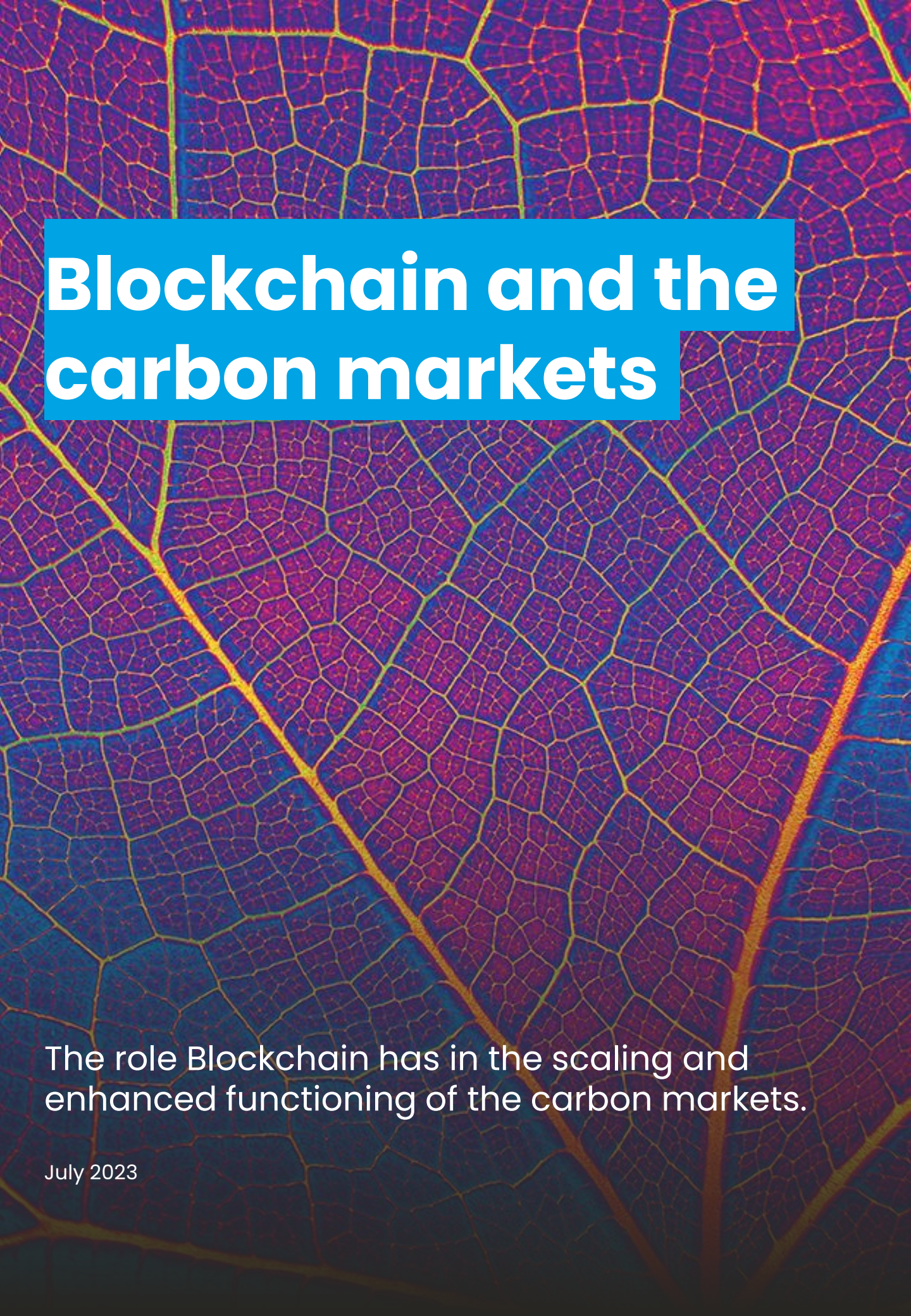
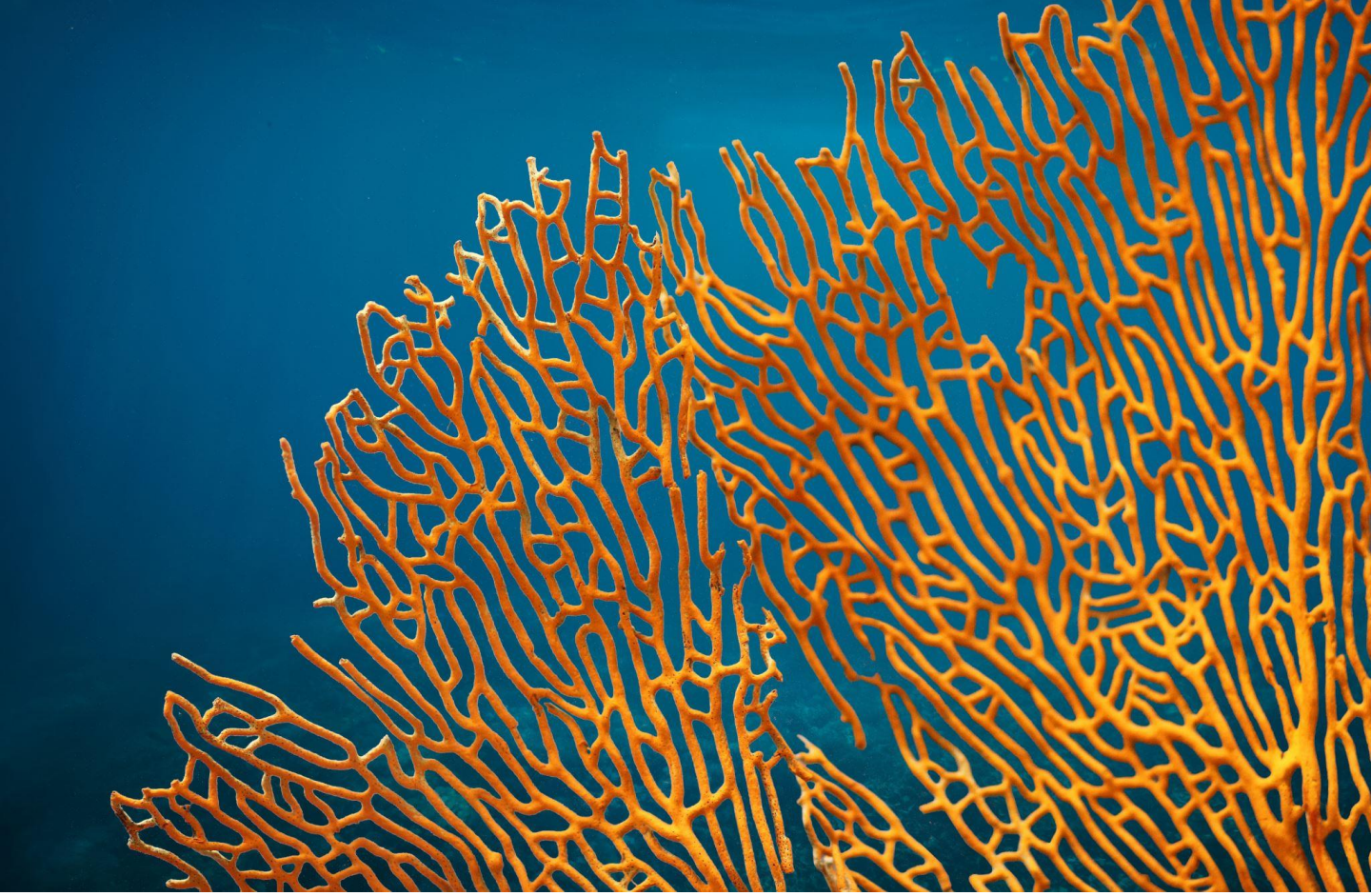


# Blockchain and the carbon markets

The role Blockchain has in the scaling and enhanced functioning of the carbon markets.

July 2023



## Acknowledgements

The Social Carbon Foundation & Wilder Earth acknowledges the following individuals for supporting in the development of this document:

Mike Davies

Raul Pedri Feldmann

## About SOCIALCARBON

SOCIALCARBON is an international Greenhouse Gas (GHG) standard focused on Nature-Based Solutions. Utilising leading technology and science, it facilitates the restoration and conservation of natural ecosystems through embedding local communities into projects to ensure lasting sustainable development. www.socialcarbon.org

## About Wilder Earth

Wilder Earth is a technology provider for the environmental asset markets. It provides an all-in-one platform to fundraise, record and track environmental assets. www.wilder.earth

# Contents.

# Executive Summary.

Blockchain technology is increasingly been looked at as a solution to address systemic challenges faced by the carbon markets. The decentralization and increased transparency offered by the technology offers an opportunity to reduce reliance on centralized technologies, improve market trust and streamline transactions.

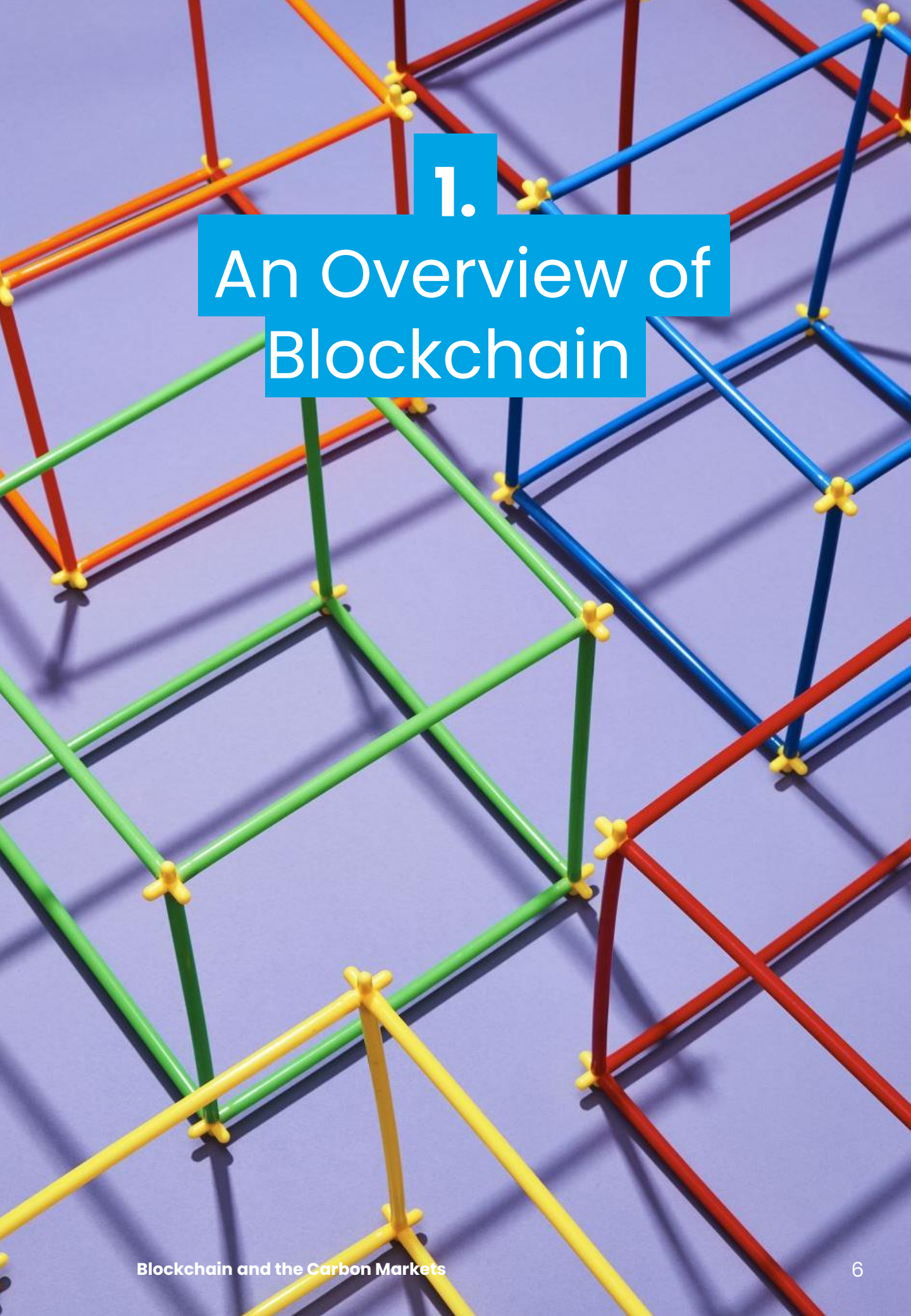
The carbon markets have historically been criticized for being opaque, lacking auditability and relying heavily on intermediaries. Many have pointed to Blockchain as a potential technology solution to address many of these issues.

A blockchain is a distributed database or ledger that is shared among the nodes of a computer network that allows secure and transparent transactions between parties without the need for a central authority or intermediary. Transactional data is stored in "Blocks" which are linked to the previous block. This connection to the most recent block creates a chain of historical records which are all verified by nodes on the network. This consensus across the nodes established an immutable record of transactions.

Current applications of blockchain in the carbon markets typically involves a two-step process whereby the carbon credits are first registered in a centralized registry, and then select carbon credits are tokenized and recorded on a blockchain by a third-party organization who then utilized smart contracts to transact the tokenized carbon credits.

As with all technology, solutions must be designed on real problems. Whilst Blockchain can add significant benefits to the market, if not designed properly, it can worsen the challenges it looks to address.

This paper assesses the potential value Blockchain can deliver to the carbon markets, current approaches taken by market participants, and then outlines how SOCIALCARBON and Wilder Earth have approached the utilization of Blockchain and the rationale for doing so.



# 1. An Overview of Blockchain

# What is a Blockchain?

At its core, Blockchain is decentralized accounting software. It tracks assets, typically recorded as Tokens (digital representations of an asset), their transactions and ownership.

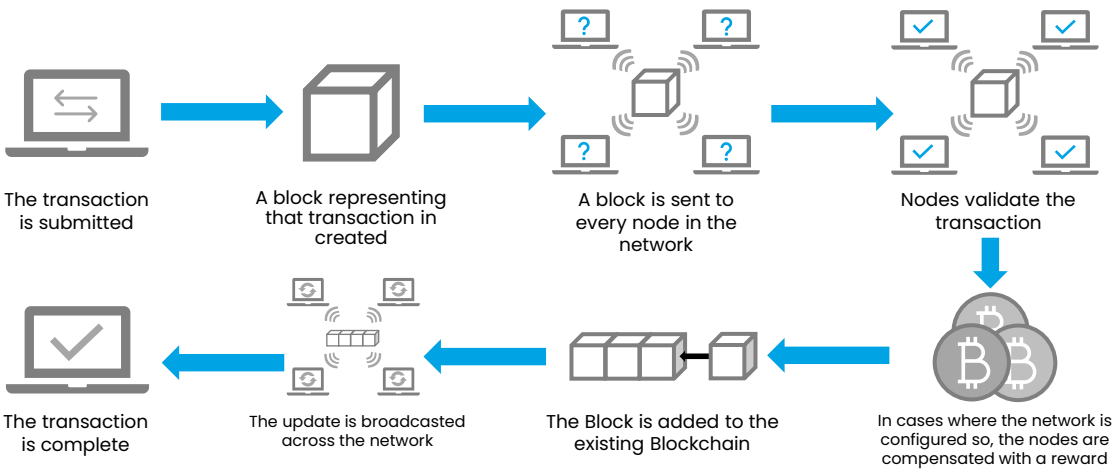
Blockchain, unlike traditional accounting systems, has its transaction history audited by a network of computers called “nodes”, that each independently verify information recorded on the Blockchain and reach consensus on what is correct. In doing so, each node stores a copy of the Blockchain’s transaction history, resulting in decentralised data storage and greater network security and resilience.

A blockchain differs from a database in the way that data is structured, storing information in blocks, each of which contains a unique cryptographic hash that links it to the previous block and a unique timestamp. This creates a chain of blocks, hence the name "blockchain.“

When a transaction is initiated, it is broadcasted to all nodes in the network. Each node then validates the transaction using consensus mechanisms, which establish the rules for auditing transactions.

Once the transaction is validated, it is added to a block, which is then added to the chain of previous blocks, forming a permanent and unalterable record of the transaction.

The blockchain network relies on cryptography to ensure the integrity and security of the data. Each block contains a unique cryptographic hash that links it to the previous block, making it impossible for anyone to tamper with the data without being detected.



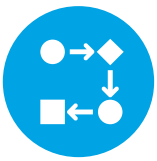
# Benefits of blockchain.

## Decentralisation

Blockchain technology is decentralized, meaning that there is no single point of control or authority. This makes it more secure and less vulnerable to hacking or fraud.

## Transparency

All transactions on the blockchain are recorded in a transparent and tamper-proof manner. This creates a high level of transparency and accountability, which can improve trust and reduce the risk of fraud.



## Efficiency

Blockchain technology can facilitate faster and more efficient transactions by eliminating the need for intermediaries and reducing transaction costs.

## Security

Blockchain technology uses cryptographic algorithms to secure transactions and protect the privacy of users. This makes it more difficult for hackers or malicious actors to access sensitive data.

## Trust

Blockchain technology can help to build trust between parties by providing a transparent and immutable record of transactions. This can be particularly useful in industries such as finance and supply chain management.

## Innovation

Blockchain technology has the potential to enable new business models and applications that were previously impossible or impractical. For example, blockchain can be used to create decentralized applications (dApps) that run on a peer-to-peer network.

# Benefits to the carbon markets.

Unlike other commodities, the carbon markets operate digitally with carbon credits electronically issued and traded. This significantly lowers the challenges with Blockchain adoption.

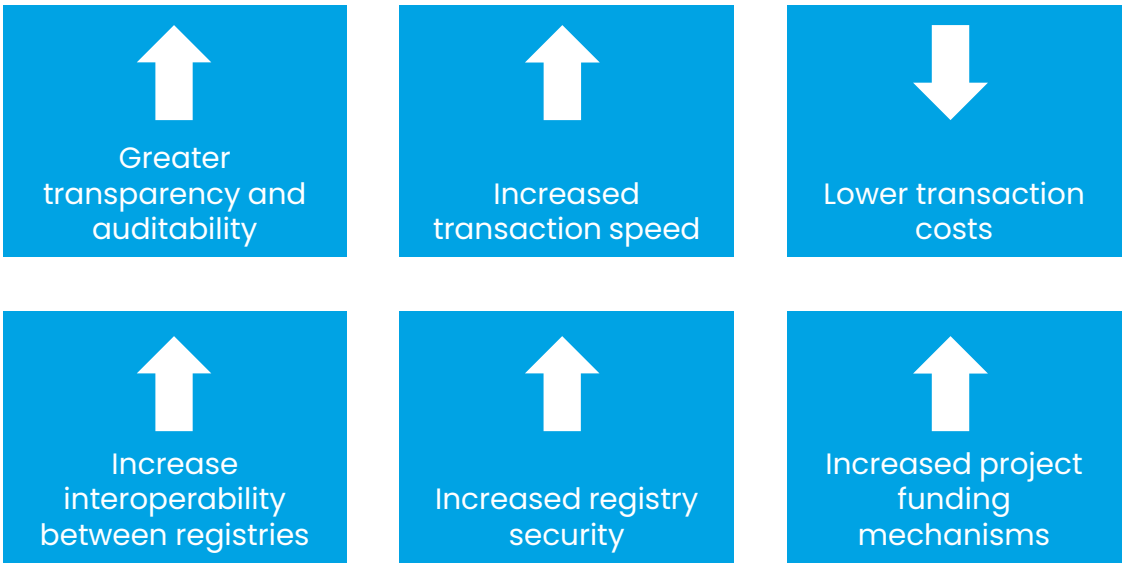
Markets that focus on physical commodities, such as Gold, often encounter challenges with implementing Blockchain. The physical nature of the commodities means that whilst Blockchain can improve digital tracking of the ownership of the commodity, if the physical good is not tracked and managed appropriately in reality, the value of Blockchain is significantly reduced.

In comparison, the carbon markets deal with an intangible asset that is issued on digital registries. Current carbon registries are basically large centralized accounting systems that track carbon credit ownership and transactions.

Blockchain has the potential to transform the carbon markets.

A blockchain-based registry, whereby the carbon credits are tokenized at source, offers the opportunity for greater transparency and auditability of transactions related to carbon credits. This increase in transparency would also be accompanied by reduced risk of double counting, fraud and inaccurate carbon credit retirement reporting.

In addition, the technology could be applied to lower transaction barriers and eliminate the need for escrow accounts. Smart contracts can be built into the Blockchain to facilitate peer-to-peer transactions. These contracts, which execute based on pre-defined conditions, would enable faster transactions, lower transaction costs, and full auditability of transactions.



# 2. Applications in the Carbon Market

# Current Applications in the Carbon Markets.

Current applications of Blockchain range from trading to registries and data oracles.

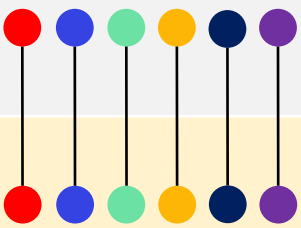
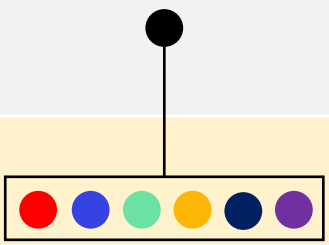
## Carbon Registries

Blockchain-based carbon registries are being developed that either store carbon credit meta data on a Blockchain or tokenized the carbon credits at their source.

## Carbon Trading

Blockchain-based trading platforms and marketplaces have been developed that tokenize carbon credits either into Non-Fungible Tokens or Fungible Tokens and facilitate the exchange of the credits in this new format.

This has been approached in a number of ways:

| | **Aggregated Token** | **Tokens per Credits** | **Non-Fungible Token (NFT)** |
|---|---|---|---|
| | Token represents a set amount of tCO2e and are backed by a pool of credits. | Tokens are minted to create a 1-to-1 replica of a set of credits. | A single NFT is created to represent a set number of credits. |
| **Tokens** |  |  |  |
| **Carbon Credits** |  | | |

## Carbon oracles

Project data is stored on a Blockchain to provide an immutable record of the results to demonstrate that the data has not changed.

# Considerations necessary for implementation.

While the implementation of blockchain technology in the carbon markets has the potential to bring numerous benefits, there are also several factors that need to be considered.

### Emissions

Blockchains are inherently energy intensive. It is important for implementors to consider the potential emissions from the use of Blockchain. Public networks that rely on Proof of Work consensus mechanisms have significantly greater emissions when compared with Proof of Stake or private networks.

### Does the solution address a real issue?

Solutions must address an unsolved issue in the market. Tokenization of carbon credits offers benefits in terms of transaction efficiency, however if the pooled credit approach is applied and the pool of credits is not transparent, the approach can result in more opaqueness than conventional approaches.

### Connectivity to existing market infrastructure

Solutions that tokenize carbon credits tracked in an external registry must have API access to ensure their tokenized balances are reflected in the external registry. The Registry is the central "point of truth" and must be updated in almost real-time. This can be challenging given most registries in the market do not offer public APIs at present.

### User experience

Private keys used to secure individual accounts on the Blockchain are typically managed by either the user or the platform provider. If these private keys are managed by the end user, significant technical barriers may exist, whereby the user lacks the technical knowledge to securely protect this information and may even lose it. Alternatively, if the private key is managed by the platform provider user accounts are vulnerable to centralized key management. If the platform provider is compromised, the intruder has the potential to access all user accounts through their private keys.

### Money Laundering

Organizations that tokenize carbon credits and enable the credits to be purchased for cryptocurrency must have strong anti-money laundering and counter terrorist finance procedures in place. Proof of origin of funds must be conducted to mitigate the risk of illicit funds entering the carbon market.

# 3. Realizing the full potential of Blockchain

# Optimising value from Blockchain.

To truly realize the value of Blockchain, specific configurations and design decisions are needed.

### Tokenize carbon credits at their source

Carbon credits should be tokenized at source at the time of issuance. Blockchain-based registries that create tokens of the carbon credits at issuance and utilize the tokens to track ownership and transactions will be more transparent and auditable. Through tokenizing at source, no discrepancy will exist between the Blockchain and a centralized accounting system.

### Make the Blockchain publicly readable

Public Blockchain explorers should be created to enable anyone to scan data on the Blockchain and verify information. Doing so would enable anyone to verify carbon ownership, retirements and transfers.

### Indexing Blockchains to registry databases

Blockchains are accounting software, they are designed to store transactional data, not store large files and monitoring data. Documents related to issuances and the underlying carbon project should be stored in the relevant carbon registry database and used to index against Blockchain data. This ensures that the Blockchain is not "bloated" and optimizes performance across the systems.

### Build transactional layers on top of Blockchain-based registries

Smart contracts should be built on top of the Blockchain-based registries to facilitate peer-to-peer transactions to significantly reduce transaction costs and execution times. Through building this on top of the Blockchain-based registry, the transactional data is recorded on a single chain, ensuring full transparency of a carbon credits lifecycle. This also ensures that registry accounts are automatically updated in real time.

# SOCIALCARBON's approach to Blockchain.

SOCIALCARBON, in collaboration with Wilder Earth, has developed the world's first Blockchain-based registry that tokenizes carbon credits at their source and facilitates peer-to-peer transactions between registry accounts.

## Unique fungible tokens per issuance

SOCIALCARBON's registry, built by Wilder Earth, is Blockchain-based. Each issuance is accompanied with the creation of unique fungible tokens. This ensures that each carbon credit is unique and auditable. All tokens are indexed with the SOCIALCARBON Registry to enable users to see project and monitoring data related to each carbon credit.

## Signature Chains

Users of the Wilder Earth ecosystem have full custody of their assets and private keys are not held or managed by Wilder Earth. However, the registry utilises a technology called signature chains which enables users to login to their account simply through a Username, Password and Pin.

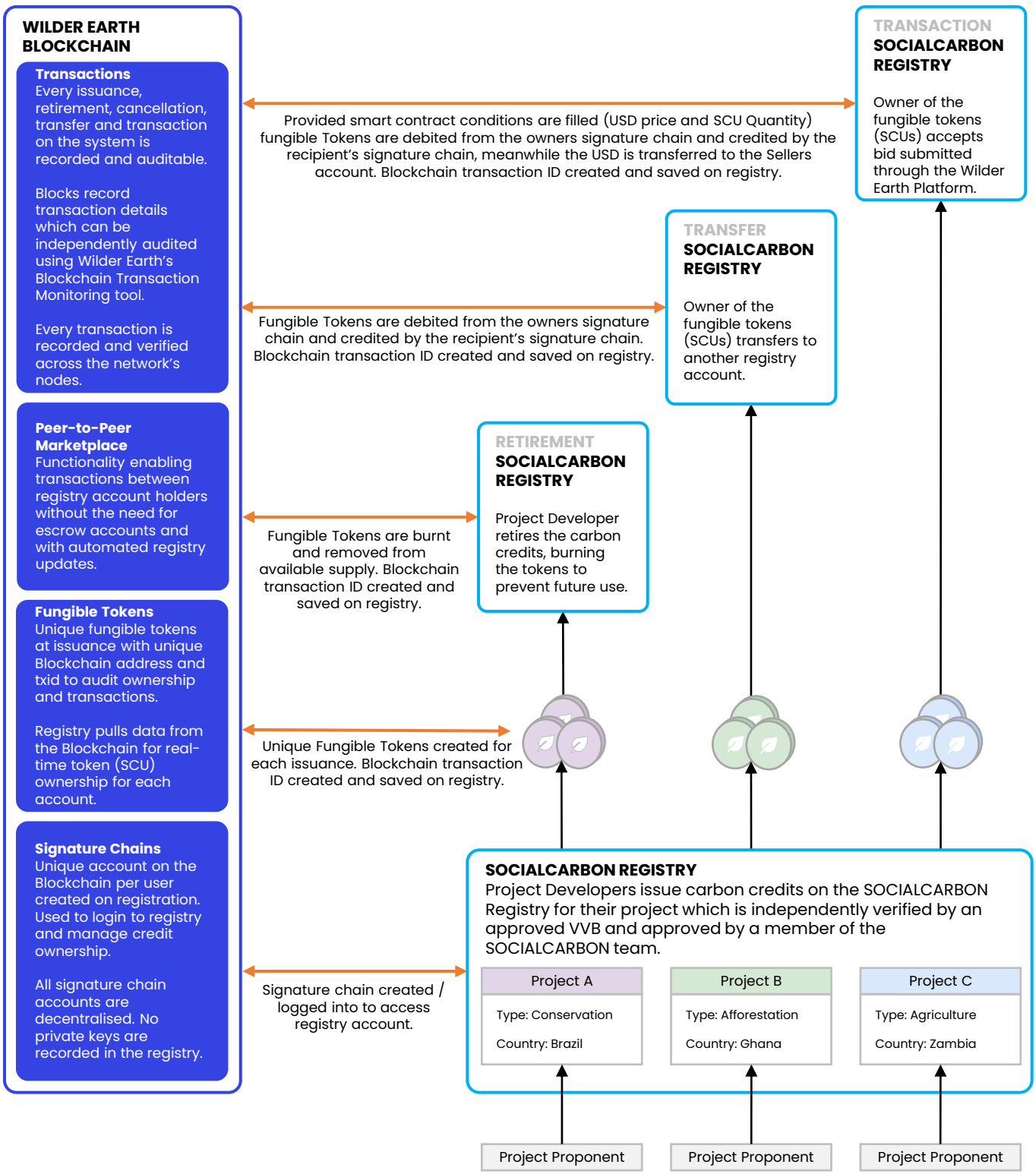
Signature Chains still use public key cryptography, but rather than maintaining the keys on disk or the cloud, they are stored in 'mathematical hyperspace' meaning that user credentials become the 'key' to a 'virtual space' that you own with a Signature Chain. This also removes the burden of key management which often require third party plugins such as MetaMask.

Signature Chains are comparable to a 'personal Blockchain'. They decouple the private key from the user account, therefore one is unbound by the possession or security of a single private key. The private key becomes obsolete when the next transaction is generated, producing higher levels of security compared to the continual reuse of a private key, as is the case with other blockchain technologies.

## Blockchain Explorer

Wilder Earth has developed a Blockchain explorer enabling anyone to scan details on the Blockchain related to SOCIALCARBON. This creates levels of transparency and auditability previous not seen in the market.

# SOCIALCARBON's approach to Blockchain.



# Innovations made possible with Blockchain.

In addition to a Blockchain-based registry and peer-to-peer marketplace, SOCIALCARBON's registry also enables projects to access pre-finance through a blockchain-based fundraising mechanism called Green Impact Units.

Wilder Earth's platform also includes a fundraising mechanism called Green Impact Units. This mechanism utilizes Blockchain to significant enhance forward purchase agreements and pre-financing.

## Integration with the registry

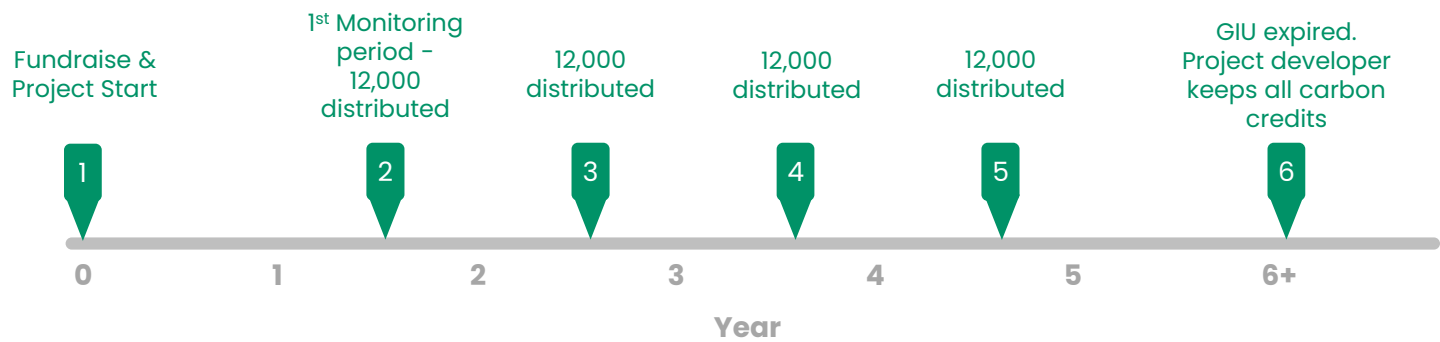
The solution is built on top of the Blockchain used by SOCIALCARBON. This enables the creation of smart contracts which can automatically distribute carbon credits associated with an issuance to the funders. This automated approach means that project proponents do not need to manually transfer carbon credits to their funding partners. In addition, it supports the fundraising of projects from a larger pool of organisations.

## Tradeable funding mechanism

The Green Impact Units are tokenised Non-Fungible Tokens that represent entitlement to future carbon credits to be issued by a project. By holding the fungible tokens users are entitled to a percentage of the carbon credits issued by the project in the future. These fungible tokens are also fully transactable through the peer-to-peer marketplace, meaning funders have greater liquidity and flexibility with regards to their funding of projects.

## Example

An afforestation project developer needs to fundraise $150,000 to start their project. The money raised will be used to start the project and cover the operational costs until the first set of carbon credits are issued. It will take 1.5 years until the project issues any carbon credits. The annual expected number of carbon credits to be issued is 80,000 (tCO2e). The project developer sells 150,000 Green Impact Units with a duration of 5 years. The project developer will distribute 15% of the carbon credits issued to the funders. Assuming a market price of $8 per carbon credit, the funders will receive the equivalent of $384,000 worth of carbon credits over a 5 year period, a 256% ROI.



# References


1. Islam, I., Munim, K. M., Oishwee, S. J., Islam, A. N., & Islam, M. N. (2020). A critical review of concepts, benefits, and pitfalls of blockchain technology using concept map. IEEE Access, 8, 68333-68341.
2. Vemuri, V. K. (2018). Blockchain: a practical guide to developing business, law, and technology solutions.
3. Zarrin, J., Wen Phang, H., Babu Saheer, L., & Zarrin, B. (2021). Blockchain for decentralization of internet: prospects, trends, and challenges. Cluster Computing, 24(4), 2841-2866.
4. Stephen, R., & Alex, A. (2018, August). A review on blockchain security. In IOP conference series: materials science and engineering (Vol. 396, No. 1, p. 012030). IOP Publishing.
5. Pan, Y., Zhang, X., Wang, Y., Yan, J., Zhou, S., Li, G., & Bao, J. (2019). Application of blockchain in carbon trading. Energy Procedia, 158, 4286-4291.
6. Lerner, J. (2018). Blockchain for Physical Commodity Markets - A Realist's Perspective. Retrieved from https://www.jpmcc-gcard.com/wp-content/uploads/2018/12/Special-Feature-Collection-111918.pdf#page=44

# Definitions

**Blockchain:** a system in which a record of transactions is maintained across computers that are linked in a peer-to-peer network.

**Cryptocurrency:** A digital or virtual currency that uses cryptography for securing transactions, controlling the creation of new units, and verifying the transfer of assets. Cryptocurrencies are typically decentralized and built on Blockchain technology.

**Distributed Ledger:** A type of digital ledger that is maintained and updated across multiple computers or nodes in a network, rather than being stored in a central location. Distributed ledgers are used in blockchain technology to ensure that transactions and data are replicated and synchronized across the network, increasing security and resilience.

**Hash:** A unique and fixed-length alphanumeric string generated from block data using a cryptographic algorithm, used for data integrity verification and as a building block for blockchain's consensus and security mechanisms.

**Private Key:** A cryptographic key that is used to secure and authenticate transactions or data on a blockchain. Private keys are kept secret by the users and are used to sign transactions or data entries, ensuring that only the rightful owner can access and modify the data on the blockchain.

**Proof of Work (PoW):** A consensus algorithm where miners compete to solve complex mathematical puzzles to validate transactions and create new blocks. The miner who solves the puzzle first gets the right to add the new block and is rewarded with cryptocurrency. PoW requires a significant amount of computational power, electricity, and resources, making it resource-intensive and costly.

**Proof of Stake (PoS):** A consensus algorithm that relies on validators, also known as stakeholders, to validate transactions and create new blocks. In PoS, validators are chosen to create blocks based on their stake, or ownership of cryptocurrency, in the network. Validators lock up a certain amount of cryptocurrency as collateral, or "stake," to participate in block creation, and they are rewarded with transaction fees. PoS is considered to be more energy-efficient compared to PoW as it does not require extensive computational power and electricity, but it still incentivizes participation and security through the collateralization of cryptocurrency.

**Smart Contract:** Self-executing contracts with the terms of the agreement directly written into code on a Blockchain. Smart contracts automatically execute once the pre-set conditions are met, without the need for intermediaries.

**Token:** A digital asset or representation of value that is created, stored, and transferred on a blockchain network, typically using smart contracts. Tokens can serve various purposes, including facilitating transactions, representing ownership, accessing services, and participating in dApps or smart contracts.