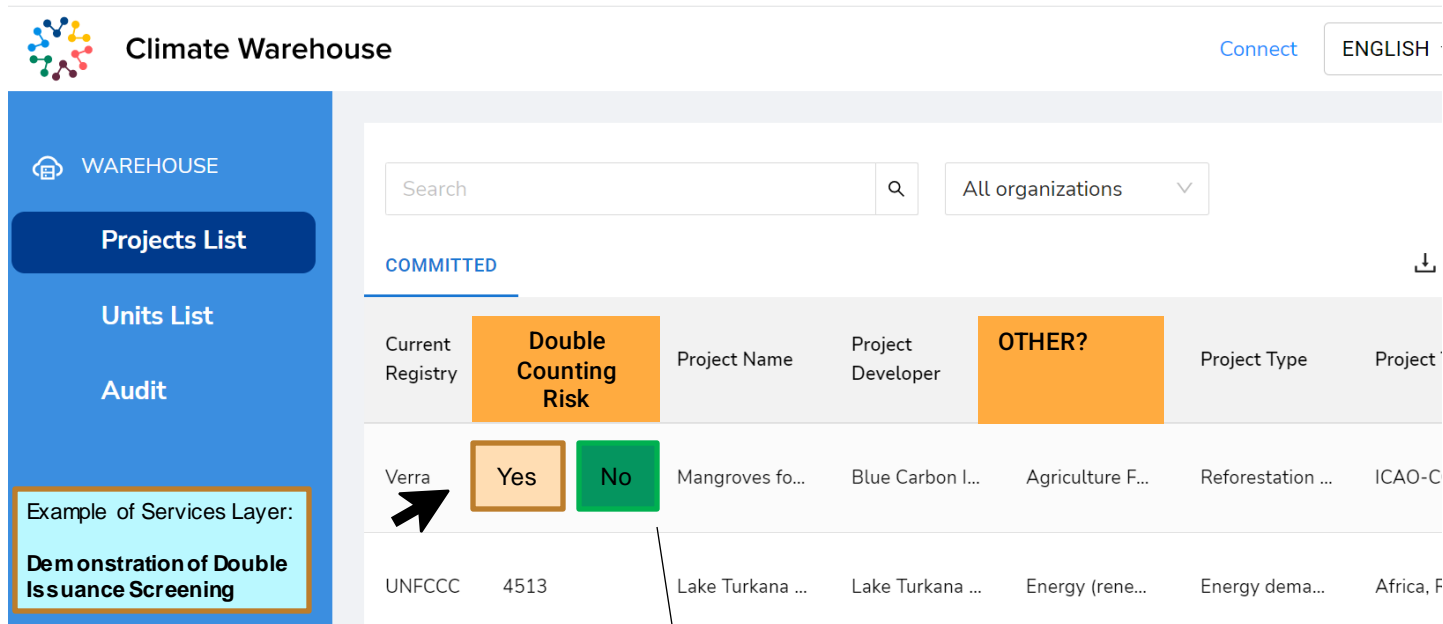
The screenshot displays the Climate Warehouse web application. On the left is a blue sidebar with navigation links: WAREHOUSE, Projects List (highlighted), Units List, Audit, and a section for 'Example of Services Layer: Demonstration of Double Issuance Screening' indicated by an arrow. The main content area features a search bar, a dropdown for 'All organizations', and a 'COMMITTED' filter. Below this is a table with columns: Current Registry, Project Id, Project Name, Project Developer, Sector, Project Type, and Project. Two rows of data are visible.

Current Registry	Project Id	Project Name	Project Developer	Sector	Project Type	Project
Verra	2001	Mangroves fo...	Blue Carbon I...	Agriculture F...	Reforestation ...	ICAO-C
UNFCCC	4513	Lake Turkana ...	Lake Turkana ...	Energy (rene...	Energy dema...	Africa, F

How Double Issuance is shown in the Observer Node

Add a pop-up note on the criteria used to flag this instance:

- For testing purposes, we have included a demonstration of double issuance in the user interface/auxiliary application of the Climate Warehouse prototype. The following criteria has been used to design the algorithm for this instance: Monitoring Period, Project Sector, Project Location, Unit Registry.



The screenshot shows the Climate Warehouse interface. On the left is a blue sidebar with the 'Climate Warehouse' logo and navigation links: 'WAREHOUSE', 'Projects List' (highlighted), 'Units List', and 'Audit'. Below the sidebar is a light blue box with the text 'Example of Services Layer: Demonstration of Double Issuance Screening'. The main content area has a header with 'Connect' and 'ENGLISH' buttons. Below the header is a search bar and a dropdown menu for 'All organizations'. A table titled 'COMMITTED' displays project data. The table has columns: 'Current Registry', 'Double Counting Risk', 'Project Name', 'Project Developer', 'OTHER?', 'Project Type', and 'Project'. The first row shows 'Verra' in the 'Current Registry' column, 'Yes' in the 'Double Counting Risk' column, and 'Mangroves fo...' in the 'Project Name' column. The second row shows 'UNFCCC' in the 'Current Registry' column, '4513' in the 'Double Counting Risk' column, and 'Lake Turkana ...' in the 'Project Name' column. A black arrow points to the 'Yes' button in the first row. A line connects the 'Yes' button to a text box at the bottom right.

Current Registry	Double Counting Risk	Project Name	Project Developer	OTHER?	Project Type	Project
Verra	Yes	Mangroves fo...	Blue Carbon I...	Agriculture F...	Reforestation ...	ICAO-C
UNFCCC	4513	Lake Turkana ...	Lake Turkana ...	Energy (rene...	Energy dema...	Africa, F

The yes/no is clickable and take you to a list of projects that the algorithm found that match the criteria for this project

Information on Chia Network

Open Source, Low Cost and Inclusive

- Open source and provided as public good
- Low hardware and low bandwidth requirements
- No commercial software licenses required
- Local installation with cloud deployment option

Secure Public Blockchain:

- New Nakamoto consensus: Proof of Space & Time
- Sustainable: Very low energy use & very low e-waste
- Cost-effective: No / low transaction fees
- Compliant: Not a security and complies with US Law

Integrated, Connected and Accessible

- Available user interface for direct access
- Fully localizable user interface
- Native integration with open-source National registry system being developed by Chia and Costa Rica

Sovereign Participants, Public Observers

- Permissionless publicly viewable / auditable data
- Permissioned write functionality to protect tables
- Versatile data entry, export & reporting
- Data model built to be easily upgraded or revised



Interconnected Autonomy

Each member government or standards registry owns their node and their data. There is no central server, no proprietary software or environments required, and no dependencies on foreign or private entities. All code is free and open source.

Easy to Use

It is easy to run a node on low-cost hardware, with limited Internet connection.

There are multiple ways to upload or sync data from a registry into the Climate Warehouse.

Intuitive interface for basic data access and update

Enables and Activates Service Layer

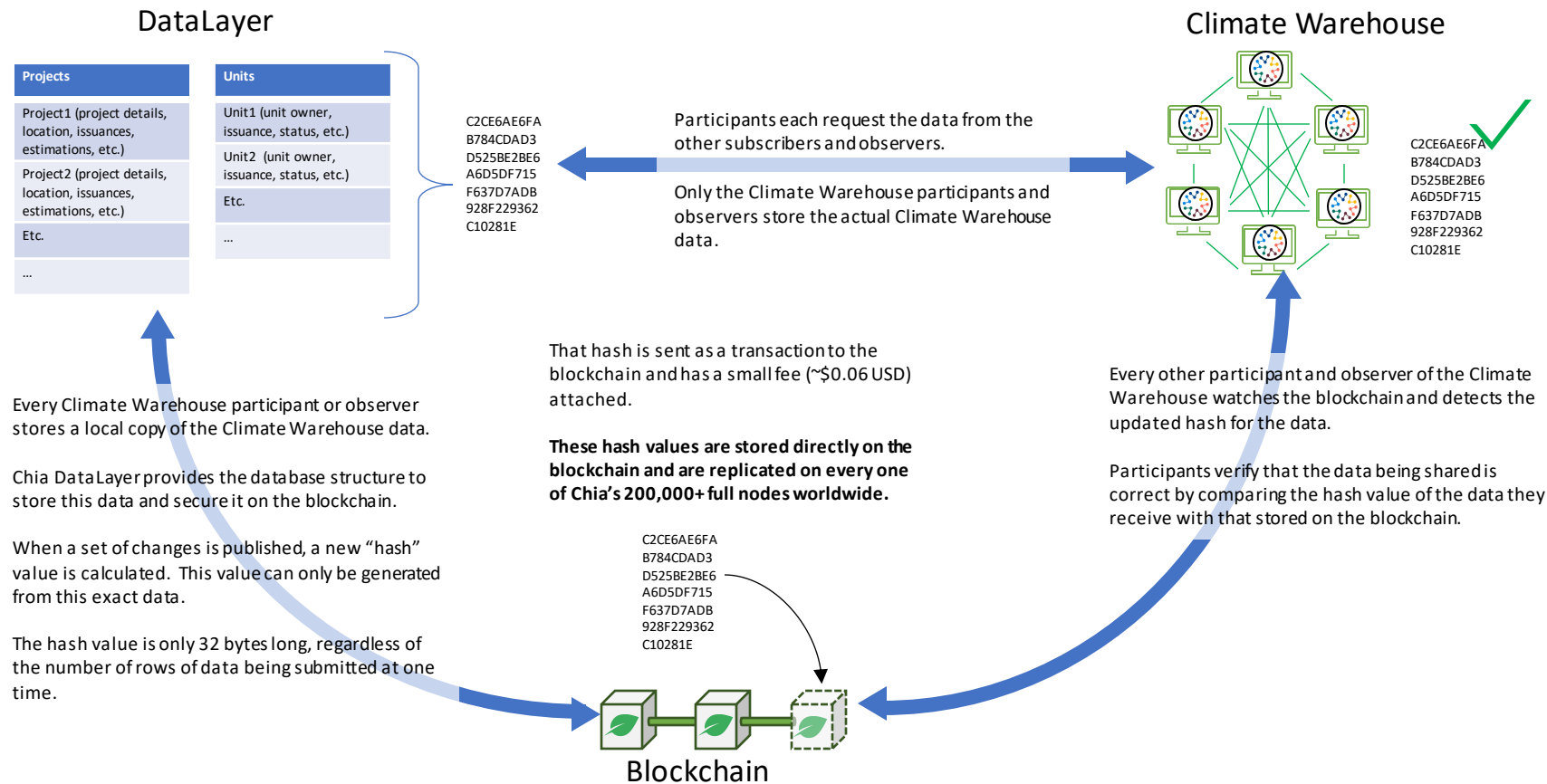
The data is stored with the blockchain and is accessible through an API. Any data analytics tool can be used to aggregate, report and visualize the data.

Secure

The data is protected by the global 250,000 node Chia public blockchain.

Each table of data has separate security settings for read and write so that only permissioned users can add or update the data in that table.

Climate Warehouse Data – What is Actually Stored on the Chia Blockchain?



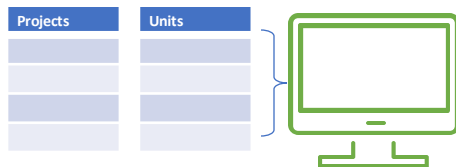
Climate Warehouse Data – Lifecycle

User Action: Create Organization

Local Computer response: Creates an organization record that stores name & logo and creates a blank table to store project data and a blank table to store unit data.

Stored on Chia Blockchain: a hash that represents the name/logo submitted in the create transaction, as well as the two blank tables that were created

Other Participants & Observers: none



cc68916756
bc37286aa2
34be20eafd
dd7f48e4d8
79e9d5227f
88d77f250d
dc6c

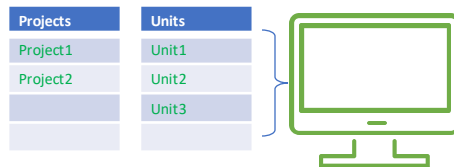


User Action: Add Project(s) and/or Unit(s)

Local Computer response: Updates the Project table with new records and/or updates the units table with new records

Stored on Chia Blockchain: a hash that represents the updates made to the tables

Other Participants & Observers: detect on-chain hash updates and request the new data from peers. Data received is verified based on the hash.



6ff00abeea2
99080dc2f1
9e116002af
2f3e43a30c
eb92388a9d
e7db839a16
ba9

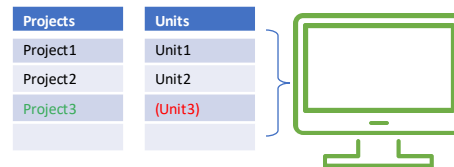


User Action: Edit Project(s) and/or Unit(s)

Local Computer response: Updates the Project table with the edits made and/or updates the units table with the edits made

Stored on Chia Blockchain: a hash that represents the edits that were made to existing records on the table

Other Participants & Observers: detect on-chain hash updates and request the new data from peers. Data received is verified based on the hash.



17e74d862f
cbd077343d
95c848551c
a440699cf8
3cff8765aa9
0997f14502
81b



- The World Bank invited a consortium of carbon leaders, tech leaders, and blockchain experts to conduct a technical assessment of Chia blockchain technology to test it in the Climate Warehouse
- Experts were given access and time to examine all of Chia's code and files. The [Chia's Climate Warehouse Whitepaper](#) was compiled to elaborate on the application of Chia blockchain as the foundational technology for the Climate Warehouse
- An expert panel of 20+ reviewers submitted oral & written questions to Chia. In the final meeting, the reviewers met and clarified any outstanding issues with Chia's management team including founder Bram Cohen.
- All questions and issues were addressed and updated in the [Chia's Climate Warehouse whitepaper](#):
 - Questions spanned a variety of viewpoints including technical, economic, sustainability, functionality, accessibility, and legal/regulatory,
 - Data was provided to support and explain claims made by the whitepaper

Participating Organizations:

1. Amazon
2. Microsoft
3. Google
4. Open Earth Foundation
5. Climate Ledger Initiative
6. UNFCCC/ITL
7. World Bank Innovation / Blockchain Lab
8. World Bank ITSFI - Architects for Simulation II
9. Forest Carbon Partnership Facility
10. WB Carbon Asset Tracking System (CATS)
11. The International Finance Corporation (IFC)
12. Stranger labs
13. IWA
14. Web3labs
15. SBK Tech Ventures
16. Global Mangrove Trust
17. SHEQONOMI
18. EU Blockchain Observatory and Forum
19. Climate Chain Coalition (CCC)

Q: Why was it important to use a public blockchain instead of a private blockchain?

A: Public blockchain is within the spirit of the Paris Agreement's decentralized bottom-up approach. It does not rely on the trust of any central authority, including the company managing the chain. It is a truly decentralized tool that democratizes access and cannot be manipulated by any authority or owner.

Q: More validators (nodes) on a blockchain network make it more decentralized and secure. Are there adequate incentives to ensure Chia's 200,000+ validators continue? Have there been any reductions in the hype leading to a decrease in validators?

A: Chia's Proof of Space & Time consensus mechanism rewards the storage ecosystem effectively and incentivizes validators. If validators start to leave the Chia ecosystem, that creates a higher rate of return for new validators allocating storage to Chia and thus incentivizes more validators to add space to the network.

Q: Carbon offset project data is often very high volume. Is this costly? Are all participants expected to store all the data in order to participate with the Climate Warehouse?

A: Chia's blockchain was designed to be simple, extremely resource-efficient and functional. Chia's unique Data Layer is a decentralized database that is calculable on-chain and secured by Chia's entire network. The Climate Warehouse Data Model is limited to critical fields to ensure fast and ultra-low-cost datasync on blockchain. Although uniquely "calculable on-chain" the blockchain only stores proofs (hashes) of the transactional data, so each node is not required to store every other node's data, but rather proofs that the other nodes' data are all provable, calculable, and correct.

Q: What are transaction fee projections? How are the projections calculated?

A: Settling transactions on the blockchain can incur a fee when block-space is limited. This fee to secure block-space accrues to validators (nodes), not to Chia. Today blocks are below capacity, so no fees are charged and there is enough excess capacity that the Chia Network does not expect fees of even 1 US cent to be required for a long time to come. Although the Chia Network cannot control when small fees could be required, Chia has been developed to easily add layer 2 functionality that would exponentially increase Chia's data capacity while still executing all smart contracts.

Q: How is Chia addressing the complications other blockchains are having in terms of regulatory problems?

A: Chia is recognized as one of a few blockchains that never did an Initial Coin Offering (ICO) and is not at risk of being classified as an illegal security. Chia Network has never sold XCH, the currency associated with the Chia blockchain, ensuring that the token cannot be considered a security in the company. In order to assure long-term regulatory compliance, the Chia Network intends to become a publicly-traded company on an accelerated timeline with all of the board and shareholder oversight that entails.