

# **FarmerNet White Paper: Next-Generation Decentralized Carbon Credit Market**

Create and Build on Chia

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## **Economic Impact of Climate Change**

This white paper proposes a new blockchain architecture based on FarmerNet's colour coin and carbon crediting ledger on the Chia network. Chia is often referred to as the green Bitcoin alternative with its eco-friendly proof of space and time consensus algorithm. Leveraging Chia's colour coins and consensus algorithms such as Proof of Space (PoS) and Proof of Time (PoT), we can enable stakeholders to track, trace, match and manage their clean energy footprint while simplifying data-driven attestation of sustainability goals and mandates. Carbon emission information is siloed, non-verified and non-standardized. The goal is to reduce environmental impacts and carbon footprint and increase progress towards global and corporate carbon emission goals. Fortune Global firms spend around \$20 billion a year on CSR activities, more than 90% of the 250 largest companies in the world now producing an annual CSR report with North America has the highest regional sustainability reporting rate. Third-party assurance of sustainability information in corporate reporting is now a majority business practice worldwide with GRI remains the dominant global standard for sustainability reporting.

If no action is taken to combat climate change, the considerable physical damages would imply a lower path of economic growth. In terms of which investment asset class markets will be more at risk. FarmerNet believes tech and health care are likely to benefit the most from the green transition, whereas energy and utilities may lag. At the broad asset class level, the appeal of developed market equities brightens at the expense of high yield credit and emerging debt due to the higher concentration of carbon intensive sectors that comprise the benchmark indices for the latter. A green transition to a low-carbon economy, consistent with the Paris Agreement goals, will deliver an improved outlook for growth and risk assets relative to doing nothing. Such an outlook rejects the commonly held notion that tackling climate change has to come at a net cost to society.

We believe in empowering individuals and communities to create a Distributed Carbon Market Exchange that is low-cost, environmentally friendly, and owned by the people of the world. The financial future will be green money that will create a better world for future generations.

## **Climate change – Turning Investment Risk into Opportunity**

The primary users of the FarmerNet's marketplace are those who benefit from quality data. The application is designed for industrial-scale use in order to create a global supply chain of data for AI consumption. The main actors are data providers, data consumers, data marketplaces, service providers and network keepers. Increasing demand for cryptocurrencies and accelerating adoption of blockchain-based solutions have highlighted an important issue: the technology's growing energy consumption and its impact on our climate.

### **1. Consumers**

Socially and environmentally responsible companies create positive brand recognition, increase customer loyalty, and attract employees. According to millennial consumer trends, 90% of millennials would switch brands to one associated with a good case. They are prepared to make personal sacrifices to make an impact on issues they care about. Changing consumer trends means that millennials are willing to pay more for a product, sharing products rather than buying, or taking a pay cut to work for a responsible company. These elements among the keys to achieving increased profitability and long-term financial success. By making blockchain technology more environmentally responsible, the industry has an opportunity to grow its user base.

### **2. Corporate**

From Fortune 250 largest companies, the underlying trend for third-party assurance of sustainability data is 71 percent (KPMG Survey of Sustainability Reporting 2020). They are listed on regulated markets requires carbon accounting and audits (assurance) of reported information which introduces more detailed reporting requirements, and a requirement to report according to mandatory government sustainability reporting standards. Companies like PwC have set aside \$1 billion further automate parts of its environmental auditing process planning to hire 100,000 employees over 5 years focused on ESGs. Our conviction is that businesses perform better when they are deliberate about their role in society and act in the interests of their employees, customers, shareholders, and communities. As ESG grows we believe our software service and support business will add to the enterprise value as well as help drive adoption of Chia globally. We believe that large institutions, corporations and other entities will be able to reap the efficiencies and benefits of using a digital blockchain currency like Chia.

### **3. Investors**

There is an increasing demand in MRV (Measurement, Reporting, and Verification) tools by people, businesses, and government to meet their ESG (Environmental, Social, and Governance) and SDG (Sustainability Development Goals). Research from investment fund Morningstar states ESG funds captured \$51.1 billion of net new money from investors in 2020, a record and more than double the prior year. The number of sustainable funds available to U.S. investors grew to almost 400 last year with a 30% increase from 2019 and 4x increase over the past decade meeting Paris Agreement and SDG13 (Climate Action) goals for 2050.

## **Carbon Climate Data Silos**

In the digital world, climate accounting involves all processes of recording climate-relevant information/data; from the physical state of the planet to the list of all climate actors, their broad set of climate actions and agreements in respect to the shared account of the climate challenge. Interoperability is important for climate action as stakeholders are implementing a policy, providing an incentive or providing information.

Standards can help making difficult comparisons using shared protocols and MRV tools for a truly globally integrated climate accounting system. We must work together to create a trustworthy decentralized climate accounting system. Digital technology tools that seamlessly integrate all elements in a transparent and participatory climate accounting system cannot be developed in a silo.

- Can we trust the data that the company has provided? Claims that a report has been prepared in accordance with the GRI Standards with principles for defining report quality addressing accuracy, comparability, and reliability?
- Can we trust judgement calls, made by either the company or a certifying entity, about which activities are not relevant and thus do not require data and auditing? How to document emissions factors used in an immutable ledger?
- How do we know if the company is in fact working on its emissions reduction plan? Giving the auditors a digital identity by publish a hash value or certain metadata on public blockchain?
- Can consumers and investors trust that the certifying entity is objective and standardized with a pricing distribution? How do consumers know that a "green product" is really better for the climate and that the offset buyers know that the offsets work? How do investors know that portfolio companies are achieving their climate goals? How do lenders know that green bonds and transition bonds are driving positive climate action?
- Can we trust the climate pledges made regularly by companies large and small? Are our cities really achieving their emissions targets? How secure is the data without cryptographic signing of any document provided or storing hash values of documents to blockchains?

## **Carbon Credit Standard Marketplace**

Carbon credit standards reduce data silos and can be used for personal climate footprinting, product/service footprinting, entity accounting, regional accounting, and policy impact assessments. Climate change is a global problem and we are all planetary stakeholders who need to define shared protocols, standards, and platform tools for a globally integrated climate accounting system to be operationalized. Standards help people to understand each other. Standards also help people to make decisions with confidence and cooperate towards joint goals. Climate change necessitates urgent action at a global scale allowing greater interoperability between these standards.

What is standardised in climate mitigation standards? First, there are technical standards like those of the W3C. How are carbon credit emissions calculated? We have Life Cycle Analysis (LCA) which is the standard analytical method for calculating the carbon emissions of a product through its carbon lifecycle supply chain. There is also Product Category Rules (PCR) with rules define how life cycle analysis should be performed based on the type of product and can be linked to other MRV tools like LCA, PCR, and EPD. We can call these calculation methodologies or data processing standards. Application of such standards produce indicators, metrics and indices with a well-defined meaning where such outputs can be tokenised. Second, there are accounting standards, including: Greenhouse Gas Protocol the standards used for compliance in different carbon sequestration jurisdictions, voluntary standards like the Verra's Verified Carbon Standard (VCS), the Gold Standard, American Carbon Registry (ACR), or Climate Action Reserve (CAR). Lastly, we have environmental performance standards like those of the IFC to accelerate Paris Accord climate goals and certifications based on accounting standards, such as the Greenhouse Gas Protocol. Accelerates the need for standardisation in the context of global climate action and reduced climate data silos. Application of these standards yield standards compliant reports. The contents of such report can also be tokenised in a Carbon Credit and Offset Ecosystem

1. Developers invests in projects, such as renewable energy or forestry management
2. Claims about the emissions reduction of the project is calculated under a methodology published by a verification body. These methodologies are based on the CDM methodologies.
3. The project is registered with a verification and validation body
4. A Validation and Verification Bureau (VVB) validates the project. See for example Gold Standard's approve auditors list
5. VVB reviews the data and independently verifies aspects of the project, to certify the amount of emissions reduced.
6. The verified emissions reductions are sold as carbon offsets, through brokers or directly to buyers. Major corporations such as Microsoft, Stripe, or CORSIA - eligibility criteria for airlines to purchase credits, ICROA, or IETA
7. Pricing References for standardization with CME Global Emissions Offsets, futures EcoSecurities Price Index , Gold Standard Marketplace or Forest Trends EcoSystem Marketplace

## **Technology: Blockchain Carbon Credits**

Distributed ledger technology solutions have the potential to provide trusted record-keeping processes, data consensus and rules automation crucially needed components in order to align actors, accelerate mitigation and adaptation action, and mobilize the trillions of dollars of climate finance required annually. Blockchain technologies are by design made for solving climate challenge issues:

Buyers question the validity of the offsets as consumers are concerned about greenwashing. FarmerNet builds trust with scalable technology: Higher quality of data due to standardized non-financial reporting processes and internal controlling systems. More transparency: In response to established reporting standards, and future rules and regulations. Addressing risk of double counting carbon credits, where the same project is listed on different registries and the offsets are sold several times. The ledger audits a certain amount of block confirmations to prove color coins were sent validly and not double counted where the carbon credits were received. Costly, time-consuming, paper-based processes could be streamlined. Save money CSR costs money to implement. Costs fall disproportionately on small businesses and lower risks in simplifying the reporting with FarmerNet's MRV tool. Better access to finance when environmental, social, and governance considerations are incorporated into external reporting.

Create trust in CO2 emissions accounts as they are transacted across industrial and national boundaries, where no trusted central repository exists by maintaining a audit trail of immutable records, so that emissions calculations could be verified later without relying on one central repository. Audits could be simplified by granting access to standard-monitoring and regulation-enforcing entities. Compliance with voluntary standards could also be made more visible, accessible, and transparent for monitoring companies and those handing out certifications and consumers. Lack of transparency in pricing standards - Increase the interoperability/integration of CSR reports of different companies where we have A lot of different registries makes it difficult for buyers to track and a very heterogeneous market with different project types (forestry, renewables, etc.) and different regions. Different offsets trade vastly differently, from under \$1 to nearly \$50 per ton, even though they're all denominated in tons of CO2 emissions. One \$FNET token will be exchangeable for one Carbon Removal Certificate (CRC). With FarmerNet, suppliers can sell their certificates into the marketplace and get paid in tokens as soon as a buyer purchases their credits on a first-in, first-out (FIFO) basis.

1. Carbon credit is listed for sale in the FarmerNet market queue in a first-in, first-out basis where once at the front of the queue, the next buyer purchases the carbon credit by sending \$FNET tokens to the smart contract acting as market operator for the CRC.
2. Owner immediately changes to the sending address tokens causing the smart contract record status to become retired and no longer allows a change of ownership which is recorded on the immutable ledger.

## **Chia Blockchain Protocol**

Chia's proof of space and time requires significantly less energy and cost to operate unlike Proof-of-Work blockchains like Bitcoin or Ethereum, making it the better consensus mechanism for building blockchain applications that are eco-friendly. This reduces the carbon footprint of crypto which is already very energy-intensive. The value of such digital assets is tied to a real-world promise by the asset issuers that they are willing to redeem those digital tokens for something of value in the real world. The advantage given by using the blockchain as the backbone for such asset manipulation is that one can rely on the blockchain's transparency, immutability, ease of transfer and non-counterfeit ability to transfer and trade such digital tokens with unprecedented security and ease. The carbon emissions token is a fungible token, whereas data on the utility emissions channel are just immutable data (not tokens), as they represent the emissions from a particular meter tied to a particular utility during a particular period of time. FarmerNet (\$FNET) will be a blockchain token native to for the purpose of carrying out functions central to the operation of FarmerNet Network. These are programmable digital tokens that can be used to access the mix of functions that make it possible to verify ecological outcome and distribute rewards for those outcomes.

How will we translate standards into software? We can find the most generic articulation of what a standard, method and transaction is and develop protobuffer. For example, Namespaced Merkle binary tree to allow each block to store multi-level data structures in a node which can be downloaded. The header of a block from one source, the small part of the tree relevant to them from another source, and still be assured that all of the data is correct.

1. Creating tokens from emissions data where the climate data with carbon emissions records, should be updated to link to the fungible token
2. The fungible token should contain a manifest of all the underlying data recorded in a secure blockchain encrypted database that is programmable with smart contracts with Time-stamped with proof of time VRF consensus protocol where time is recorded on a block Offsetting emissions with transactions between tokens
3. Fully distributed where all network participants have a copy of the ledger for complete transparency and unanimous agreement to each of the records. Immutable to avoid double counting where all validated records can not be changed certifying net emissions

## **Chialisp Colored Coins**

This section describes the Chialisp Colored Coins protocol specification for issuing and transacting digital carbon assets on top of the Chia Blockchain. Coloured coins virtually allow any kind of asset or contract can be represented. The target market would be for individuals, financial institutions, corporations, and governments to issue on-chain carbon assets that inherit the smart transaction capabilities of Chia Network's blockchain. It describes a class of methods for representing and managing real world carbon emission data and carbon credit assets. Chialisp coloured coins inherit all of the capabilities of Chialisp which makes them far more suitable to high compliance such as the creation of carbon credit assets.

- Low prices with minimal bloat and zero confirmation on transaction fees and no extra currency layers like XCP or MSC
- Better performance and efficiency which takes advantage of the power of miners
- Better metadata handling using peer to peer torrents
- Increased security protocols with globally decentralized secure validation that Proof of Space and Time compared to solidity smart contracts. Unlike solidity, Chialisp coloured coins can be used to create ephemeral value and thus applications on the Chia blockchain don't generally require flash loans.
- Properly used, ownership of Colored Coins can be made anonymous, while still enjoying the benefits of ownership.
- They can be stored digitally without needing a third party in safe storage with multi-signature transactions.

In the case of carbon emissions, smart contracts could support the following participants on a tokens network:

- Token authority where a network operator or a supranational/national/regional carbon authority which authorizes a number of issuers of tokens.
- Token issuers who auditors of carbon emissions or certifiers of renewable energy or carbon offsets. Auditors would issue tokens based on audits of companies' operations. Certifiers would issue tokens based on projects they've certified.
- Token concerned consumers who businesses and individuals who buy offsets to offset their own

## **Token Operations**

- Add new token definition – Multiple types of emissions tokens can be supported on the network, such as emissions, Renewable Energy Certificates (REC's), and offsets. Issues tokens based on results of operations from audited companies and renewable/offsets projects. Note that each issuer would be able to only issue allowed types of tokens, so an emissions auditor can issue Audited Emissions, a carbon offset developer or certifier Carbon offset tokens, and renewables developer REC's.

- Register/Unregister issuer – In our case, it would be registering and unregistering auditors or project certifiers authorized to issue tokens with Auditors and project certifiers would register their customers on the network.
- Transfer – Emissions audit tokens cannot be transferred: They are retired as soon as issued and stay with the organization that was audited as a record of their emissions. Offsets and REC's can be transferred until they are retired. The total amount that could be transferred from one account to another is the sum of the tokens in their account minus the amount that has been retired.
- Retire - When a token is marked as "retired," it is counted towards the emissions reduction of the retiring organization and cannot be transferred again.



### **Three Types of Color Coins**

Carbon emissions offset tokens: represents reduction of emissions through projects such as forestry, sequestration, etc.

- Issuer ID = Certifier or Issuer
- Recipient ID = Buyer
- Asset Type = Emissions Offset
- Quantity = amount
- From/thru date time stamp = do we need this for emissions offset?
- Metadata = type of project, location, etc.

Audited emission tokens: represents the actual emissions of an organization, as reported by an auditor.

- Issuer ID = auditor
- Recipient ID = organization or entity
- Asset Type = CO2 emissions
- Quantity = amount of emissions
- Metadata =
- From/thru date time stamp = time period of the net emissions

Renewable energy certificate tokens: represents energy generated from renewable sources such as wind and solar

- Issuer ID = Generator of REC
- Recipient ID = Buyer of REC
- Asset Type = REC
- Quantity = 1
- From/thru date time stamp
- Metadata = Region and Time of energy enerated

### **BitTorrent Metadata Storage**

Each carbon credit color coin includes metadata storage as part of the Chia protocol. This includes static and dynamic data that can be unlocked by smart contract functionalities. Here, we are using peer-to-peer BitTorrent files with colored addresses and number encoding schemes. We are using SHA1 information hash to reference the file that stores the actual data and SHA-256 hash for higher security data for metadata to be stored directly on the blockchain allowing for maximal decentralization, scalability, and unlimited size storage.

- Issuer identifier
- Recipient identifier
- Color coin token type (carbon emission, audited emission, or renewable energy certificates)
- Quantity
- Date/time stamp with VRF
- BitTorrent metadata
- Date/time stamp of when the asset was created with VRF
- Automatic retirement date, when the token will be retired in the account of whoever holds it at the end of the year

## **Proof of Space**

Microsoft's Bill Gates told the New York Times, "Bitcoin uses more electricity per transaction than any other method known to mankind." This is because Bitcoin, Ethereum, and other blockchains use Proof-of-Work to secure their ledgers which have proven the utility of decentralized transaction ledgers with smart contract applications and market assets with a market capitalization of billions of dollars. However, Bitcoin was not designed with scalability in mind so the amount of computational power required to mine greater amounts of Bitcoin is burning through natural resources. Proof of work mining has risen exponentially in the past 12 years. Bitcoin is very energy intensive with environmental consequences making up 0.5% of total global electricity consumption. Most Bitcoin miners use the cheapest forms of electric energy on the planet, independent of location, and are guaranteeing a minimum price for it. If we look at the hash rate, mining cost, energy use, and CO2 emissions of Proof of Work technology. Energy use might have grown more than mining cost, due to miners gaining access to cheaper energy because it is mostly surplus. Energy use is inversely correlated with energy price and mining cost is rising exponentially slower than hash rate (because of technology improvements). Mining cost dependent on the price of bitcoin, has been growing exponentially but exponentially slower than bitcoin price because of halvings and mining cost BTC leading this to be an ESG nightmare.

Unlike Proof-of-Work blockchains like Bitcoin or Ethereum, Chia's proof of space requires significantly less energy and cost to operate, making it an ideal alternative consensus mechanism for building blockchain applications that are eco-friendly. This will reduce the carbon footprint of crypto is to switch to a less energy-intensive approach to securing public ledgers. Proof of space can be thought of as a way to prove that you are keeping some storage unused on your hard-disk drive. FarmerNet's Chia blockchain will "seed" unused space on their hard-disk drive by installing software which stores a collection of cryptographic numbers on the disk into "plots." These users are called "farmers" who are on the FarmerNet network where they are plotting, proving/farming, and verifying

1. Farmer verifier can send a challenge to a prover
2. Prover can demonstrate to the farmer verifier that the Prover is reserving a specific amount of storage space at that precise time.

## **Proof of Time and Verifiable Delay Functions (VDF)**

The blockchain building block combinations of PoS and PoT provides a premium service by being immutable and protecting against forgery of the ledger with respect to time ordering and storage. Chialisp uses VDF which is a cryptographic puzzle piece is used to secure this system with a verifiable delay function where computations are made for a cryptographic proof that real time has passed. A verifiable delay function (VDF) is an important tool used for adding delay in decentralized applications. It is a sequential operation (like hashing a number many times:  $\text{hash}(\text{hash}(\text{hash}(a)))$ ) that takes a prescribed amount of time to compute tasks that cannot be sped up by parallelism. However once computed, the output can be quickly verified by anyone. By repeated squaring in a class group of unknown order or class groups with a large prime discriminants, the VDF consensus algorithm is secure. Therefore we can assume that computing a VDF requires real (wall-clock) time. What makes Chia different is that the farmer prover cannot buy more machines to go faster, unlike Bitcoin's proof of work system. This can have many applications in the real world. For carbon credit tokens we might want to add the right of adverse possession of carbon that is already sequestered, or formalized squatting. Transfers must be securely timestamped with a verifiable delay function.

1. Carbon credits buy and sell transfers and their expiration date. To maintain ownership, the owner must issue a new transfer to self before expiration. For example, constructing a verifiable randomness function, or providing a "proof of elapsed time". They can be transferred digitally to a new owner with no need for central authorization, which has implications for ease of use, efficiency and availability. They can be exchanged for other Colored Coins or uncolored bitcoins in a single atomic transaction – meaning there is no counterparty risk, even without blockchain confirmations. And once again the entire range of scripting options is available to allow more complex trades, such as exchanging for coins of a different blockchain with a similar security guarantee, or automated escrow. Currency could be removed from circulation or "burned", but emissions records could not be, because the physical greenhouse gases stay in the atmosphere (hundreds of years at least).
2. Upon the expiration, the carbon credit may be homestead on a first-come or emergent respect basis for certain blockchain consensus algorithms. The audited emissions tokens are retired as they're issued from an auditor to a company or consumer. The carbon offsets could be traded but are eventually retired when used to count as emissions offsets.

## **\$FNET Sale Agreements for Future Tokens (SAFTs)**

FarmerNet token holders will have the ability to participate in the carbon removal economy with our carbon credit tokens. This incentivizes stakeholders to come together and govern a shared system to achieve ecological accounting with a DAO governance. Tokens will raise funds for the continued growth and operation of FarmerNet to create a two sided liquid carbon credit marketplace with third-party exchanging of the \$FNET tokens. This establishes a standard and price incentives for carbon stakeholders to remove CO<sub>2</sub> and get paid in \$FNET. Standard blockchain DAO governance applied where color coin tokens can be staked to be used in the governance processes. Stakeholders who have staked their position can vote on polls and voting power is assigned a weight by the total amount of staked \$FNET each holder has. Therefore, users with a larger amount of \$FNET tokens will have more influence on voting with a limit of an individual holding 30% of \$FNET to ensure fairness of protocol governance agents. Tokenization via \$FNET cryptocurrency enables a new method of financing carbon removal. The main way to purchase these color coin tokens will be through an Agreements for Future Tokens (SAFTs) will give project supporters the rights to receive token allocations once FarmerNet is operational. From the initial Token Generation Event (TGE) forward, newly minted tokens will be issued by FarmerNet.

Private securities offering of Simple Agreements for Future Tokens (SAFTs) conducted under the Regulation D 506(c) exemption to accredited investors. Following accordance with SEC regulation rule 144, SAFT contributors will receive their \$FNET a year after signing. Buyers of either Class A or Class B SAFTs must be accredited and due-diligence will be made with a minimum purchase fee. No single individual or entity can hold more than 30% of the tokens and exceptions will only be made case-by-case with a contractual requirement. Community crowdfunded securities offering conducted under Regulation CF. Public sale of tokens to anyone so that they can use them to purchase credits on a first-come first-serve basis. A buyer wishing to pay for the removal of 10,000 tonnes of CO<sub>2</sub> would purchase 10,000 carbon credits in \$FNET plus a commission fee. In terms of technical roadmap, we are in beta testnet development with Chia color coins. There will be a 3 month window after mainnet is launched to keep the supply increase more dynamic. Token supply at mainnet launch will be 500 million tokens with 5 million tokens representing 1% of the total supply. Inflation will be between 7-20% which is to account for the rising price of carbon credits (from \$25 to estimated %170) relative to the percentage of \$FNET staked with distribution of 500 million \$FNET tokens:

- 350 million unlocked tokens will be sold in both a private securities offering and an ongoing legally compliant public offering sale after the mainnet market has launched including additional fees like legal, tax, audits and exchange approvals
- 100 million tokens will be set aside for an insurance fund to cover faulty carbon removal certificates will be locked with minimum 1 year with a discount schedule depending on the 3<sup>rd</sup> party verifier stability pool
- 50 million tokens will be held by the FarmerNet community team (founders, employees, investors, DAO treasury, and advisors), non-sale allocations, company bootstrapping funds, and go-to-market strategy to be staked permanently. DAO governance with airdrops where staking rewards are managed with 33% voting power for long term sustainability with linear unlock of 5 years