

DRAFT document – latest version as of June 6<sup>th</sup>, 2022





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

**OVERVIEW** 

# 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.



REGISTRY



REGISTRY





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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.





# **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

# 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)

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.





# EXPECTED IT REQUIREMENTS FROM PARTICIPANTS

# 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

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#### 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

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# AUX APP REQUIREMENTS



#### STANDARD WINDOWS/MAC APP

The Aux App runs as an 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 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: <u>Climate</u> <u>Warehouse Github Repo</u>



#### **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 svnc







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





**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

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.

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.

# 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

# Spreadsheet Import/Export – Testing the spreadsheet 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.







# DATA MODEL

# **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**

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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.





WORLD BANK GROUP

# 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.

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Projects Units **Related Projects** Warehouse Project ID\* (PK) Warehouse Project ID\* (FK) Warehouse Project ID\* (F Issuance ID\* (FK) Current Registry\* Related Project ID (PK) Warehouse Unit ID\* (PK) Governance (ref)  $\infty$ Project Location ID\* (PK) Unit Issuance Location\* Project ID\* **Relationship Type** Country\* (FK to project loc ID) Registry values Registry of Origin\* Registry Label ID\* (FK) In-Country Region **Project Sector values** Program Related Project Note Unit Owner\* **Geographic Identifier\* Project Status values** Project Name\* Country Jurisdiction of Owner\* City **Project Rating** Issuances Unit Metric values Project Link\* On-Country Jurisdiction of Street Address Project Developer\* Warehouse Project ID\* (FK) Validation Body values Warehouse Project ID\* (FK) Öwner Zip Code Project Rating ID\* (PK) Issuance ID\* (PK) Country values Sector\*  $\infty$ Issuance Start Date\* Rating Type values Rating Type\* Project Type\*  $\infty$ Issuance End Date\* Unit Count\* Unit Type values **Rating Range Lowest\*** Project Tags Vintage Year\* Unit Status values Covered by NDC\* Verification Approach\* Rating Range Highest\* Unit Transaction Type Unit Type\*  $\infty$ Verification Report Date\* Rating\* Key: values Marketplace Corresponding No change Rating Link\* Project Status\* Verification Body\* Marketplace Link Adjustment Declaration New field Project Status Date\* values Marketplace Identifier Changed Co-Benefits Labels Corresponding Unit Metric\* name Unit Tags Adjustment Status Warehouse Project ID\* (FK) Warehouse Project ID\* (FK) Removed Methodology\* values Unit Status\* Co-Benefit ID (PK) Label ID (PK) Related Project  $\infty$ Methodology Version Unit Status Reason Fields with an \* are Relationship type  $\infty$ Co-Benefit Label Type\* Unit Registry Link\* Validation Approach values required form fields Label\* **Corresponding Adjustment** Label Type values Validation Body Estimations Declaration\* Verification Body Crediting Period Start Date\* Validation Date **Corresponding Adjustment** values Warehouse Project ID\* (FK) Crediting Period End Date\* Status\* EstAvgAnnEmmissions Estimations ID\* (PK) Validity Start Date\* Transaction Type  $\infty$ Reductions Crediting Period Start\* Validity End Date\* **Transaction Hash Project Description** Crediting Period End\* Unit Quantity\* Unit Count\* Label Link\* 00 Climate WORLD BANK GROUP Warehouse

# Local Deployment



Chia Blockchain





- 1) Download Chia select the link below corresponding to your OS
  - 1) Windows: <u>https://download.chia.net/dev/ChiaSetup-1.3.4698-b4e6064b.exe</u>
  - 2) Mac (Apple chip): <u>https://download.chia.net/dev/Chia-1.3.4.dev698-b4e6064b-arm64.dmg</u>
  - 3) Mac (Intel chip): <u>https://download.chia.net/dev/Chia-1.3.4.dev698-b4e6064b.dmg</u>
- 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)
  - 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 <u>https://github.com/Chia-Network/climate-warehouse/releases/</u> select the latest release and the version for your OS
  - I) Unzip the package and place it into a new folder you create called 'app'
- 6) Download Aux App <u>https://github.com/Chia-Network/climate-warehouse-ui/releases/</u> 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

# CLI Commands: Full Node Synced



# Running Climate Warehouse:



# Running Aux App:

Climate Wareh	ouse									Connect	ENGLISH -
WAREHOUSE	Search			Q, All organizat	ions 🗸						
Projects List	COMMITTED										Ł
Units List	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 Electrifica	Energy distrib	Energy dema		Inside NDC	Registered	tCO2e	TÜV Nord Cer
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	Verra	2458	Guoluo Grass	Qinghai GuangL	Agriculture F	Improved For		Unknown	Registered	tCO2e	TÜV Nord Cer
	UNFCCC	6055	Teesta Stage	Lanco Teesta Hy	Energy (rene	Energy dema		Outside NDC	Registered	tCO2e	EPIC Sustaina



# SYSTEM ARCHITECTURE

# **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 <u>https://app.climatewarehouse.chia.net/</u>
- 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

Climate Warehou	use										Connect	ENGLISH -
WAREHOUSE Projects List	Search			Q All organiz	zations V							Ŀ
Units List	Current Registry	Project Id	Project Name	Project Developer	Sector	Project Type		Project Tags	Covered By NDC	Project Status	Unit Metric	Validation Body
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					Cancel	Connect						
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# **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 <u>Github</u>.

orga	nizat	ions	
Function	ality: Use	GET, POST, and PUT to list, create, and update organizations	
GET Opti	ions: None		
GET Ex	amples		
List all s	ubscribed	lorganizations	
// Req curl -	uest —location	1request GET 'localhost:31310/v1/organizations'hea	der 'Content-Type: application/json'
	7641db780 "orgUid "name": "icon": "isHome "subscr	adc6c74f1ff357804c26a799c4a09157f426aac588963a39bdb2d9 """"7641bb780adc6c74f1ff357804c26a799c4a09157f426aac588 "org Test", "https://climate-warehouse.s3.us-west-2.amazonaws.com/f "!true, ibed":true	:{ 963a39bdb2d9", ublic/orgs/me.svg",
POST Op	otions:		
Key	Туре	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 <u>here</u> to find API collections. Download them into your local or hosted instance and upload the JSON files into postman.

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			S Working locally in Scratch Pad. Switch	to a Workspace				
Scratch Pad	New Import	Overview	chia-localhost OET GET Project	s No Query P: CET GET Projects 7xls+true	Projects API	+	chia-localhost	~
Collections	+ = + · · · · · · · · · · · · · · · · ·	Projects API / GET Projects No	Query Params				🖺 Save 👻 🖬	. / .
8	<ul> <li>Projects API</li> </ul>	GET ~ ((default))/	projects					Send ~
e.	OET GET Projects No Query Params OET GET Projects ?search Query Param OET GET Projects ?search Query Param	Params Authorization Hea	ders (7) Body Pre-request Script	Tests Settings				Cookies
-	GET Projects ?page&limit Query Param	KEY	v	ALUE		DESCRIPTION		eee Bulk Edit
tock Servers	OET GET Projects ?page&limit&orgUid Query Param	Key	v	lalue		Description		
	POST POST Projects with REQUIRED params							
	PUT POST Projects batch - create projects PUT PUT Projects program, sector DR. DELETE Projects							
	PUT POST Projects batch - oreate projects PUT Projects program, sector UL DERLTE Projects > Staging API > Units API	Body Cookles Headers (10)	Test Results		0	Status: 200 OK Time:	79 ms Size: 5.85 KB	Save Response ~
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# **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.

Climate Wareh	puse	Connect ENGLISH -
	Organization Information	С
	Org UID         48d4176x820x077r27cx847x38x2r5225776d1051a59xx27fe175724xeb0b1x631           Public Address         Organization Subscriptions         X	
My Units ft ORGANIZATION My Organization	Address QR Code Address QR Code Code Code Code Code Code Code Code	





# 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 AUXILLIARY APP:

#### **Project Functions:**

- Add or edit project information, including related projects and rating ٠ information
- Change the status of a project
- Add labels, authorizations or other types of gualifications to a ٠ project
- Create new issuances for a project
- Full text search on all Projects fields



#### Unit Functions:

- Issue units to the project
- Edit unit information, including status information for unit blocks ٠
- Assign labels, authorizations or other types of gualifications 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:

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





# **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.

# 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.

Climate Wareho	use									Connect	ENGLISH ¥
WAREHOUSE Projects List	Search COMMITTED			Q. All organizat	tions V						Ł
Units List	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 Electrifica	Energy distrib	Energy dema		Inside NDC	Registered	tCO2e	TÜV Nord Cer
	Verra	2458	Guoluo Grass	Qinghai GuangL	Agriculture F	Improved For	-	Unknown	Registered	tCO2e	TÜV Nord Cer
	UNFCCC	6055	Teesta Stage	Lanco Teesta Hy	Energy (rene	Energy dema		Outside NDC	Registered	tCO2e	EPIC Sustaina
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# 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

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WAREHOUSE     Projects List	DE	MD Registry V		123>	Org UID: b8c1172b10d710706241e66cd55bb1511009ced347bbab0e37101692e74edd
Units List		Table	Timestamp Ol	Туре	Root Hash
Audit	٩	issuances	2022-03-13 08:06:05	INSERT	0x1035c7e4e5d8bb023b181795298ab5a9185549d99209821f98105989a3e8799e
Decistory	٩	issuances	2022-03-13 08:06:05	DELETE	0x1035c7e4e5d8bb023b181795298ab5a9185549d99209821f98105989a3e8799e
My Projects	٩	projectLocations	2022-03-13 07:56:53	INSERT	0x1e9d5d669780bd6ea9bd2522d0690004246831d0316943dec30c895624c03c63
My Units	٩	issuances	2022-03-13 07:56:53	INSERT	0x1e9d5d669780bd6ea9bd2522dd690004246831d0316943dec30c895624c03c63
	٩	projectLocations	2022-03-13 07:56:53	DELETE	0x1e9d5d669780bd6ex9bd2522d0690004246831d0316943dec30c895624c03c63
ORGANIZATION	٩	project	2022-03-13 07:56:53	INSERT	0x1e9d5d669780bd6ex9bd2522dd690004246831d0316943dec30c895624c03c63
My Organization	٩	project	2022-03-13 07:56:53	DELETE	0x1e9d5d669780bd6ea9bd2522d0690004246831d0316943dec30c895624c03c63
	Q	issuances	2022-03-13 07:56:53	DELETE	0x1e9d5d669780bd6ea9bd2522d0690004246831d0316943dec30c895624c03c63
	Q	projectLocations	2022-03-13 07:53:03	INSERT	0x09ab243458d4a15f9b4b448b4aa9926315443ed246d8a5a273410a345f8a11c0
	٩	project	2022-03-13 07:53:03	INSERT	0x09ab243458d4a15f9b4b448b4aa9926315443ed246d8a5a273410a345f8a11c0
	٩	project	2022-03-13 07:42:02	DELETE	0x976518726aea9a2b64b66e7bebd654deaer477bc722e2a67e11773b4696bdfe2
	Q	project	2022-03-13 07:15:48	INSERT	0xde4656c94bda937dedde7ae30b2b5e78cab06053abebe81e030b7927676f490d
	٩	project	2022-03-13 07:15:48	INSERT	0xde4656c94bda937dedde7ae30b2b5e78cab06053abebe81e030b7927676f490d
v0.1.23					

# **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.

an.			
fable ssuances	Timestamp 2022-03-13 07:56:53	Type INSERT	
Root Hash bx1e9d5d669780bd6ea9bd2522d069000424683 dd0316943dec30c895624c03c63			
End Date	Start Date	Verification Approach	
020-12-31122:09:50:0002	2016-06-21103:09:34:0002	Details located on website	
/erification Body	Verification Report Date	ld	
FÜV Nord Cert GmbH	2021-06-22T02:10:35.000Z	deb372c3-2f18-4e55-9c45-a1a349c30a30	
Drg Uid	Warehouse Project Id	Project Id	
a8c11f2b10d710706241e66cd55bb151f009ced34		12d2a74d.9aa4.40(0.babb.122402d(22af	
ht	1,203a/40-8ae4-4019-bebb-1,234920132at	770391 40-0864-4012-0800-75343591359	
Rt	12038740-5864-40/9-5606-123492035287	Trans in one of the second sec	
fk fable Suarces Sources	1.038/48-5864-409-5606-1.239203287 Timestamp 2022-03-13 08:06:05	Tige DELETE	
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# **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.







# **USER INTERFACE & FEATURES**

# **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.

Projects	Registry A		Regist 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.



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.





# **USER INTERFACE & FEATURES**

arehouse

# **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.

WAREHOUSE	domin				٩					+ Create
Projects List	СОММІТ	TED §	STAGING (0)	PEND	ING (0) FAILED	(0)				± ±
Units List Audit	Unit Block Start	Unit Block End	Unit Count	Vintage Year	Unit Type	Marketplace	Unit Tags	Unit Status	Corresponding Adjustment Declaration	
REGISTRY	40	101	61	2021	Reduction - n			Held	Committed	-
My Projects										Edit Unit
My Units		< 1								Split Delete Unit
D ORGANIZATION										
My Organization										

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



Registry A will commit the change to the blockchain

		Connect ENGLIGH
Climate Warehous	se	Connect ENGLISH •
WAREHOUSE	Edit Unit	X
Projects List	*Country Jurisdiction Of Owner (2) *Unit Type (2)	
Units List	Djibouti $\lor$ Removal - nature	~
	*Unit Status ③	
Audit	Transferred $\vee$	
	Unit Status Reason 💿	
- REGISTRI	Unit Status Reason	
My Projects	*Unit Registry Link 💿	
My Units	abc.com	
	*Vintage Year ③	
命 ORGANIZATION	2016	
My Organization		
	-	Cancel Next
v0.1.28		

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

±±



# **USER INTERFACE & FEATURES**

# **TRANSFERS – SIMULATION SCREENSHOTS**

Climate Warehouse		Connect	ENGLISH -
warehouse     Search			Commit
Projects List COMMITTED STAGING (1) PENDING (0)	FAILED (0)		土土
Units List			
Audit	Add Unit	1	0
REGISTRY	Project Location Id	1	
My Projects	Unit Owner New Owner123		
My Units	Country Jurisdiction Of Owner Antigua and Barduba		
	In Country Jurisdiction Of Owner		
My Organization	ABC100-ABC200		
	[*/D]+[[0-9]+)+[-][* D]+[[0-9]+]S Marketplace		
	 Marketplace Link		
	 Marketplace Identifier		
	Unit Tags		
	Unit Startus Reason		
	Vintage Year 2016		
	Unit Registry Link abc.com		*****
+0.128	Unit Type		

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"

Climate Wareho	use	Connect ENGLISH -
WAREHOUSE     Projects List	Search     Q       COMMITTED     STAGING (0)       PENDING (1)     FAILED (0)	ڭ ئ
Units List Audit	Add Unit Project Location Id	



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



# 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:**

- <u>Cloud credentials stolen</u> 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. <u>Wallet credentials stolen</u> 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. <u>Internal user hacked</u> 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. <u>OSS code tampering</u> 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:**

- <u>Dust storm</u> 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
- <u>Majority attack</u> one malicious user (or group of users) controls over 51% of the blockchain storage space

# Threat

<b>1</b> 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.
<b>3</b> 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.
	Climate Warehouse. Chia node, and Chia datalver code can all be tampered with as all code is released as
<b>4</b> OSS code tampering	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.<br/>This is a possible circumstance, but one that corrects itself based on the design of Chia blockchain fees. 6 Majority attack

# **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 \*~\$.06 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.
- 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



# address.

# Step 1b:

Chia Network, Inc. reimburses the private wallet holder with an equivalent amount of fiat currency.

specific tables for a participant's organization.

units list and commits the changes. A small fee (~\$.06 USD) is attached to the commit to ensure it makes it to the blockchain quickly.

blockchain. Participant wallet balance reflects the fee paid for the transaction.

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



# Step 1:

XCH is bought through a broker, an exchange, or in a transaction from a private wallet. The transaction can be made using any currency supported by the counterparty.

Participants may also choose to set up a small Chia farm to offset transaction costs. See next slide for details.

# Step 2:

XCH is split to allow singleton IDs to track specific tables for a participant's organization.

# Step 3:

Participant makes changes to projects or units list and commits the changes. A small fee (~\$.06 USD) is attached to the commit to ensure it makes it to the blockchain quickly.

# Step 4:

Committed changes are added to the blockchain. Participant wallet balance reflects the fee paid for the transaction.

Participants can obtain more chia as needed by repeating step 1.

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 diskspace (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 (.001 XCH)
- 2. Pool fees remain approximately the same (1%)

3. Total space allocated to Chia farming stays approximately the same

Note: Farming XCH can be volatile and XCH return per TB may vary due to many factors.

# Climate Warehouse Governance Node

# **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 than 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

# **Overview of Double Counting**

# 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:





issuance in both.



# 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 3<sup>rd</sup> 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.





# 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 critera, and while this is very broad, it avoids missing double issuance cases from different methodologies covering the same project type. The 3<sup>rd</sup> 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 occured, 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

Climate Wareho	ouse					Connect	ENGLISH
Hereit Warehouse	Search			Q All	organizations	~	
Projects List	СОММІТТІ	ED					Ţ
Units List Audit	Current Registry	Project Id	Project Name	Project Developer	Sector	Project Type	Project
Example of Services Layer:	Verra	2001	Mangroves fo	Blue Carbon I	Agriculture F	Reforestation	ICAO-C
Demonstration of Double Issuance Screening	UNFCCC	4513	Lake Turkana	Lake Turkana	Energy (rene	Energy dema	Africa, F



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.



# Information on Chia Network

# **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: Chiq

- 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.

EEE

# Easy to Use

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

ĪĪ

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.

# **CHIA NETWORK**

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

DataLayer

 
 Projects
 Units

 Project (project details, location, issuances, estimations, etc.)
 Unit1 issuan Unit2 issuan issuan bocation, issuances, estimations, etc.)

 Etc.
 ...

Unit1 (unit owner, issuance, status, etc.) Unit2 (unit owner, issuance, status, etc.) Etc.

B784CDAD3 D525BE2BE6 A6D5DF715 F637D7ADB

C2CE6AE6FA

928F229362

C10281E

Participants each request the data from the other subscribers and observers.

Only the Climate Warehouse participants and observers store the actual Climate Warehouse data.

That hash is sent as a transaction to the blockchain and has a small fee (~\$0.06 USD) attached.

These hash values are stored directly on the blockchain and are replicated on every one of Chia's 200,000+ full nodes worldwide.

**Climate Warehouse** 

C2CE6AE6FA B784CDAD3 D525BE2BE6 A6D5DF715 F637D7ADB 928F229362 C10281E

Every other participant and observer of the Climate Warehouse watches the blockchain and detects the updated hash for the data.

Participants verify that the data being shared is correct by comparing the hash value of the data they receive with that stored on the blockchain.

Every Climate Warehouse participant or observer stores a local copy of the Climate Warehouse data.

Chia DataLayer provides the database structure to store this data and secure it on the blockchain.

When a set of changes is published, a new "hash" value is calculated. This value can only be generated from this exact data.

The hash value is only 32 bytes long, regardless of the number of rows of data being submitted at one time. C2CEGAE6FA B784CDAD3 D525BE2BE6 AGD5DF715 F637D7ADB 928F229362 C10281E

# **CHIA NETWORK**

# 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 Block #100 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.



#### 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.



- 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 <u>Chia's Climate Warehouse</u> <u>Whitepaper</u> 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 <u>Chia's Climate Warehouse whitepaper</u>:
  - 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.