Climate Warehouse Program: Building an End-to-End Digital Ecosystem for Carbon Markets

Digital work-flow
project preparation from document development, approval, validation to registration in applicable standards
A global public metadata layer to foster greater transparency, integrity and security in the carbon markets
CLIMATE ACTION DATA (CAD) TRUST: Overview
• Individual commitments through nationally determined contributions (NDCs). The Paris Agreement introduced a bottom-up approach for addressing climate change.

• Decentralized cooperative approaches to achieve their NDCs. This is expected to lead to heterogeneous climate markets, which may have differences in governance rules and operate under different technological systems.

• Climate Action Data Trust: a decentralized information technology approach to connect climate markets systems.

Source: Adams, Tim. Winters, Bill. Nazareth, Annette and Mark Carney Taskforce on Scaling Voluntary Carbon Markets (TSVCM)
Climate Action Data Trust – Value Proposition

**Climate Action Data Trust**
Climate Warehouse
Digital Ecosystem

- **An open-shared infrastructure**

**Global public good that aims to empower a new global carbon market infrastructure.** Metadata platform that aims to link, aggregate and harmonize underlying registry data to enable transparent accounting as per Article 6.

**Designed as an open shared infrastructure** with a common taxonomy of data that facilitates connection and communication between entities enabled by blockchain technology.

**Registry service providers and countries** share data to the platform and **public and private sector market players** can host a node and build out the service layer.

**Provide visibility into corresponding adjustment procedures and the lifecycle of carbon offsets** from issuances to retirement, which will safeguard against double counting and ease reporting requirements.
<table>
<thead>
<tr>
<th>Stakeholder type</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governments</td>
<td>• Increases visibility and credibility of a country’s climate activities&lt;br&gt;• View MOs to potentially purchase&lt;br&gt;• Promotes new project activity&lt;br&gt;• Can increase market participation of private sector&lt;br&gt;• Can provide an aggregate view of projects within their jurisdiction, ability to identify duplicative projects&lt;br&gt;• Increases accountability</td>
</tr>
<tr>
<td>Independent Standards</td>
<td>• Reduces burden on monitoring external systems for due diligence processes because of the ease of aggregating information together&lt;br&gt;• Facilitates trust and transparency between systems</td>
</tr>
<tr>
<td>UNFCCC</td>
<td>• Aggregate reporting</td>
</tr>
<tr>
<td>Exchanges</td>
<td>• Decreases market fragmentation and eases integration&lt;br&gt;• Promotes standardization and asset integrity&lt;br&gt;• Adds information security to the data needed from registries for transactions&lt;br&gt;• Increases volume of standard asset types</td>
</tr>
<tr>
<td>Project Developers</td>
<td>• Building trust in the accounting of MOs will enable transparency and trade, benefiting project developers</td>
</tr>
<tr>
<td>Verification Bodies</td>
<td>• Access to aggregated information, ability to audit transactions and changes to data</td>
</tr>
<tr>
<td>Buyers and Traders</td>
<td>• Aggregated trustworthy data to search through. Easier access to project developer information</td>
</tr>
</tbody>
</table>
CLIMATE ACTION DATA (CAD) TRUST: Data Ecosystem
Climate Action Data Trust in the Data Ecosystem

**DATA SOURCES**

- National Statistics
- Companies
- Facilities
- Programs
- Projects
- Policies

**DATA USES**

- International Reporting
- National, Subnational Reporting
- Policy Compliance (e.g., Tax, ETS)
- UNFCCC Reporting
- Market Information
- Due Diligence Checks and Auditing

**MEASURE/CALCULATION**

- Independent Standard Registry
  - Records carbon units for market mechanism and results-based payments

**AGGREGATION AND ACCOUNTING**

- Market Infrastructures (e.g., Trading Platforms)
  - Due Diligence Checks (Read only)

**REPORTING, COMMUNICATION & ANALYSIS**

- Climate Action Data Trust
  - Shared Open Metadata Repository for climate activities, authorizations, units and transactions

- Country Data Management Systems
  - Records information on policy/program/project activities, carbon units, and additional information (e.g., safeguards, data on other air pollutants)

- GHG Inventories
  - Record physical GHG emissions and removals
    - National/Subnational Levels
    - Program/Project Levels
Building a public good data layer

- Designed as an open shared infrastructure layer
- Common taxonomy of data facilitates communication between entities
- Registry service providers and countries share data to the Climate Action Data Trust (CADT)
- Public and private sector market players can host a node and build out the service layer
CLIMATE ACTION DATA (CAD) TRUST: Overview of Testing and Simulation Activities
Timeline of WB Testing Activities

Product development, Stakeholder participation and Governance model

- **August 2019**: Simulation I
- **November 2019**: Simulation II
- **January 2022**: Simulation III
- **July 2022**:
Phased Approach Participation in Simulation III

**Phase I**

**Group 1 (Internal testing)**
- World Bank Carbon Assets Tracking System
- World Bank Carbon Markets and Innovation Unit

**Observers:**
- International Emissions Trading Association
- Open Earth Foundation

**March – April 2022**

**Phase II**

**Group 2**
- Chile
- Japan
- Singapore
- Sweden
- Switzerland
- IHS Markit
- Verra
- Climate Action Reserve
- American Carbon Registry
- Gold Standard
- Global Carbon Council

**Observers:**
- Spain
- UNFCCC
- EBRD
- UNDP

**April – May 2022**

**Phase III**

**Group 3**
- Rwanda
- Senegal
- Peru
- Uganda
- United Kingdom
- EcoRegistry Columbia
- GenZero
- IFC
- SK Certification Center

**Observers:**
- Climate Ledger Initiative
- ClimateCheck

**May – July 2022**

**Phase IV**

**Feedback consolidation and documentation**

**Capture feedback in six tools:**
- Test scripts
- Feedback notes
- Feedback survey
- Feedback tracker
- Action items tracker
- Participant & feedback profiles

**Produce documentation:**
- Simulation III final report
- Transition plan
- Simulation III onboarding package

**July - August 2022**
Key Results of Simulation III

Platform

- Developed operational prototype as a global public good that aims to empower a new global carbon market infrastructure through a decentralized information technology platform built on blockchain technology.
- Designed as an open shared infrastructure with a common taxonomy of data that facilitates connection and communication between entities and secured on blockchain technology.
- Registry service providers and countries share data to the CADT and public and private sector market players can host a node and build out the service layer.

Testing activities

- 75 individual testers
- 11 governments
- 58 testing sessions
- 30 kick-off and onboarding meetings
- 30 participating organizations
- 40 weekly office hour sessions
- 14 individual points of feedback, which helped identify 156 development actions, 139 of which were implemented during Simulation III and reflected in the final version of the operational prototype at the end of the simulation.

Governance

- Implemented the recommendations from the governance consultations on the operational CADT conducted by IETA and the Government of Singapore:
  - Conducted fundraising
  - Formation of governing bodies
  - Set up independent legal entity anchored in Singapore

Key lessons learned and a complete log of all participant feedback shared with the governing body of the operational CAD Trust at the end of Simulation III in August 2022 (Climate Warehouse Simulation III – Final Report)
### Simulation III scope

- Sim III pushes participants to envision an interconnected ecosystem, beyond their own standalone system.
- Data added to the CADT must be able to bridge process flows across participants.
- Participants must validate the Climate Action Data Trust’s level of data granularity, status information and units transfer methodology.

### Benefits & Feedback

#### Benefits
- Increased transparency and data sharing
- Addressing double counting risks across registries
- Identifying a common data model
- Interaction with experts across registries
- Ability to access information outside of their own systems

#### Feedback
- Difficulty defining minimum standards needed to link registries
- IT complexity, upgrades to existing systems, building integration
- Ability to connect regional registry systems
- Multiple groups within the same organization will need to coordinate and play a role

### 3 types of experts are needed

#### Policy Setter
- Provides policies, guidelines, strategy for implementing, projections on future impacts on the inner workings of the organization
- Needs to understand how the data will be used internally and by partners in the future, what changes need to occur for this to happen, and what is possible due to technology advances.

#### Registry Administrator
- Create procedures for implementing policies
- Needs to understand how workflows will change in the future, implications for their technology tools and the data that needs to be available and captured.

#### IT Support
- Ensure data structure and registry functions are fit for purpose
- Needs to understand direction of policies, field definitions to figure out equivalencies for integration.
CLIMATE ACTION DATA (CAD) TRUST:
Technical Architecture and Data Model
Prototype Architecture

The architecture has 2 layers – the data layer and the public blockchain layer

Data Layer...

- Defines a common data model and taxonomy
- Reconcile data across registries
- Identify potential double counting
- Enable auditing and reporting

... on a Public Blockchain Layer

- Transparent and Immutable Data
- Auditable
- Accessible and Inclusive
- Public and Transparent
- Open source
- Peer-to-peer governance
Initial Simulation III Data Model (March 2022)

**Project Location**
- Warehouse Project ID* (FK)
- Project Location ID* (PK)
- Country*
- In-Country Region
- Geographic Identifier*

**Project Rating**
- Warehouse Project ID* (FK)
- Project Rating ID* (PK)
- Rating Type*
- Rating Range Lowest*
- Rating Range Highest*
- Rating*
- Rating Link*

**Co-Benefits**
- Warehouse Project ID* (FK)
- Co-Benefit ID (PK)
- Co-Benefit

**Estimations**
- Warehouse Project ID* (FK)
- Estimations ID* (PK)
- Crediting Period Start*
- Crediting Period End*
- Unit Count*

**Projects**
- Warehouse Project ID* (FK)
- Current Registry*
- Project ID*
- Registry of Origin*
- Program
- Project Name*
- Project Link*
- Project Developer*
- Sector*
- Project Type*
- Project Tags
- Covered by NDC*
- NDC Information
- Project Status*
- Project Status Date*
- Unit Metric*
- Methodology*
- Validation Body
- Validation Date
- Project Description

**Related Projects**
- Warehouse Project ID* (FK)
- Related Project ID (PK)
- Relationship Type
- Registry

**Issuances**
- Warehouse Project ID* (FK)
- Issuance ID* (PK)
- Issuance Start Date*
- Issuance End Date*
- Verification Approach*
- Verification Report Date*
- Verification Body*

**Labels**
- Warehouse Project ID* (FK)
- Label ID (PK)
- Label Type*
- Label*
- Crediting Period Start Date*
- Validity Start Date*
- Unit Quantity*
- Label Link*

**Units**
- Issuance ID* (FK)
- Warehouse Unit ID* (PK)
- Unit Issuance Location* (FK to project loc ID)
- Label ID* (FK)
- Unit Owner*
- Country Jurisdiction of Owner*
- In-Country Jurisdiction of Owner*
- Unit Block Start*
- Unit Block End*
- Unit Count*
- Vintage Year*
- Unit Type*
- Marketplace
- Marketplace Link
- Marketplace Identifier
- Unit Tags
- Unit Status*
- Unit Status Reason
- Unit Registry Link*
- Corresponding Adjustment Declaration*
- Corresponding Adjustment Status*

**Governance (ref)**
- Registry values
- Project Sector values
- Project Status values
- Unit Metric values
- Validation Body values
- Country values
- Rating Type values
- Unit Type values
- Unit Status values
- Unit Transaction Type values
- Corresponding Adjustment Declaration values
- Corresponding Adjustment Status values
- Related Project Relationship type values
- Label Type values
- Verification Body values

Each ID is globally unique, meaning no organizations will generate the same ID for any table.
Updates to the Simulation III Data Model Based on Feedback

**Project Location**
- Warehouse Project ID* (FK)
- Project Location ID (PK)
- Country*
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- Geographic Identifier*

**Project Rating**
- Warehouse Project ID* (FK)
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- Rating
- Rating Link*

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- Co-Benefit ID (PK)
- Co-Benefit

**Estimations**
- Warehouse Project ID* (FK)
- Estimation ID (PK)
- Crediting Period Start*
- Crediting Period End*
- Unit Count*

**Projects**
- Warehouse Project ID* (PK)
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- Project ID*
- Registry of Origin*
- Program
- Project Name*
- Project Description
- Project Link*
- Project Developer*
- Sector*
- Project Type*
- Project Tags
- Covered by NDC*
- NDC Information
- Project Status*
- Project Status Date*
- Unit Metric*
- Methodology*
- Validation Body
- Validation Date

**Related Projects**
- Warehouse Project ID* (FK)
- Related Project ID (PK)
- Relationship Type
- Registry

**Issuances**
- Warehouse Project ID* (FK)
- Issuance ID (PK)
- Issuance Start Date*
- Issuance End Date*
- Verification Approach*
- Verification Report Date*
- Verification Body*

**Issuance Details**
- Warehouse Project ID* (FK)
- Issuance ID (PK)
- Issuance Start Date*
- Issuance End Date*
- Verification Approach*
- Verification Report Date*
- Verification Body*

**Units**
- Warehouse Unit ID* (PK)
- Unit Issuance Location*
- (FK to project loc ID)
- Label ID* (FK)
  - Unit Owner
  - Country Jurisdiction of Owner*
  - In-Country Jurisdiction of Owner
  - Serial Number Block*
  - Serial Number Pattern
  - Unit Block Start* (derived)
  - Unit Block End* (derived)
  - Unit Count* (derived)
  - Vintage Year*
  - Unit Type*
  - Marketplace
  - Marketplace Link
  - Marketplace Identifier
  - Unit Tags
  - Unit Status*
  - Unit Status Reason
  - Unit Registry Link*
  - Corresponding Adjustment Declaration*
  - Corresponding Adjustment Status*

**Governance (Picklist values)**
- Registry values
- Project Sector values
- Project Status values
- Project Type values
- Methodology values
- Unit Metric values
- Validation Body values
- Country values
- Rating Type values
- Unit Type values
- Unit Status values
- Corresponding Adjustment Declaration values
- Corresponding Adjustment Status values
- Related Project Relationship type values
- Label Type values
- Verification Body values
- Tag values
- CoBenefit values

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Updated Simulation III Data Model (August 2022)

- **Project Location**
  - Warehouse Project ID* (FK)
  - Project Location ID (PK)
  - Country*
  - In-Country Region
  - Geographic Identifier*

- **Project Rating**
  - Warehouse Project ID* (FK)
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  - Rating Type*
  - Rating Range Lowest*
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  - Rating Link*

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    - Verification Approach*
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  - Unit Issue Location*
  - (FK to project loc ID)
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  - Unit Owner
  - In-Country Jurisdiction of Owner*
  - Unit Block Start*
  - Unit Block End*
  - Unit Count*
  - Vintage Year*
  - Unit Type*
  - Marketplace
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  - Unit Tags
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  - Unit Status Reason
  - Unit Registry Link*
  - Corresponding Adjustment Declaration*
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- **Governance (picklist values)**
  - Registry values
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  - Unit Status values
  - Corresponding Adjustment values
  - Corresponding Adjustment Status values
  - Related Project values
  - Relationship type values
  - Label Type values
  - Verification Body values
  - Tag values
  - Cobenefit values

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*Each ID is globally unique, meaning no organizations will generate the same ID for any table.*

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*Fields with an * are required form fields

*PK denotes primary key for a specific table

*FK denotes foreign key which links tables together
The blockchain layer supports inclusiveness, accountability, transparency and integrity.

**Inclusiveness**
- Public, fully open source and permissionless
- Anyone in the network can access both the data layer and Chia Network blockchain node and add blocks

**Accountability**
- Decentralized governance/peer-to-peer support
- Only registries can edit their own data, allowing countries to flexibly choose their approaches
- Follows the Article 6 bottom-up approach

**Transparency**
- Fully auditable and secure record of transactions

**Integrity**
- Fully immutable and traceable

The Chia Blockchain Layer

The World Bank's collaborative partnership with Chia is non-exclusive. It is for open-sourced public good, bears no costs or intellectual property rights from the World Bank and promotes interoperability.
There are 3 ways to integrate data – User Interface, API and Spreadsheet import/export

The CADT web application has two main interfaces with the blockchain. One is the **Auxiliary App**, which helps **Integrated Participants** manage their data sync and entry point into the Climate Action Data Trust (CADT). The other is a tab that showcases the data in the CADT blockchain. **Node Participants** hold a full copy of the blockchain via direct integration. **Observer participants** view the CADT data via an Auxiliary App made available by the WBG.
<table>
<thead>
<tr>
<th>Testing Areas – Who Should Test By Functional Area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Installation</strong> – Testing that is solely focused on installing and running the prerequisite software to run the CADT</td>
</tr>
<tr>
<td><strong>User Interface (UI)</strong> – Testing that is centered around entering, manipulating, or viewing data within the Climate Action Data Trust UI</td>
</tr>
<tr>
<td><strong>API</strong> – Testing the CADT API endpoints to understand how they are structured with the intent to integrate own registry with CW APIs</td>
</tr>
<tr>
<td><strong>Mirrored Database</strong> – Testing the ability to perform SQL queries using a traditional MySQL database</td>
</tr>
<tr>
<td><strong>Excel Import/Export</strong> – Testing the excel upload/download features</td>
</tr>
</tbody>
</table>
CLIMATE ACTION DATA (CAD) TRUST: Governance
Governance and Finance consultation
September 2021 – March 2022

70+

Entities involved
- Governments
- Independent standards
- Exchanges
- Traders
- Project developers
- Private sector
- Financial institutions
- Technology providers
- NGOs
- Think tanks
- Law firms
- Multilateral development banks
- Observer: UNFCCC

5

Governance models reviewed
- Western Climate Initiative, Inc (WCI, Inc.)
- Integrity Council for Voluntary Carbon Markets (IC-VCM)
- EU-Swiss ETS link
- Joint Crediting Mechanism (JCM)
- British Standards Institution (BSI) & Enterprise Singapore (ES)

6

Focus groups conducted
- 4 on governance (46 entities)
- 2 on finance (45 entities)

+ polls and surveys for participant feedback throughout
Interim governance structure of the operational Climate Action Data Trust (CADT)

Inception

Jan 2023

Interim Period

Jan 2025

Permanent Governance

Council (~10 members)
Leads strategy/policy mandate

Secretariat

Technical Committee
• Data specification development
• IT development

User Forum
• Open to registered and approved Warehouse community participants
• Community consultation forum
• Potentially: Council recruitment
2022 Outlook

- **Aug**: Simulation III concluded
- **Sep**: Non-profit entity est. in Singapore
- **Oct**: MVP software & data model transfer, 26th Oct: Public launch (soft launch)
- **Nov**: First registry commitments documented
- **Dec**: COP, First TC & UF meetings, 1st IC meeting, 7-8 Dec: Asia Climate Summit (official launch)
For further information:

**Climate Warehouse**
- Website: [https://www.theclimatewarehouse.org/work/climate-warehouse](https://www.theclimatewarehouse.org/work/climate-warehouse)
- Testing Activities Video: [https://www.youtube.com/watch?v=cXwTV2bAnvl](https://www.youtube.com/watch?v=cXwTV2bAnvl)
- Online Library: [https://olc.worldbank.org/content/climate-warehouse-learning-series](https://olc.worldbank.org/content/climate-warehouse-learning-series)

**Climate Action Data Trust**
- Website: [https://climateactiondata.org/](https://climateactiondata.org/)

**Contacts:**
Gemma Torras Vives, IT Officer, Carbon Markets and Innovation, World Bank, gtorrasvives@worldbank.org
Chandra Shekhar Sinha, Adviser, Climate Change Group, World Bank, csinha@worldbank.org
Annex
### Climate Warehouse

**Projects List**

<table>
<thead>
<tr>
<th>Current Registry</th>
<th>Project Id</th>
<th>Project Name</th>
<th>Project Developer</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Standard</td>
<td>GS1</td>
<td>Keith Test Project</td>
<td>KB Development</td>
<td>Electricity, gas, ...</td>
</tr>
<tr>
<td>Ghana National</td>
<td>12022UNDP10...</td>
<td>Sustainable Ric...</td>
<td>UNDP</td>
<td>Not elsewhere ...</td>
</tr>
</tbody>
</table>
Knowledge and Capacity Building

Resources

Websites

- Website: Climate Warehouse Program
  - Webpage: CAD Simulation III
- Website: Climate Warehouse Library – Open Learning Campus (OLC)

Weinars:

- Webinar: Climate Warehouse: End-to-End Digital Ecosystem for Carbon Markets (2022)
- CAD Workshop: A meta-data infrastructure to support transparency and integrity of climate markets (2022)
- Webinar: Climate Warehouse: A Meta-data Infrastructure to Support Transparency and Integrity of Climate Markets (2022)
- Webinar: Is Blockchain/DeFi the Future for Carbon Credits? (2022)
- Workshop: Building an enabling environment for operationalizing Article 6 (2021)
- Webinar: Testing the use of blockchain to build a meta-registry for decentralized climate markets (2019)
- Webinar: Catalyzing the next generation of climate markets through the World Bank’s Climate Warehouse Initiative. (2019)

Blog:

- Blog Post: Carbon Markets: Why Digitization Will Be Key to Success(2022)
- Blog Post: Lessons from creating mitigation outcomes(2021)

Reports:

- Final Report: Climate Warehouse Simulation III (Report) (2022)
- Blockchain and Emerging Digital Technologies for Enhancing Post-2020 Climate Markets (2018)

Technical papers:

- Test Scripts: Simulation III (2022)
- Data Model: Simulation III (2022)
- Chia White Paper: Blockchain technology for the Climate Warehouse (2021)

Videos:

- Net Zero: The Integrity Pathway (2022)
- Climate Warehouse: Helping countries leverage climate markets and carbon pricing. (2022)
- Demo: Climate Warehouse Simulation II (2021)

Data visualization:

- Tool: How do we ensure environmental integrity under the Paris Agreement?
<table>
<thead>
<tr>
<th>Media Articles</th>
<th>Headline</th>
<th>Date</th>
</tr>
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<tr>
<td>Ledger Insights</td>
<td>World Bank backs blockchain project to harmonize carbon registry data</td>
<td>28 Oct 2022</td>
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<tr>
<td>Regulation Asia</td>
<td>Singapore to Host Platform to Unify Carbon Market Registry Data</td>
<td>29 Oct 2022</td>
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<td>Finextra</td>
<td>Climate Action Data Trust launched to unify carbon credit registry data</td>
<td>26 Oct 2022</td>
</tr>
<tr>
<td>ESG Investor</td>
<td>This Week’s Tech and Tools News: MSCI Launches Climate Action Index</td>
<td>28 Oct 2022</td>
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<tr>
<td>Disruption Banking</td>
<td>Climate Action Data Trust to unify carbon credit registry data</td>
<td>26 Oct 2022</td>
</tr>
<tr>
<td>BeSpecific</td>
<td>Climate Action Data Trust</td>
<td>27 Oct 2022</td>
</tr>
<tr>
<td>Político</td>
<td>Crypto, but for the climate</td>
<td>27 Oct 2022</td>
</tr>
<tr>
<td>Business Time</td>
<td>Global platform to unify carbon credit registry data to be domiciled in Singapore</td>
<td>26 Oct 2022</td>
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<tr>
<td>IETA</td>
<td>IETA Article &quot;Climate Action Data Trust to unify carbon credit registry data&quot;</td>
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<td>Carbon Pulse Article “Interview: World Bank to launch metadata project to clean up carbon market’s information problem”</td>
<td>7 Jul 2022</td>
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<tr>
<td>Financial Times</td>
<td>Bureaucratic World Bank goes experimental with a blockchain for carbon offsets</td>
<td>7 Feb 2022</td>
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