WEB3 IN REAL ESTATE DECARBONIZATION

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Web3 applications offer unique capability to monetize real estate carbon value—but Web3 tech alone cannot solve dysfunction of the carbon marketplace.

The building sector's decarbonization progress made to date has not been enough to achieve the target of limiting global warming to 1.5°C.[1] According to UN's Intergovernmental Panel on Climate Change (IPCC), many of these limiting solutions already exist, but what is missing is the political ambition and financial incentives needed to make this happen at scale.[2]

To avert a catastrophic climate disaster, industries need to mobilize capital at the requisite scale and speed. However, as things stand, the investment in building decarbonization is unlikely to increase radically in the next few years. One of the biggest challenges to sea-change in this space is the financial barrier of decarbonization on the demand and supply side of the building sector. This barrier will lead to significant investment gaps and a subsequent market failure to deliver the net zero carbon emission target.

Monetizing carbon value in commercial real estate through the voluntary carbon market has been explored by various research programs and modeling, but implementation has faced challenges. For example, a 2010 MIT Center for Real Estate research paper explored the idea of monetizing carbon value in commercial real estate via the voluntary carbon market.[3] In 2020, the US commercial and residential sectors generated significant carbon emissions with 1.8 GMtCO2e. Approximately 5% of these emissions could qualify for tradable carbon offsets, resulting in a potential market value of $2.1 billion annually, with $45 per ton of Co2e, and the $30 billion asset value with a capital rate of 7%.

However, the idea has yet to gain traction due to regulatory and technological obstacles. Four challenges hinder the progress of tapping into the significant financial value that exists in commercial real estate decarbonization:

1. Lack of a robust, consistent methodology to measure and verify carbon emission reduction
2. Lack of a highly streamlined, automated, cost-effective process to monetize carbon reduction from individual properties
3. Split incentives between stakeholders in the decarbonization value chain, especially owners, operators, and tenants
4. A failing voluntary carbon market, which otherwise allows carbon emitters to offset their emissions by purchasing carbon credits emitted by projects targeted at removing or reducing greenhouse gas from the atmosphere.

EMERGING WEB3 APPLICATIONS IN DECARBONIZATION

In recent years, many notable use cases have emerged in to solve climate challenges with Web3 technologies. In 2022 COP27, the Climate Change Coalition expressed interest in using blockchain to develop greenhouse gas emissions accounting.[5] US President Biden's March 2022 Executive Order 14067 calls for a discussion of the potential uses of blockchain for monitoring or mitigating climate impacts.[6] The Hyperledger Climate Accounting Special Interest Group (CA2SIG), uses blockchain, AI, IoT, and Big Data to create a climate accounting system to pool, verify, and certify emissions data of corporate supply chains to create efficient marketplace.[7]

Web3 refers to applications running on decentralized blockchains, facilitating transactions without intermediaries. Web3 applications are built on three key technologies: blockchain, smart contracts, and digital assets. The technology represents a paradigm shift towards decentralization in digital application business models. Blockchain serves as a decentralized database that records assets and transactions. Smart contracts automate transactions based on predefined logic. Digital assets, such as tokens and NFTs, provide a permanent record of value.

Web3 technology has gained traction with projects like Ethereum, enabling user-friendly interactions with the blockchain through decentralized applications (dApps). These dApps allow users to perform actions like generating audit reports or trading tokens directly on the blockchain.

With the rise of the voluntary carbon market, increasing carbon data disclosure mandates, and advancement in Web3 technologies, an emerging cohort of Web3 applications is helping corporations track, tokenize, and transact energy or carbon impact.

For this present analysis, we compiled a list of 79 Web3 startups that have decarbonization solutions (founded between 2012 to November 1, 2022) from Pitchbook, Crunchbase, World Economic Forum, CB Insights. We excluded all startups in the metaverse (AR/VR).

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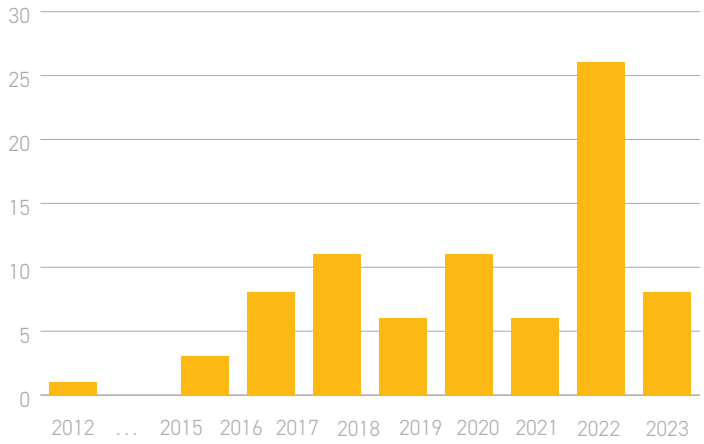
Year founded: 71% of the startups in this analysis were founded from 2018 to present, with 2022 serving as a pivotal year for Web3, when it evolved from a nascent sector to a mainstream industry; 26 of the 79 startups were founded in 2022.

EXHIBIT 1: FOUNDING DATES FOR STARTUPS

Source: Authors



Geography: The US is home to 29 out of the 79 startups, followed by the UK (10), Singapore (7), Canada (6), and Germany(5). Nine out of the top ten most-well funded startups are also based in the US, suggesting a more mature and developed market.

EXHIBIT 2: GEOGRAPHIC LOCATIONS FOR STARTUPS

Source: Authors

Most well-funded startups: The top ten most well-funded startups each have raised more than $20M of funding. Most are in Series A and B, except for Data Gumbo. Data Gumbo raised a $4M Series C in August 2022. Regarding categorization, there is no evidence to conclude favourability, but Patch and FlowCarbon are carbon offset marketplaces with carbon tokens.

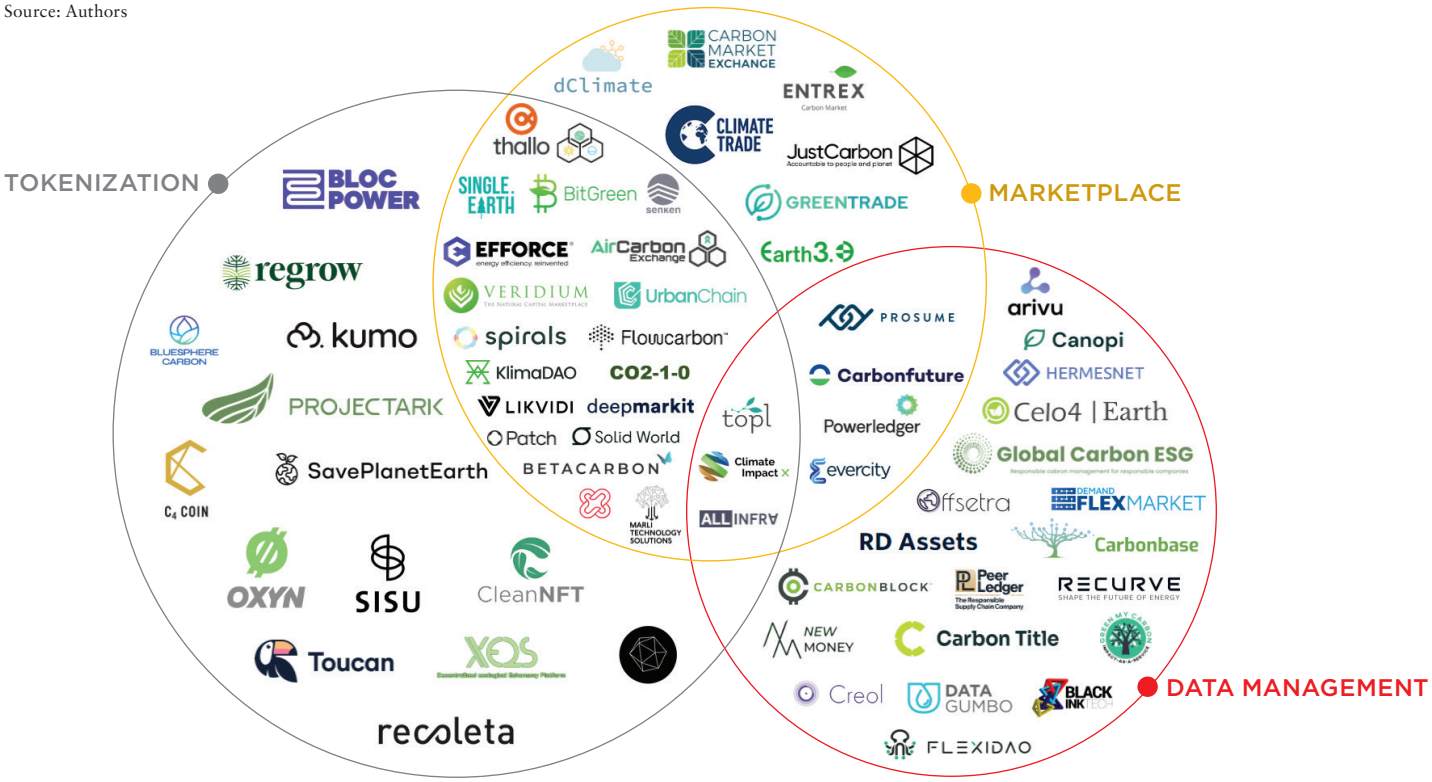
EXHIBIT 3: TOP 10 MOST -WELL FUNDED STARTUPS

Source: Authors

NO	STARTUP LOGO	AMOUNT RAISED (IN US$M)	MOST RECENT ROUND (SERIES A,B,C ETC)	HQ LOCATION (CITY + COUNTRY)	CATEGORY
1	BLOC POWER	265	B	New York, US	Token
2	Patch	81	B	San Francisco, US	Token/MP
3	Flowcarbon	71	A	New York, US	Token/MP
4	regrow	63	B	San Diego, US	Data MGNT/Token
5	BLACK INK TECH	50	B	Charleston, US	Data MGNT
6	Powerledger	35	ICO following by a grant	Perth, Australia	Data MGNT / Token /MP
7	RECURVE SHAPE THE FUTURE OF ENERGY	32	B	Mill Valley, US	Data MGNT
8	DATA GUMBO	26	C	Houston, US	Data MGNT
9	Cleartrace	24	B	Austin, US	Data MGNT
10	topl	20	A	Houston, US	Data MGNT / Token / MP

EXHIBIT 4: THREE CATEGORIES OF STARTUPS

Source: Authors



THE THREE CATEGORIES OF STARTUPS

This cohort of 79 startups focused on decarbonization are using Web3 technologies to do three things: data management (45 out of 79 firms); tokenization (31 out of 79 firms) and marketplace (42 out of 79 firms). But can they offer unique capabilities to tackle the four challenges in monetizing building decarbonization?

To answer this question, we examined each of their applications to unpack what problems are they solving, and what are the unique capabilities and use cases? The goal was to discover if and how these applications are different from the existing approaches to accelerate decarbonization in commercial real estate.

Our findings are a mixture of "the emperor's new clothes" and "the next big thing." Broadly, Web3 startups are immature; most are at or before proof-of-concept. Nonetheless, Web3 technologies can play a role in providing improvements to carbon data management, aligning stakeholders' incentives, and increasing efficiency in the energy or carbon markets.

Data management startups focus on two main use cases: carbon tracking and measurement, and audit automation.

1: DATA MANAGEMENT

Web3 technology uses blockchain to record internet-connected device measurements, ensuring trusted and tamper-proof environmental data. Data management startups in the decarbonization space leverage Web3 and other technologies including IoT, AI, and ML to monitor decarbonization initiatives in real-time and improve accuracy. Blockchain and smart contracts enable data transparency and immutability, benefiting asset owners, lenders, insurers, and rating agencies.

Data management startups also focus on two main use cases: carbon tracking and measurement, and audit automation. These solutions provide verifiable energy and carbon records, automate sustainability reporting, and ensure accurate measurement of carbon consumption. For example, Recurve helps measure energy usage and efficiency impact, while Black Ink Tech.io and Data Gumbo automate ESG reporting.

Measurement, verification, and audit automation can be addressed using none Web3 approach. Singularity, Wattcarbon, and Resurety record real-time emissions data to a centralized database. These solutions allow the customers to visualize energy data or automatically scale back their emissions. The existing approach is a centralized model. Applications developed in this model are proprietary, and their functionality and governance are controlled by centralized institutions, with revenues distributed to shareholders.

The difference of the Web3 approach is it utilizes open standards and decentralized protocols. The control is no longer centralized in large platforms and aggregators but is distributed through blockchains and smart contracts. This means that trusted, centralized intermediaries may no longer be necessary for data sharing and value exchange. For example, Cleartrace and FlexiDao operate with the Web3 approach by recording energy source emissions data to a public blockchain. Brookfield Properties used Cleartrace's ledger to digitally match One Manhattan West's electrical consumption to generate immutable and auditable records of reduced consumption for all hours of the year.

The main value brought by Web3, within and beyond the decarbinzation niche, is the immutability of the record and not requiring intermediaries. Data management protocols using public blockchains provide permanent records through smart contracts, independent of the creators' business status. However, Web3 approaches have limitations, such as high costs associated with storing and processing large volumes of data on public blockchains. A Web3 targeting the removal of intermediaries as an advantage must demonstrate that the added trust provides more value than the costs associated with storage and processing via the blockchain. Existing companies such as WattPower can also use open standards to automatically producing audit reports, which performs the same function as smart contracts in the Web3 approach. For these reasons, using blockchains for data management does not provide additional value until improved protocols reduce storage and processing costs drastically.

2: TOKENIZATION

The second category of Web3 apps for deccarbonization is tokenization, which simplifies the sourcing and financing of carbon credits by representing them as digital units on the blockchain. This brings transparency, generates pricing data, and facilitates pre-purchase agreements on a public ledger. Tokenized carbon credits can be divided into smaller units, benefiting small-scale projects and enabling easier buying, selling, and retirement of credits. For example, SolarCoin, a blockchain-based cryptocurrency, encourages the adoption of solar panels by tokenizing solar photovoltaic assets. Recognized by IRENA, SolarCoins are issued for each megawatt-hour of solar power generated and can be traded for fiat currency. With over 1.7 million MWh of solar energy incentivized across 44 countries, SolarCoin proves its effectiveness in promoting renewable energy adoption.[8]

Startups in the tokenization category focus on three key use cases. The first is issuing utility tokens that directly link their value to carbon emissions. These tokens store information related to certified carbon credits, auditing, and project monitoring, fostering transparency and growth in the voluntary carbon market. Companies such as Topl, AllInfra, and Single.Earth's MERIT enable investors and stakeholders to trace the origin of GHG data associated with these tokens, providing access to data and economic rights.

The second use case for tokenization involves regenerative finance (ReFi) and decentralized finance (DeFi). ReFi on the blockchain estimates the value of natural assets based on their regeneration and preservation properties, challenging traditional finance models. Startups such as KlimaDAO and Toucan utilize utility tokens to monitor, automate reporting, and create additional financial benefits, fostering peer-to-peer transactions.

The third use case revolves around non-fungible tokens (NFTs) that certify climate impact. Platforms such as IMPT offer tokenized carbon credits as NFTs, representing specific CO2 emissions to be removed from the atmosphere. IMPT incentivizes retailers to contribute a portion of their sales margin to environmental projects, and members can track their carbon score and earn points through burning NFTs and collecting IMPT tokens.

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BlocPower, a real estate sector initiative, aims to tokenize building decarbonization through a protocol for environmental justice carbon offset tokens. These tokens represent energy savings and offset greenhouse gas emissions from BlocPower's retrofit projects. However, the tokenization initiative is still in the conceptual stage due to several challenges. Firstly, the application's ability to establish token pricing is hindered by the absence of a functioning voluntary carbon market, with Verra and Gold Standard proving inefficient and difficult to approve methodologies. Additionally, the lack of digital infrastructure in buildings poses a challenge in automating and aggregating carbon data, limiting the ability of smaller landlords to leverage the monetary value of carbon reduction. These obstacles have delayed the launch of BlocPower's tokenization initiative, highlighting the need for market development and digital infrastructure improvements.

Tokenization has the potential to address broader decarbonization challenges, such as split and misaligned financial incentives among stakeholders. By aggregating carbon value, tokenization facilitates trading accessibility and incentivizes pro-environmental behavior. NFTs can be used to reward conservation efforts in buildings and encourage energy optimization. While BlocPower and other similar tokenization initiatives are generally still in the conceptual stage, they have the potential to overcome hurdles related to token pricing and the lack of digital infrastructure in certain sectors.

3: MARKETPLACE

The third category of Web3 applications for decarboniation is the marketplace, which focuses on improving the transparency and efficiency of carbon and renewable energy trading. Startups such as Flowcarbon, Bluesphere Carbon, Carbonfuture, Patch, and UrbanChain offer Web3-enabled trading infrastructure, bringing voluntary carbon credits and renewable energy credits onto the blockchain. These marketplaces streamline the process of evaluating and purchasing carbon credits from projects that impact the climate, biodiversity, and local communities.

Carbon Trade Exchange (CTX), Xpansiv CBL, AirCarbon Exchange (ACX), EKO Marketplace, and Thallo are blockchain-based exchanges that provide secondary markets for tokenized carbon credits, adding liquidity and data transparency to carbon credit trading. There are also peer-to-peer renewable energy trading platforms such as Urbanchain, enabling decentralized energy sharing using blockchain technology; FLEXMarket, a demand flexibility platform that compensates aggregators for delivering value to the grid; and the Reneum Institute in Singapore, which operates a vertically-integrated renewable energy marketplace, issuing renewable energy credits (RECs) called RENW to certified clean energy producers, allowing them to monetize their energy production and accelerate renewable energy deployment.

Blockchain platforms in the carbon market offer liquidity, transparency, security, and automation through smart contracts, addressing issues such as double-counting and fraud. However, while blockchain improves the efficiency of trading, it may not solve the fundamental challenges of the voluntary carbon market, which requires more regulation and buyer trust.

In other words, Blockchain cannot solve the root cause of voluntary carbon market failure. Verifiable data linked to carbon tokens is crucial to establish a risk profile and encourage investment in high-quality carbon credits. Each carbon project has unique characteristics and benefits, and platforms with verifiable data help investors identify, source, and track high-quality carbon projects. Regulatory measures and verifiable data are necessary to address the underlying challenges of the carbon market.

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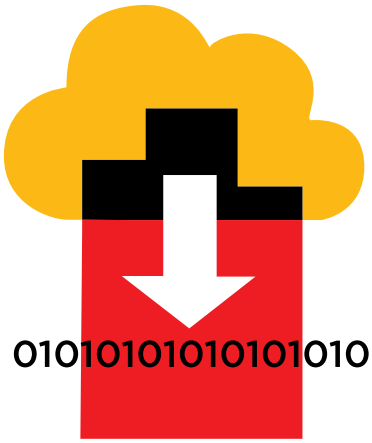
TRACKING, TOKENIZING, AND TRANSACTING

The following table summarizes how emerging Web3 startups are helping corporations track, tokenize, and transact energy or carbon impact.

EXHIBIT 5: HOW WEB3 STARTUPS HELP WITH TRACKING, TOKENIZING, AND TRANSACTING CARBON IMPACTS

Source: Authors

CATEGORY	USE CASE	CURRENT APPROACH	WEB3 APPROACH
Data management	**Carbon measurement and verification**	IoT devices collect and store data on a centralized platform, e.g., smart meters. Examples: *Singularity, Watttime, and Resurety*	IoT devices collect data and store data on blockchain that is verifiable and immutable, and thus tamper-proof, Examples: *Carbon base, carbon title, ClearTrace, FlexiDao*
	Audit Automation	Manual generation of energy audit reports (e.g., Excel) or generation of reports via a centralized 3rd-party service. In some cases, audit reports can be automatically generated using open standards that cannot be altered.	Energy audit reports are generated based on transparent, pre-defined rules specified in a smart contract. The smart contract generates these reports using tamper-proof data recorded on the blockchain. Example: *Recurve, Evercity,*
Digital Asset/ Tokenization	**Green building certification**	Carbon footprint assessment conducted as part of a third-party certification process (e.g., LEED, BREAM)	Carbon footprint reductions are converted to digital tokens representing avoided emissions. These tokens can then be held to represent the value of reduction efforts or be exchanged for goods and services. Example: *Topl, AllInfra*
	Energy efficiency financing	Traditional bank loans, energy performance contracts	Digital tokens are used for crowdfunding of decarbonization projects; retrofit projects receive tokens in exchange for carbon offsetting. Tokens can be lent via decentralized finance (DeFi) infrastructure. Example: *SolarCoin, Green Bonds*
	Stakeholders engagement	Manual tracking and incentives for energy savings programs; competitions on the conservation effort Example: Utility incentive, green lease	Incentives and rewards are automatically and transparently administered to tenants who meet reward criteria; smart contracts administer these based on tamper-proof data logged to the blockchain. For example, a climate NFT, or climate non-fungible token, is a digital asset that represents a specific environmental benefit or impact, such as a carbon offset or a renewable energy credit.
Marketplace	**Primary Market-Carbon offset Platform**	Carbon offset assessment conducted as part of a third-party certification process (e.g., Verra)	Offsets are automatically tracked, evaluated, and tokenized by smart contracts reading tamper-proof historical data logged to the blockchain by IoT devices.
	Secondary Market-Carbon offset exchange	Centralized trading platform for carbon offsets. Run by the centralized institution to facilitate transactions and provide spot prices for CO2 offsets. Carbon TradeXchange	Automated, transparent marketplaces determine the price of carbon offsets, which are traded as digital assets via a smart contract. (Alternatively, traditional marketplaces are used for trading tokenized carbon credits). The added liquidity helps drive supply and demand by making carbon offset pricing more reliable. Example: *AirCarbon*
	Renewable Energy platform	Centralized control and management, some with grid integration, e.g., of virtual power plants	Decentralized control and management (i.e., power trading is negotiated among peers, rather than by the central utility company) example: *FlexMarket, Reneum*



In the existing startup landscape, Web3 applications offer unique capability to monetize real estate carbon value through increased data transparency and aligning stakeholder via tokenization to unlock new sources of investment.

Given Web3's decentralized and immutable nature, it can play a critical tool in helping address climate change. In the existing startup landscape, Web3 applications offer unique capabilities to monetize real estate carbon value through increased data transparency and aligning stakeholder via tokenization to unlock new sources of investment. But the Web3 technology alone cannot solve the dysfunctions of the carbon marketplace, because a. functioning voluntary carbon market needs centralized and coordinated regulations, which is a must-have to govern the carbon accounting and corporate claim standards.

The Web3 market needs policies and standards for monitoring carbon offset projects. And besides carbon market regulation, Web3 also needs to meet certain technological and industry prerequisites to achieve its disruptive potential. These prerequisites include automated data collection systems involving IoT devices (e.g., for carbon credit verification), and all data sources contributing to a final report must be verifiably embedded in the Web3 ecosystem. Any gaps in this ecosystem break the chain of trust and introduce an opportunity for tampering or introducing illicit data. The distributed ledger must become faster and memory-efficient to process and store the large volume of data that needs to be recorded for climate impact monitoring. The industry also needs a straight-through process for issuing, trading and valuing carbon and decarbonization actions via a blockchain platform. The main goal of this process is to enable the digital monitoring and measurement, reporting, and verification tools that allow for the creation, allocating, and trading of carbon products by directly connecting the performance of an ESG action and/or asset to an industry-recognized mechanism and financial products.

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NOTES

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