

Introduction to the Digital Carbon Market

Driving real-world impact through ReFi

The Regenerative Finance – ReFi – movement emerged early in 2022 and has since grown from a largely conceptual existence to infrastructural maturity, primed for increased access and adoption in 2023. It is fitting that ReFi has been named by Forbes as one of the top five Web3 trends for 2023, as we believe that over the next year the space will mature further and form the bedrock of a new Digital Carbon Market (DCM), with KlimaDAO at its center.

ReFi employs the Web3 technology stack to retool the global financial system so that it is in balance with the needs of the planet. Its most fundamental building block is digital carbon: a tokenized representation of a carbon credit that inherits the immutability, transparency, and trust of the underlying blockchain database. Digital carbon is a 'money Lego' – it can be used to power applications, enable new use cases, and, ultimately, scale financing to climate projects. The potential for digital carbon to help achieve the environmental Sustainable Development Goals is the most exciting thing we have seen at KlimaDAO, and the opportunities for stakeholders in the ReFi space are massive and yet-to-be tapped.

KlimaDAO launched on October 18th, 2021, with a vision to accelerate the delivery of climate finance globally by building transparent, neutral, and public infrastructure for the carbon market. Since then, significant progress has been made within the DCM. Over 25 million carbon credits – representing 2.52% of all Verra-issued credits – have been brought onto the blockchain using the KlimaDAO treasury's bonding mechanism. The resulting liquidity pools, and KlimaDAO's offsetting infrastructure, have been increasingly adopted, bringing the total retired tonnage in the DCM to over 500,000 tCO2e.

The State of Digital Carbon dashboard (accessible at carbon.klimadao.finance) is an unprecedented, open tool to help you navigate these developments, and the DCM more generally. This report illustrates the mechanism as well as the context and benefits of transacting in digital carbon and facilitating retirements or redemption (acquisition) of digital carbon credits from specific projects. We also illustrate how you can use KlimaDAO's tooling and infrastructure to be positioned to take advantage of the digital carbon opportunity.

Along with over 50 contributors at KlimaDAO, and our 80,000+ KLIMA stakeholder community, I hope that you benefit from this report, and join us in accelerating climate finance via the DCM in 2023 and beyond.



Andrew Bonneau
Head of Strategic Partnerships,
KlimaDAO

See Sipthorpe, A. et al. (2022). Blockchain solutions for carbon markets are nearing maturity. One Earth, Volume 5, Issue 7, pp. 779–791.



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Trading digital carbon: the opportunity

KlimaDAO facilitates the sale and acquisition of carbon credits that have been bridged onto the blockchain – we call this 'digital carbon'. We provide a suite of tools that allow traders and brokers to access digital carbon from our pools to source and retire on behalf of their clients. In addition, for market players who originate carbon themselves, the KlimaDAO carbon pools can serve as a counterparty for these assets.

At the moment, an opportunity exists whereby the price of on-chain carbon credits is lower than that of their off-chain equivalents despite representing the **exact same projects.** This pricing differential can be up to 286% in favor of on-chain credits. Beyond this, our tools offer unprecedented transparency and insight into the pools and projects you are sourcing from – an added benefit for future trades or certification once the credits are utilized or retired.

Price discrepancy between on-chain and off-chain carbon credits

Saint Nikola Wind Farm **Bulgaria**	**$4.96*** OFF-CHAIN PRICE	**$1.55** ON-CHAIN PRICE (AS OF AUGOST 29TH, 2022)	**52,986** TONNES (VOLUME AVAILABLE ON-CHAIN)	**220%*** DIFFERENCE
29.70 MW Wind Power project in Karnataka **India**	**$5.99*** OFF-CHAIN PRICE	**$1.55** ON-CHAIN PRICE (AS OF AUGOST 29TH, 2022)	**80,000** TONNES (VOLUME AVAILABLE ON-CHAIN)	**286%*** DIFFERENCE
Salto Pilão Hydropower Plant Project Activity **Brazil**	**$5.08*** OFF-CHAIN PRICE	**$1.55** ON-CHAIN PRICE (AS OF AUGOST 29TH, 2022)	**187,677** TONNES (VOLUME AVAILABLE ON-CHAIN)	**227%*** DIFFERENCE

*Estimated



Trading digital carbon: the opportunity

We encourage traders, brokers, and other stakeholders to explore our carbon pools to find digital carbon credits representing projects they would like to have on their books either to hold via redemption of TCO2s (non-fungible tokens representing specific carbon projects and their corresponding information) or trade.

Further to this we are seeding new carbon pools, including nature-based, blue carbon, and energy, efficiency and impact credits, and will bridge demand and supply through our suite of on-chain tools. We already have extensive liquidity, with more than 25 million tonnes of carbon credits in our ecosystem across the BCT, NCT, MCO2, UBO, and NBO pools.

Comparison of Carbon Tokens

	Bridge	Carbon Project Types	Vintage	Carbon Liquidity**
BCT Base Carbon Tonne	Toucan	Mostly Renewables	2008 or later (Oct 2021 till May 9th, 2022) At most 10 years prior to the year of bridging (since May 10th, 2022)	1.05M
NCT Nature Carbon Tonne	Toucan	Nature Based	2012 or later	111,000
MCO2 Moss Carbon Credit	Moss	Amazon Forest	2013 or later	17,800
UBO Universal Basic Offset	C3	Mostly Renewables	2014 or later	18,000
NBO Nature Based Offset	C3	Nature Based	2014 or later	15,500

*Anyone can bridge carbon on chain using a permissionless bridge, while a permissioned bridge requires human verification

**Number of tokenized carbon units available (correct as at July 13th, 2022)



The benefits of digital carbon

Digital carbon offers unique benefits in terms of automated offsetting, transparency and traceability, liquidity provisioning, and accessibility. The Voluntary Carbon Market (VCM) is expected to grow exponentially over the coming years, with the Taskforce on Scaling Voluntary Carbon Markets predicting a 15-fold increase in the VCM by 2030 to a market cap of upward of $50 billion, further growing to 100 times its current size by 2050. In line with the increasing digitalization of the global economy, we expect the nascent Digital Carbon Market (DCM) to be the powerhouse behind this growth.

Some of the dynamic benefits and features that make digital carbon superior to traditional carbon credits are as follows:

Fractionalized offsetting

KlimaDAO enables fractionalized offsetting as well as whole tonne amounts, which means small, repeatable, transactional activities can be automatically offset through smart contracts, using KlimaDAO's mechanisms.

Automated offsetting

Smart contracts can be used to trigger purchases and retirement based on certain criteria being realized – for example, to offset emissions associated with a supply chain based on available off-chain data or to automatically offset emissions associated with trades occurring on a Web3 platform.

Example: KlimaDAO integration with SushiSwap

Transparency and traceability

KlimaDAO's carbon pools can be explored by project and by geography, so you can see exactly what is being redeemed or retired. This also means that transaction certificates clearly show what an individual or organization has retired or redeemed, and for what purpose (if you wish to make this public). Furthermore, this is viewable on a dashboard for all to see, traceable down to the project. The traceability of digital environmental assets on the blockchain is clearly visible via the Klima Data Carbon Dashboard, which provides near real-time information on the status of various digital carbon pools and their prices.

Further information:
Carbon Dashboard: Unprecedented carbon market transparency

Liquidity provisioning

Web3 vastly improves the liquidity of the VCM, and digital carbon enables more dynamic investment and funding models for projects that would otherwise be hard to fund but can produce very high-quality credits. For example, an improved cookstoves project for Rohingya refugees in Bangladesh will potentially be funded by the KlimaDAO treasury, yielding Gold Standard registered credits for a new energy efficiency and social impact (EEIMP) digital carbon pool.

Reference: EEIMP project on KlimaDAO forums
Overview of liquidity: KlimaDAO Carbon Dashboard

Accessibility

Digital carbon is directly accessible and transactions are almost instantaneous. This makes redemption or retirement of digital carbon easy and facilitates both choice and speed with readily accessible pricing information.

Resource: Klima Infinity User Guide



The Digital Carbon Market (DCM) ecosystem

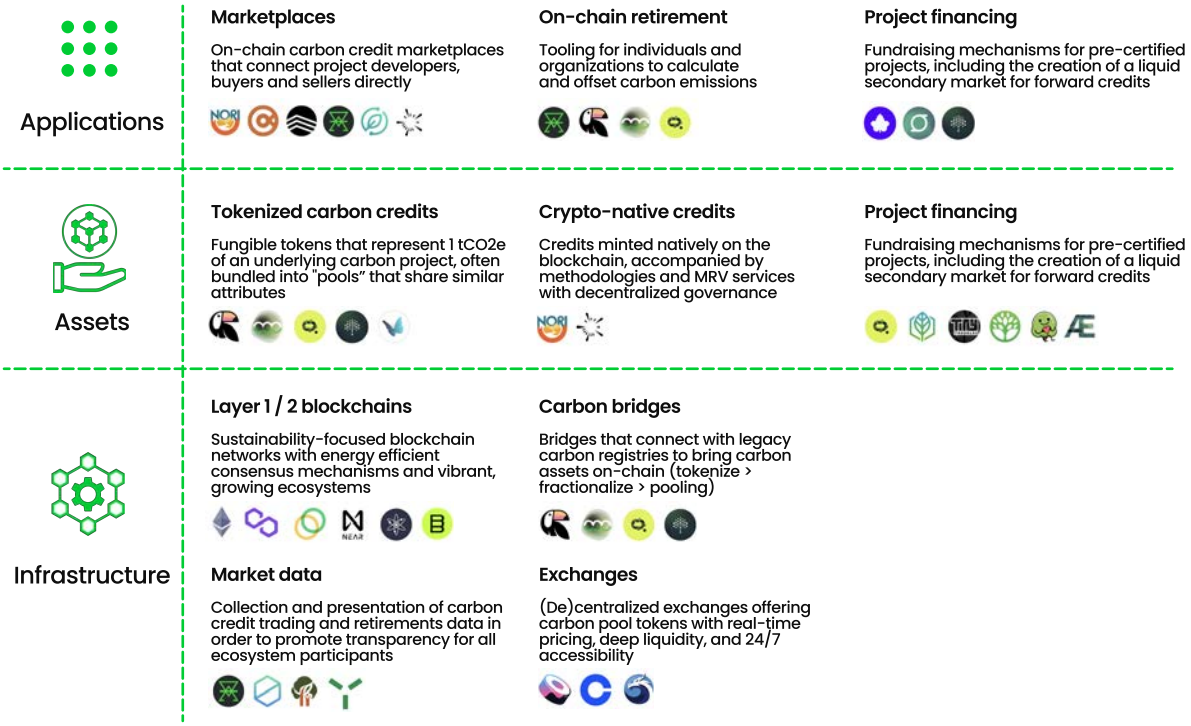
The DCM ecosystem is the segment of the carbon market that has emerged on public blockchains. The benefits of public blockchains include their open, permissionless nature (writability), their transparency (readability), and the development of novel incentive mechanisms and governance systems (tokenomics).

In addition to leveraging the explicit benefits of the blockchain, DCM solutions also leverage existing technologies that have been developed through Decentralized Finance (DeFi), such as programmable smart contracts and Automated Market Makers (AMMs). These enable interoperability between applications and the instant settlement of market activities.

To date, the digital carbon ecosystem has primarily provided the infrastructure rails to allow already-issued carbon assets access to the benefits of the blockchain, with marketplaces and on-chain retirement applications being developed to enable the environmental benefit of the assets to be claimed.

As the space evolves, there is an ambition to enable greater participation in this ecosystem. For example, forward agreements can be entered into with project developers, enabling the issuance of carbon credits that specifically fulfil the needs of the digital carbon ecosystem.

The below diagram summarizes the ecosystem that has emerged in 2022.



Nori · Thallo · Senken · KlimaDAO · GreenTrade · Regen Network · Toucan · C3 · Moss · Ivy · Solid World DAO · Flow · Coorest · Tiny Troubles · Aerth · NFTrees · Allied offsets · Sushi · Coinbase · Quickswap · Ecosystem Marketplace · ZeroLabs · Polygon · Celo · Near · Cosmos · Bitgreen



WANT TO LEARN MORE ABOUT
BRINGING OFFSETS ON-CHAIN?

KlimaDAO

PRESENTS

((ON SET))

In these sessions you'll learn
how carbon is bridged on-chain,
how you can go digital,
and most importantly,
how you can utilize digital carbon.

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Introduction to the KlimaDAO Ecosystem



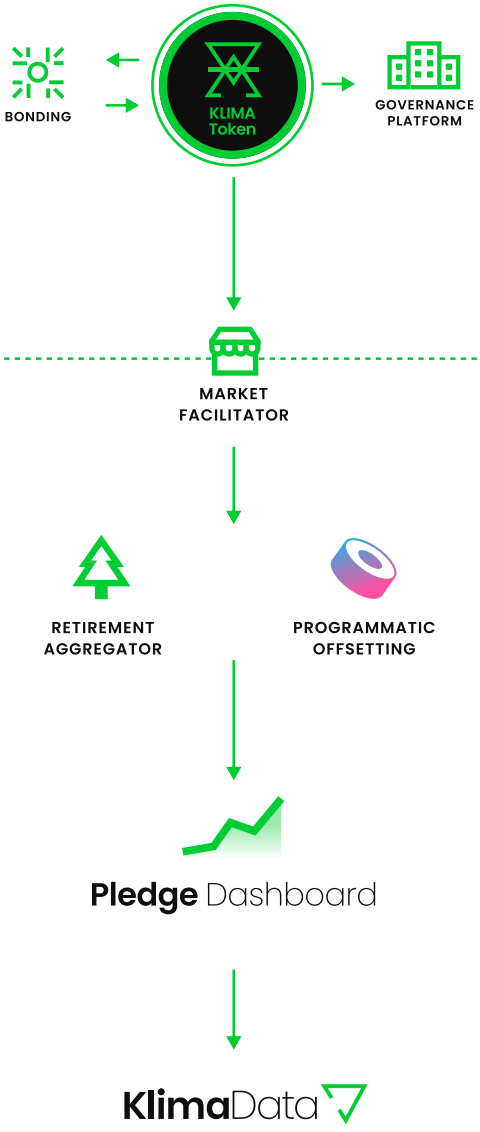
The KlimaDAO ecosystem

KlimaDAO consists of a protocol layer and a product layer, both of which are designed to pass benefits on to those who hold and generate carbon credits and those who wish to use them for environmental claims.

KlimaDAO's protocol layer is responsible for the development of its incentives and treasury management system, which in turn enables the development of supply of digital carbon within the ecosystem, as well as a liquid market for these assets. In addition, it enables and manages DAO governance activities, giving project stakeholders a direct say in the project's development.

Within the product layer, KlimaDAO offers a number of applications and services that have been built on top of the infrastructure and assets within the DCM; fundamentally, these are applications that are interoperable and can integrate with other (off-chain or Web3) applications and other assets that are onboarded into the DCM ecosystem.

The diagram illustrates the KlimaDAO ecosystem, with further discussion of key components overleaf.



The protocol layer

The KLIMA token ("tokenomics")
The protocol mints the KLIMA token, which sits at the center of the protocol layer. KLIMA offers a set of unique benefits to the ecosystem, and enables it to achieve a number of objectives. These include the following:

- Providing an incentive to holders of digital carbon to give their digital carbon to the KlimaDAO treasury via 'bonding';
- Facilitating a liquid market for digital carbon held within the ecosystem via Automated Market Maker technology
- Acting as a utility token that enables the holders of the token to vote directly on Klima Improvement Proposals (KIPs) posted on the KlimaDAO governance platform.

Further information:
What is the KLIMA token's role in the Digital Carbon Market?

The product layer

Applications and services
Digital carbon is intended to be used for productive, pro-environmental activities. Typically this is through the 'retiring' of the asset itself to claim its environmental benefit, although innovative use cases have emerged in ReFi that may offer other avenues for the utilization of digital carbon assets.

KlimaDAO's product layer is designed to enable these activities to happen as effectively and efficiently as they can, by developing novel applications and tapping into the the benefits of public blockchains.

Offsetting demand
By leveraging the liquidity of digital carbon within the ecosystem, users of KlimaDAO's infrastructure can acquire assets and claim the environmental benefit by writing this activity directly onto the blockchain itself, and acquiring a proof of retirement.

The depth of liquidity and versatility of the technology available for digital carbon gives users optionality over the type of carbon credits they wish to utilize for their specific needs.

In addition, the interoperable nature of blockchain technologies can allow direct integrations with third-party applications (both off-chain and Web3) to achieve automated offsetting in response to certain conditions, for example at predefined time-intervals or in response to cumulative carbon emissions from a given platform, entity, or product.

Data insights
As the DCM is hosted on public blockchains, and all activity is publicly readable, data is readily available and increasingly accessible. Our Klima Data service provides two tiers of data services:

User level: each individual wallet on the blockchain can be read to understand previous actions that they have taken. This means that the type of carbon assets that have been retired by a given entity or individual can easily be seen and understood. Users can actively claim their wallet history, or elect to remain pseudonymous.

Market level: all market activity is tracked and logged on the blockchain, meaning there is complete, longitudinal data recorded in real time. This information can be used by a range of market stakeholders to understand the health of the market, inform market decisions, and analyze trends and events.



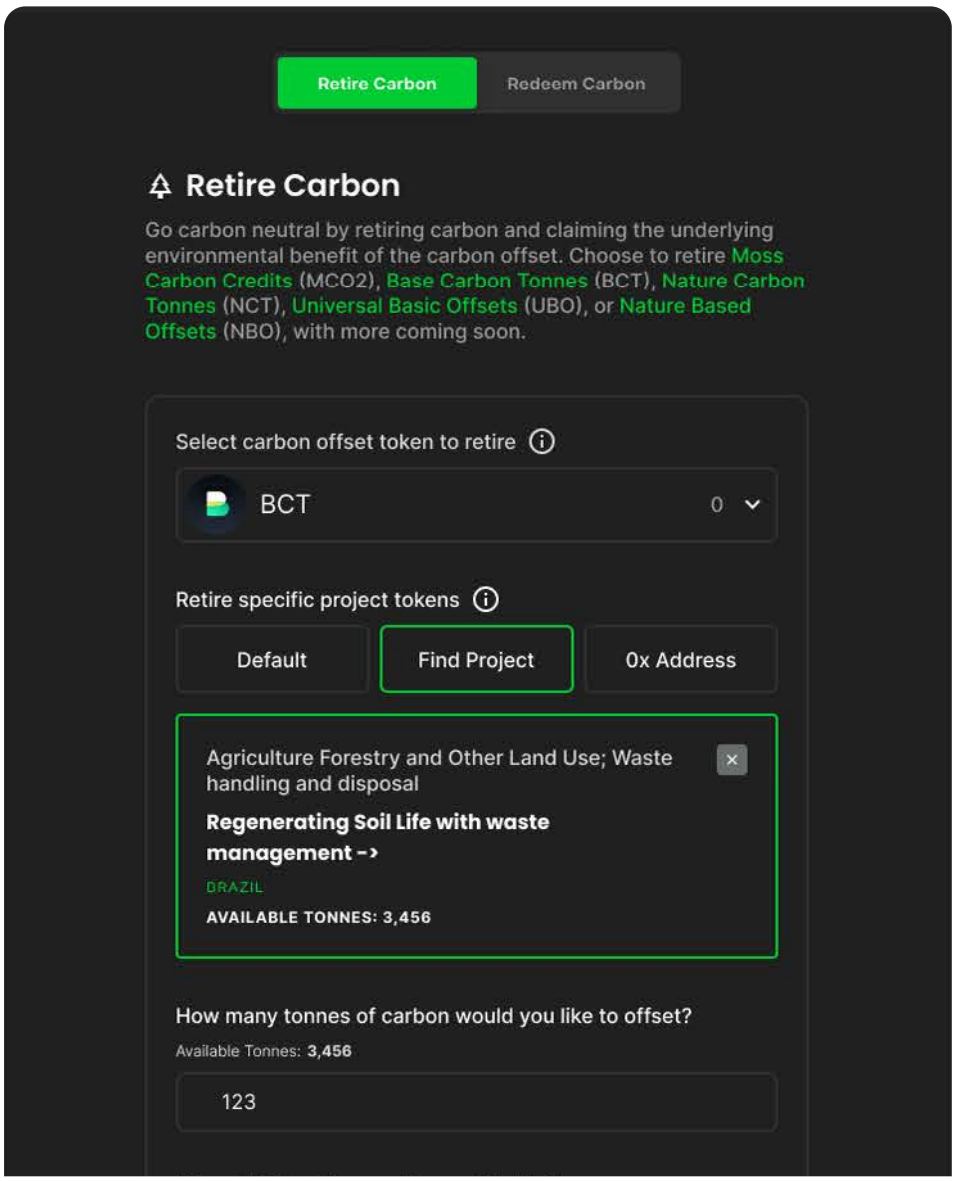
The KlimaDAO retirement aggregator and project redemption

Example use case:
Buying BCT and redeeming a specific project to hold in a Web3 wallet.

A Web3 wallet is analogous to a 'user account' that allows an entity to interface with blockchain-based applications through a web browser via a browser plugin.

Using a Web3 wallet, individuals or businesses can purchase BCT, or swap other digital assets for BCT, in order to redeem a specific project, which can be kept in the wallet for future retirement. BCT can be acquired by swapping various tokens (e.g. USDC, MATIC) through a 'Decentralized Exchange' (e.g. SushiSwap). Once USDC is in a wallet following the steps above, the USDC can be swapped for BCT by connecting the wallet and authorizing the transaction.

Using KlimaDAO's Retirement Aggregator, it is possible to utilize this BCT to selectively redeem carbon credits associated with the project(s) of choice, by choosing the selective redemption feature.



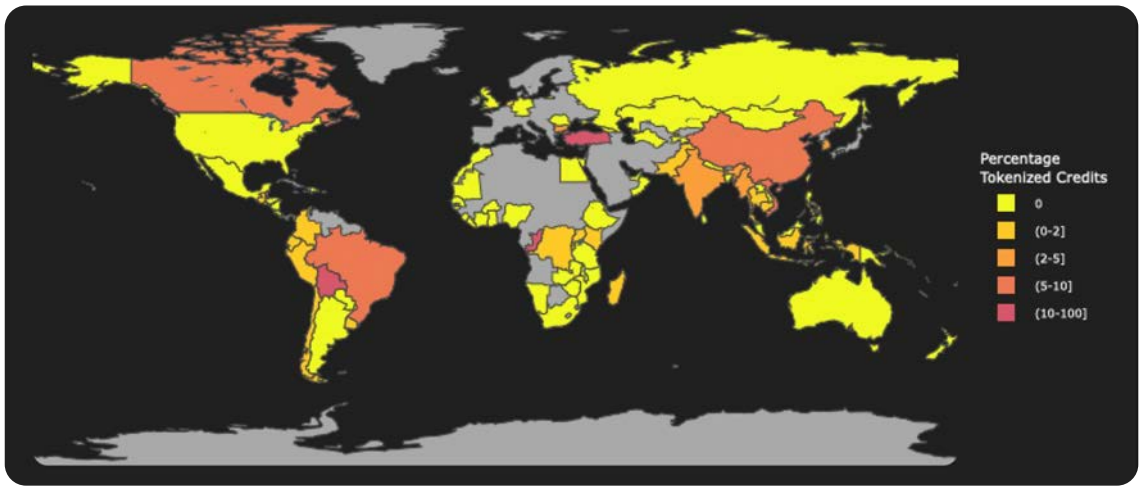
Klima Data

Example use case: Leveraging Klima Data for on-chain market insights

KlimaDAO's Carbon Dashboard allows you to view on-chain carbon market data, including project availability and volumes traded, as well as prices.

Visit the dashboard at carbon.klimadao.finance and explore the current state of the DCM.

▼ Carbon credits in the DCM are surfaced by the Klima Data Carbon Dashboard

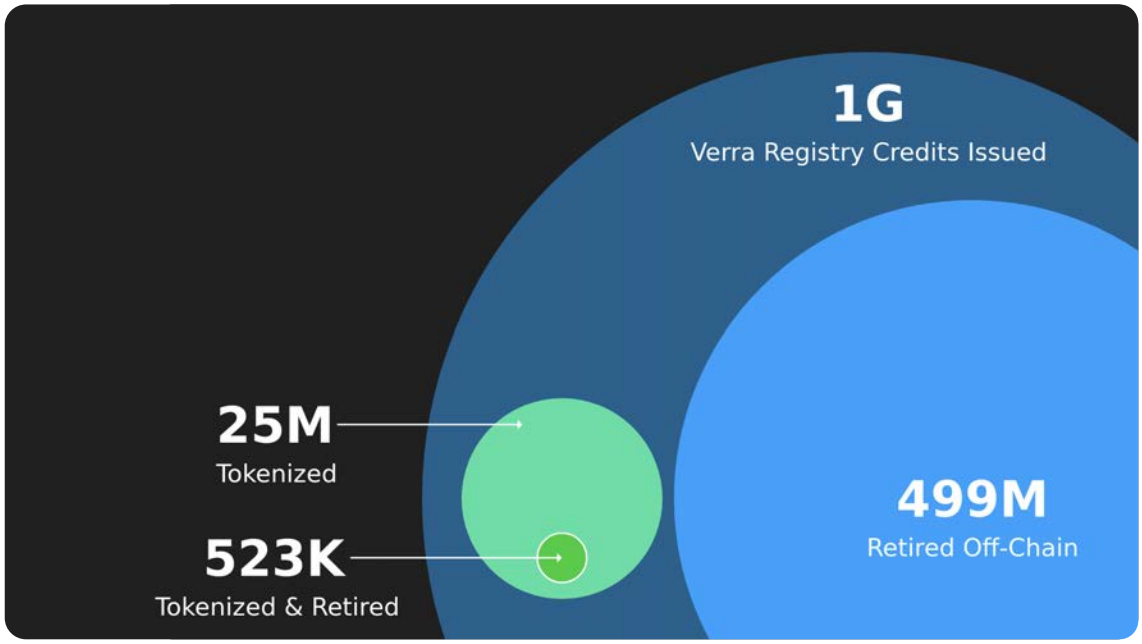


▼ Enabling users to select specific projects from digital carbon pools

NBO Pool Composition Details

Project ID	Token Address	View on PolygonScan	Quantity	Vintage	Country
VCS-981	0xb6ea7a53fc048d6d3b80b968d696e39482b7e578	Click Here	1182.1099	2014	Brazil
VCS-981	0x7dbeebf8c2356ff8c53e41928c9575054a6f331b	Click Here	27295.996	2017	Brazil
VCS-1935	0xfeafae1ff1daeab8fd570dc702228422edd1c9f7	Click Here	100	2015	China
VCS-1686	0x9e61e4f9772eae60099d168f11c7d746899bd305	Click Here	0.99	2018	Brazil
VCS-1715	0x6fae231513be2d149583f597c835ad915fd132bf	Click Here	10	2017	China
VCS-875	0xd28dfeba8fb9e44b715156162c8b6076d7a95ad1	Click Here	4998	2015	Brazil

▼ And providing data visualizations about the state of the DCM





KlimaDAO integrations

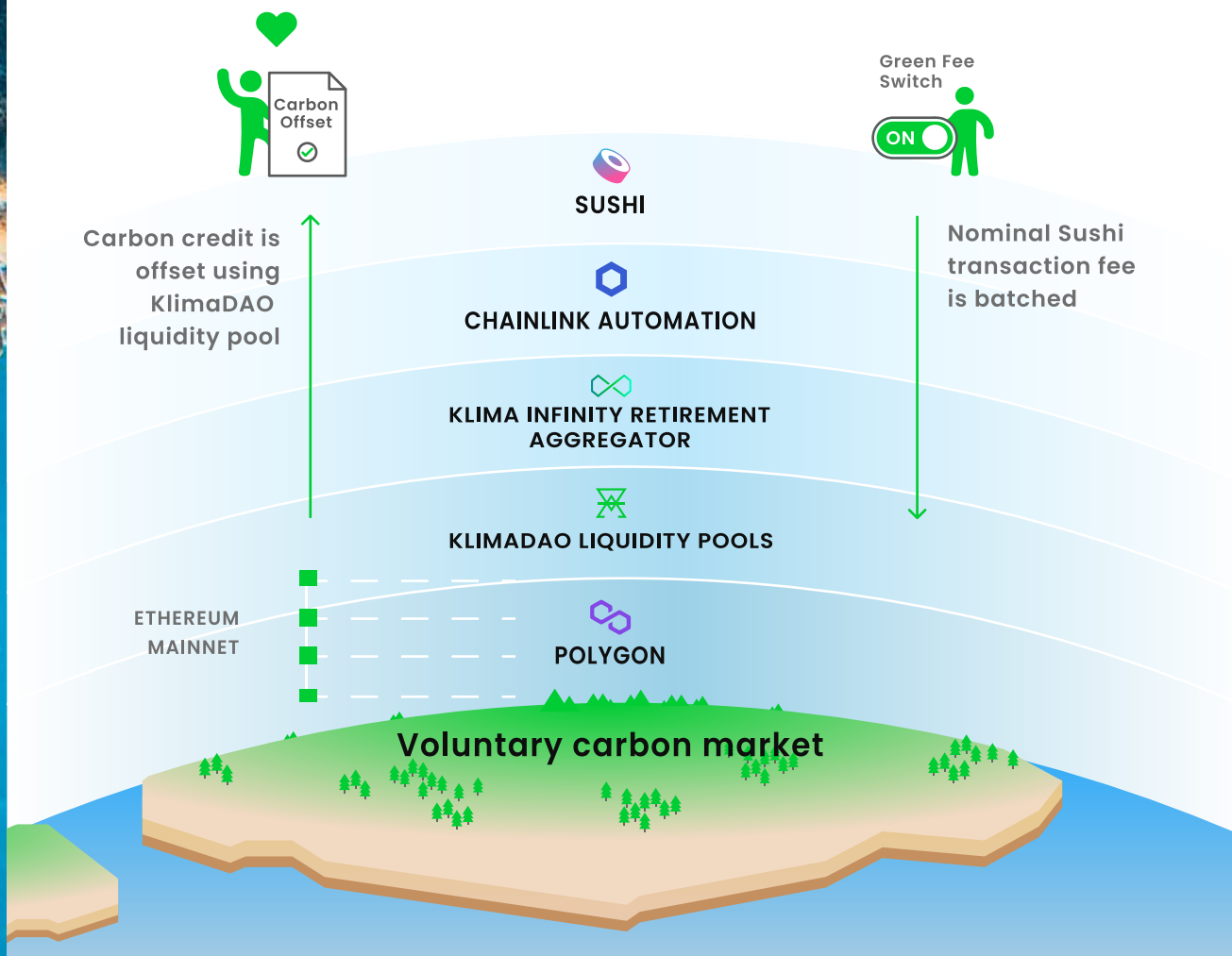
Example use case:
Integrating the Green Fee tech stack to enable automated offsetting

The interoperability of KlimaDAO's Web3 tooling allows for both off-chain and Web3 integrations for programmatic or automatic offsetting, using fractionalized carbon credits for repeated offsetting needs.

A powerful example of this is the implementation of our Green Fee switch on the SushiSwap Decentralized Exchange, which allows users to programmatically offset up to one hundred times their transactions' carbon emissions. This development represents a new type of financial infrastructure that ensures the negative externalities associated with climate breakdown can be addressed at their source. Similarly, our partnership with Confluence Analytics on the Climate Optimized Direct Index (CODI) will allow investors of all sizes to systematically offset the emissions of their portfolios through a robo-investment tool linked to Klima Infinity.

Digital carbon and KlimaDAO's product and service rails make the aforementioned innovations possible—and open up a new wave of possibilities for automatic and programmatic offsetting associated with specific process and transaction types across a variety of off-chain and Web3 applications.

The Green Fee tech stack





Navigating the Digital Carbon Market



How to transact in digital carbon

Once oriented within the DCM and KlimaDAO ecosystem, you can start using the tooling available to you. These are the steps to follow to acquire, redeem and hold, retire, and trade digital carbon through KlimaDAO.

1. Set up a Web3 wallet

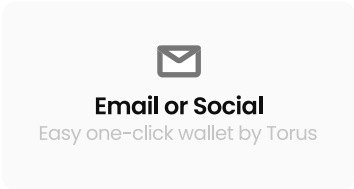
Engaging with the DCM is currently possible via a Web3 wallet such as Metamask or Torus. With a Web3 wallet you can hold digital environmental assets and directly interact with decentralized applications (dApps). We've provided two guides below to get started.

Getting started with Metamask:

View the following guide to install Metamask in your web browser:
https://geekflare.com/finance/beginners-guide-to-metamask/

Getting started with Torus:

Navigate to our application page and then click 'connect' in the upper right hand corner. Once there, select the option 'Email or Social'.



Torus allows you to create a Web3 wallet using a classic Web2 email and password sign in.

2. Purchase a digital asset (e.g. USDC)

USDC can be acquired from widely used crypto exchanges such as Binance, Crypto.com, or Coinbase.

For smaller orders, it is also possible to acquire USDC and/or KLIMA in our application (at app.klimadao.finance) via your credit card. KLIMA can be traded for various digital carbon assets on chain, or used to directly offset through our retirement aggregator. Note that assets purchased on exchanges should be sent to a wallet via the Polygon network.



How to transact in digital carbon

3. Use digital assets to retire, redeem, hold, and trade carbon credits

Simple retirement of carbon credits
Once you have a digital asset like USDC in your wallet, it can be swapped through a decentralized exchange for other assets that have applications on KlimaDAO. This can be the native KLIMA token, or an underlying carbon token like BCT, NCT, NBO, UBO, or MCO2. With the underlying carbon tokens, you can perform a retirement through the KlimaDAO app directly through the offsetting tool.

Selective retirement
Select to retire specific carbon credits based on your or your clients' needs and priorities.

Selective redemption
Select to redeem specific carbon credits that you wish to hold in your wallet for retirement, trading, or disposal at a later date.

Trade
Once you hold TCO2 tokens relevant to specific projects, it is possible to transfer or trade these in the open market.

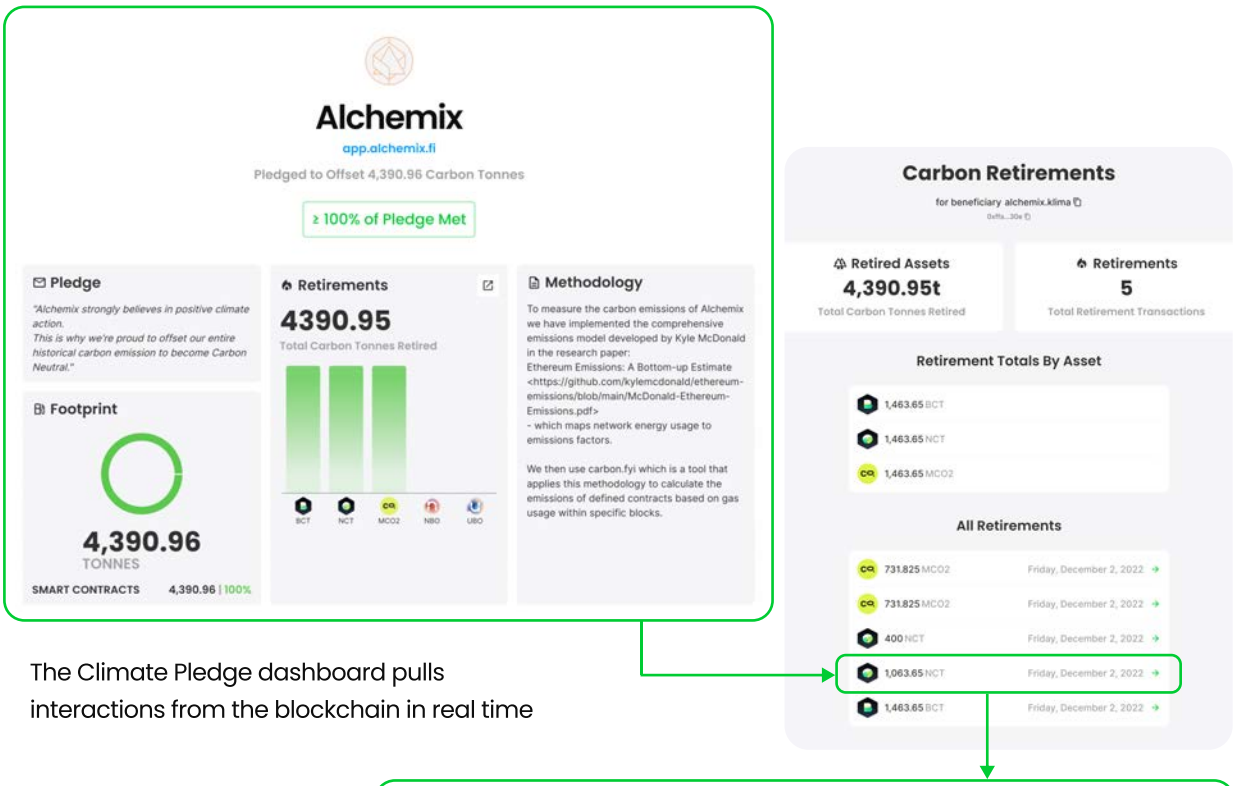


How to trace digital carbon

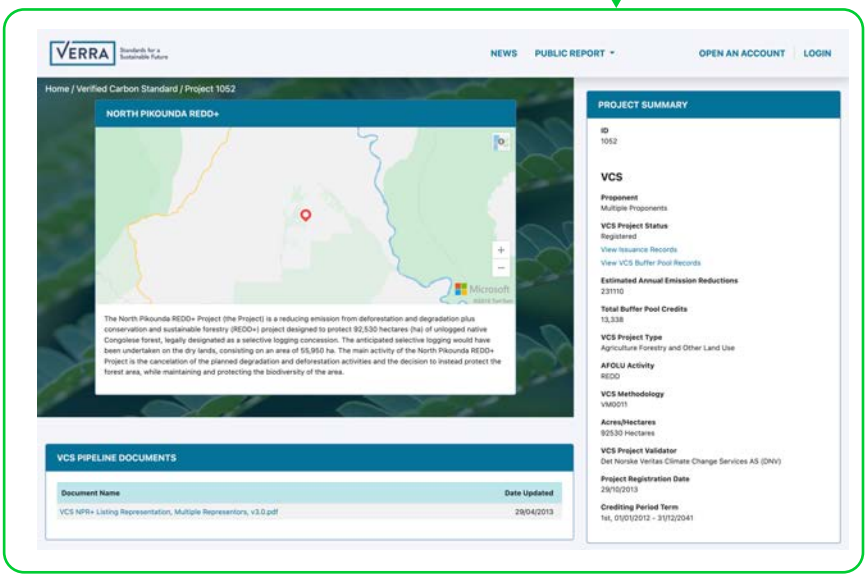
Once you begin to interact with digital carbon, KlimaDAO's tooling helps you to surface data that is derived from the Polygon blockchain. Digital carbon interactions are logged immutably on the blockchain, bringing unprecedented transparency to the DCM.

The starting point for an individual or organization interacting with the DCM can be to set up a Climate Pledge Dashboard. The Dashboard is uniquely associated with each Web3 wallet address, and can aggregate multiple wallets into a group – for example, if your organization uses multiple different wallets to interact with the DCM.

Your Pledge Dashboard displays your historical digital carbon retirements, and updates in real time. Clicking through, each offset transaction can be traced, and the associated carbon project details allow you to easily view the project in the carbon registry's database.



The Climate Pledge dashboard pulls interactions from the blockchain in real time



Each retirement transaction can be drilled down, allowing you to easily view the project in the carbon registry

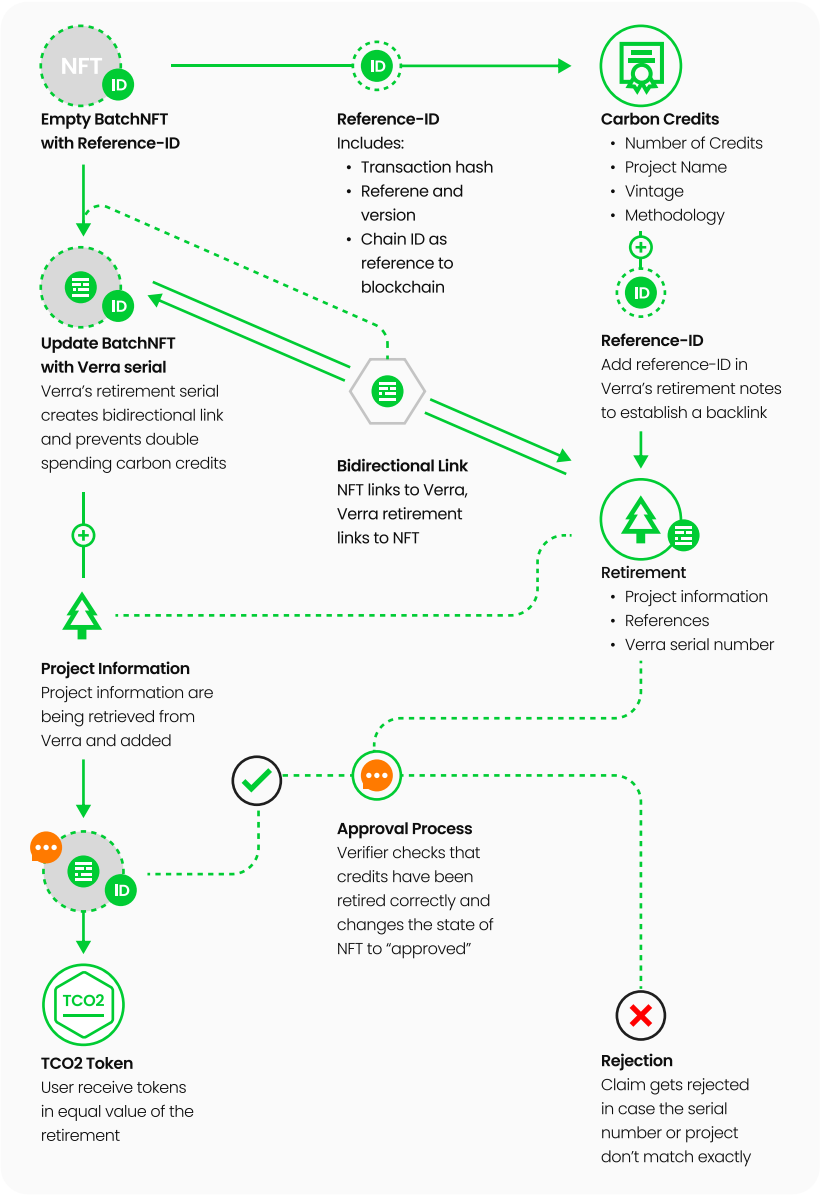


How digital carbon is bridged

Web3 carbon bridges like C3, Toucan Protocol, and MOSS.earth bridge carbon onto the blockchain to create digital carbon assets. Through KlimaDAO, these carbon assets can be retired or redeemed as described above. Throughout this process there is transparency around the specific provenance of the digital carbon and the projects being retired from.

The diagram below outlines the steps required for carbon credits to be bridged to form TCO2 tokens.

How does the Carbon Bridge work?



You can read more about the bridging process used for the ~25 million existing VCUs on chain here on the Toucan Protocol documentation repository.

Note that the Rimba Raya project batch above can be verified as being created on the Polygon blockchain by viewing the transaction history for the project's contract address on Polygonscan (linked here).



The Outlook for the Digital Carbon Market



Digital carbon – unlocking innovation

Blockchain is often regarded as a revolutionary technology, and its innate properties are hard to emulate. When you combine its properties of decentralization, immutability, transparency, and security, a notion of "trustlessness" is created that will ultimately enable a more efficient carbon market.

By integrating the high-integrity credits generated by climate projects across the globe that sit within the VCM today with the emerging protocols and applications that sit on top of public blockchains, the DCM offers a tremendous opportunity to scale the VCM for the benefit of the planet.

2022 saw significant developments in the asset layer of ReFi and the DCM, with unprecedented volumes of carbon credits bridged onto the blockchain. As we move into 2023, the supply, interfaces, and infrastructure are in place to continue growing the VCM, and offering new solutions that can enable it to grow further.

KlimaDAO itself is a unique example of a blockchain solution changing the way business is done. In 2023 and beyond, KlimaDAO will continue to leverage its tech stack and position within the market to increase the scale and impact of climate finance globally. It will achieve this by building the transparent, neutral, and public infrastructure needed to supercharge the growth of the DCM and transform the carbon markets overall.

KlimaDAO will be starting off 2023 with a focus on accelerating the throughput of the DCM. We invite you to join our **ON SET webinar series**, starting with 'An Introduction to Digital Carbon' on the 7th of February 2023 at 16:00 UTC, where we will be exploring how this can be achieved, and how you can take advantage of the opportunities in this untapped market.

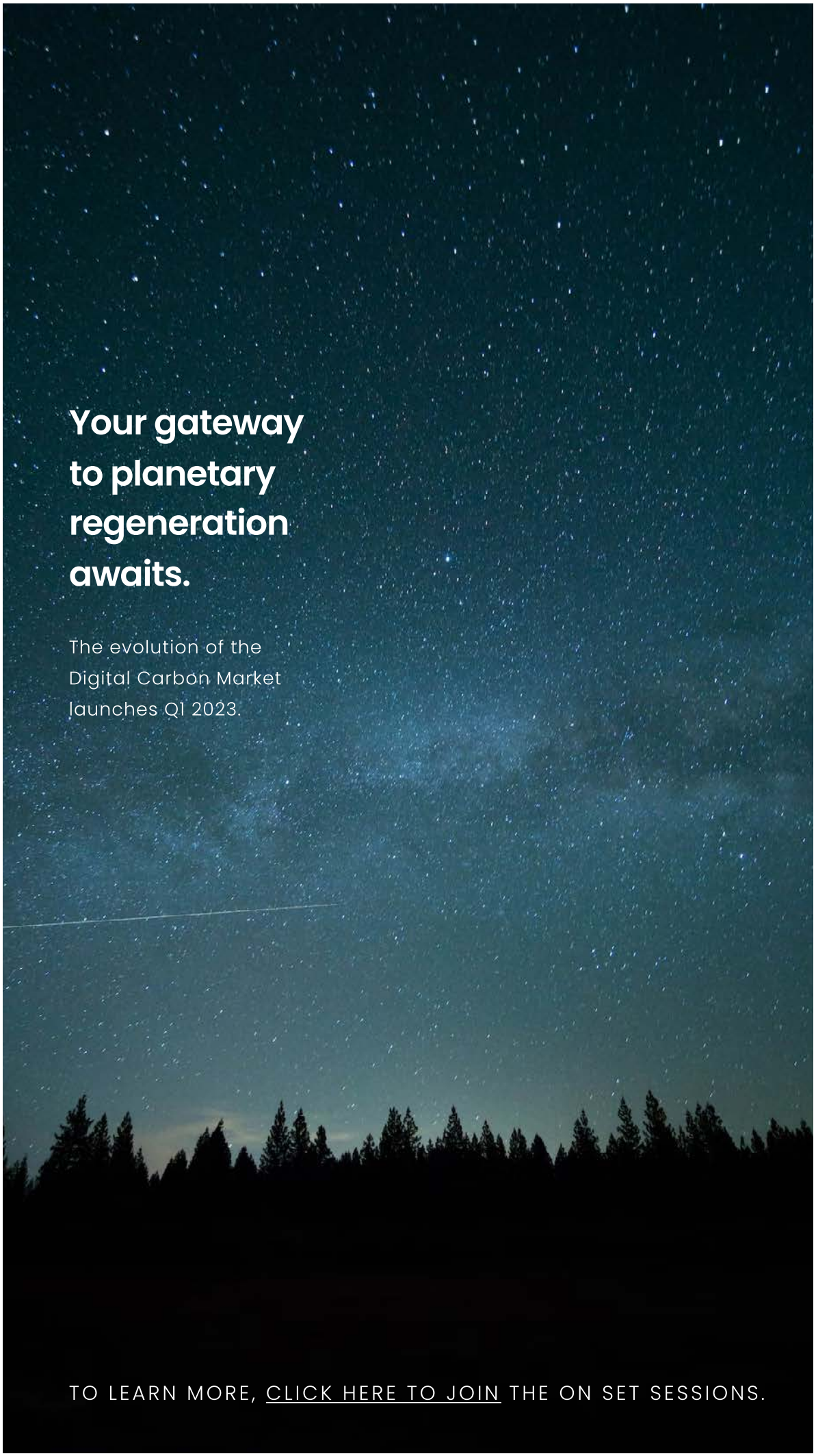
Click here to sign up – we look forward to seeing you there.

KlimaDAO

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Your gateway to planetary regeneration awaits.

The evolution of the Digital Carbon Market launches Q1 2023.

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