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Real-World Assets

Bringing Real-World Value to DeFi

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Research and Insights

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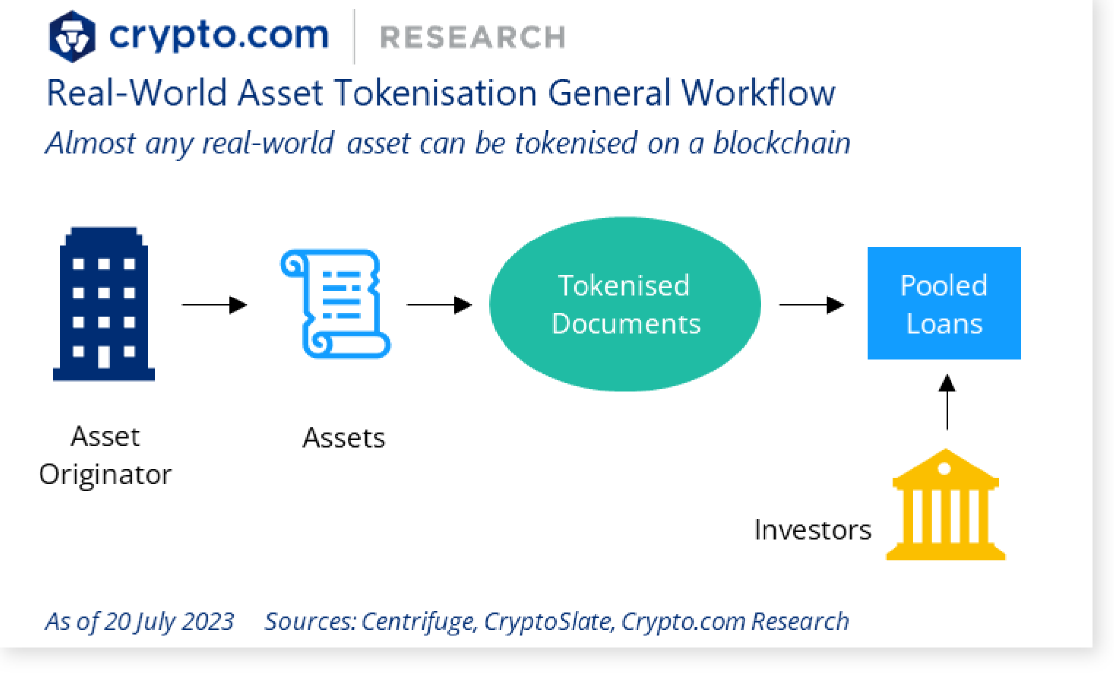
Executive Summary

- **Real-world assets (RWAs)** utilise distributed ledger technology like blockchain to track assets, with performance and valuation derived from sources outside the blockchain.
- There are two main ways of tokenising RWAs:
    - **Non-native tokens:** On-chain tokens are issued to represent RWAs that are managed off-chain by a custodian. This is currently the more common form of RWAs. For example, all existing USD-collateralised stablecoins are currently in the form of a non-native token.
    - **Native tokens:** An on-chain token is issued and acts as the RWA itself. In other words, the token does not represent any other off-chain asset, such as a bond issued on a blockchain.
- Currently, RWA protocols backed by money market, bond, and equities dominated the market with around 60% market share in terms of total value locked (TVL), followed by RWA lending and real estate. Regenerative finance has significantly plunged by over 80% since 2022. We deep dived into several representatives of the RWA protocols:
    - **Centrifuge** is an on-chain ecosystem for structured credit that helps to bring real-world assets on-chain. The protocol is asset-class agnostic with pools for a diverse range of assets from mortgages, invoices, microlending, and consumer finance.
    - **Ondo Finance** is a RWA platform that creates institutional-grade financial products and services. It mainly provides liquid exposure to US government money market funds.
    - **Tangible** is an ecosystem designed for tokenising tangible assets. Its stablecoin (USDR) is backed by real estate, and allows users to access RWAs on the platform. A TNFT (Tangible non-fungible token) that represents the purchased physical item is issued for purchasing on the platform.
    - **Toucan Protocol** is a platform that tokenises carbon credits. The tokenised carbon credits are transferred to the Open Climate Registry.
- The tokenisation of financial and real world assets has the potential to become the game-changing use case that drives blockchain breakthroughs. Tokenisation is estimated to grow by a factor of 80 times in private markets and potentially reach a value of nearly US$4 trillion by the year 2030.

1. Introduction

Real-world assets (RWAs) utilise distributed ledger technology like blockchain to track assets, with performance and valuation derived from sources outside the blockchain. An example of RWA is the issuance of tokens that represent ownership in real estate investments, or participation in funding initiatives for entrepreneurs in developing nations. Although these tokens exist on a blockchain, the underlying assets and transactions take place in the physical world. RWAs is a promising application for blockchain technology that is gaining traction. According to a report by Boston Consulting Group, the on-chain RWA market is projected to reach US$4 trillion to US$16 trillion by 2030.

RWA tokens are essentially representations of assets that are not inherently native to the blockchain, and they differ from volatile assets commonly associated with cryptocurrencies. Meanwhile, RWA tokens, similar to other cryptographic tokens, possess programmable capabilities, enabling the inclusion of features like lockup periods and requirements for accredited investors.



There are two main ways of tokenising RWAs:

- **Non-native tokens**
    - On-chain tokens are issued to represent RWAs that are managed off-chain by a custodian.

- Currently, this is the more common way due to the early stage of RWAs, as well as the advantage of leveraging existing financial infrastructure around asset custody.
- For example, all existing USD-collateralised stablecoins are currently in the form of a non-native token.

- **Native tokens**
    - An on-chain token is issued and acts as the RWA itself. In other words, the token does not represent any other off-chain asset.
    - For instance, the European Investment Bank issued EUR 100 million two-year digital bonds on the Ethereum public blockchain in 2021.

There are various significant advantages of RWA tokenisation:

- **Transparency**: The true value of an asset can be reflected on-chain.
- **Efficiency**: Distributions to asset owners can be facilitated through their crypto wallets.
- **Liquidity:** The on-chain nature of blockchain enables the buying and selling of assets that were previously illiquid.
- **Self-custody**: Individuals have the ability to retain control over their assets.
- **Collateralisation**: Assets can potentially be utilised as collateral on decentralised finance (DeFi) protocols.

Traditional finance (TradFi) has also started participating in tokenising real-world assets, as more and more financial giants are beginning to establish their presence in this field.

TradFi Involvement in RWAs

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Financial Institution	Date	News
UBS	Nov. 2022	• UBS AG introduces the world's first publicly traded digital bond that can be settled on both blockchain-based and conventional exchanges. • The digital-only bond worth 375 million CHF (approximately US$432 million) is issued on the blockchain-based platform of SIX Digital Exchange (SDX).

Goldman Sachs	Jan. 2023	• Tokenisation Platform GS DAP goes live. • European Investment Bank leverages Goldman Sachs's platform to issue the first fully digital bond on a private blockchain. • Hong Kong issues HK$800 million in tokenised green bonds using GS DAP.
Siemens	Feb. 2023	• Siemens issues a US$64 million blockchain-based euro-denominated bond on Polygon blockchain.
Bank of China	June 2023	• Bank of China's investment banking arm BOCI issues tokenised securities on Ethereum. • 200 million CNH (US$28 million) of structured notes offered, with Swiss bank UBS underwriting the issuance.
JP Morgan	June 2023	• Deploys its blockchain-based payment system, JPM Coin, to introduce euro-denominated payments for corporate clients. • The system provides wholesale payment capabilities to clients, allowing them to transfer euros to and from their JPMorgan accounts instantly.

As of 17 July 2023 *Sources: CoinDesk, Business Wire, Crypto.com Research*

2. Market Overview

RWAs have the ability to represent physical assets like real estate, as well as intangible assets like bonds and carbon credits. Real-world asset tokenisation involves converting these assets into security tokens by leveraging blockchain technology.

This process enables any valuable asset to be tokenised and utilised for on-chain transactions, leading to the prediction that almost everything could be tokenised within five to 10 years. There is a wide variety of real-world assets with different characteristics, which are listed in the table below.

Characteristics of RWA

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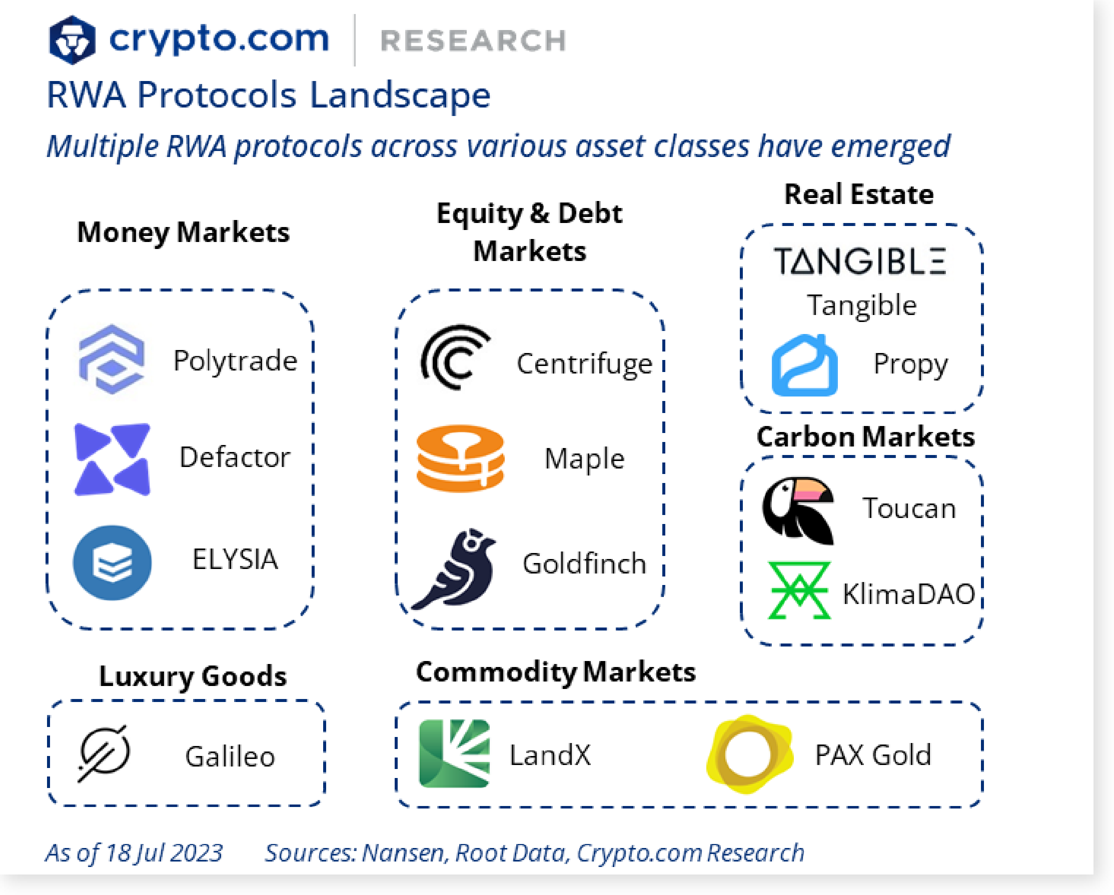
Dimension	Money Markets	Equity Markets	Debt Markets	Real Estate	Commodity Markets	Others
Liquidity	High	Medium High	Medium Low	Low	Medium Low	Low
Standardisation	High	Medium High	Medium Low	Low	High	Low
Scalability	High	Medium High	High	High	Medium High	High
Return	Low	Medium High	Medium Low	Medium High	Medium Low	Depends on asset
Relative Safety of Principal	High	Low	Medium	Medium	Low	Depends on asset

As of 17 July 2023 *Sources: Crypto.com Research*

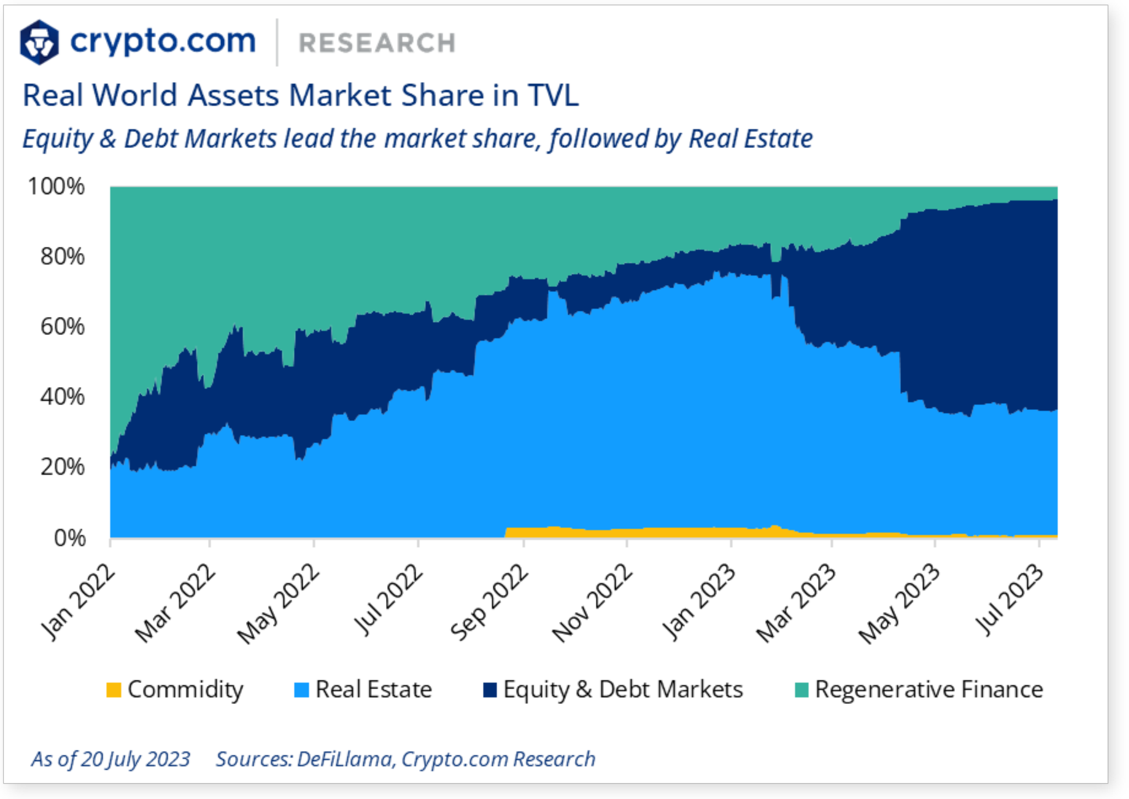
There are various RWA protocols capable of tokenising RWAs from a wide variety of asset classes, including:

- Money markets (e.g., term certificates of deposit of interbank loans, money market mutual funds, commercial paper, Treasury bills)
- Equity and Debt markets (e.g., stocks and bonds)
- Real estate (e.g., property consisting of land and the buildings on it)

- Carbon markets (e.g., trading systems in which carbon credits are sold and bought)
- Luxury goods (e.g., designer handbags, high-end watches, jewellery)
- Commodity markets (e.g., gold, oil, coffee, soybeans)



Currently, the Equity & Debt Markets category has been dominating the RWA market share since Q2 2023, as seen in the data shown below. Additionally, RWA lending and real estate are other popular asset categories. Meanwhile, it is also notable that regenerative finance like the carbon market has significantly plummeted.



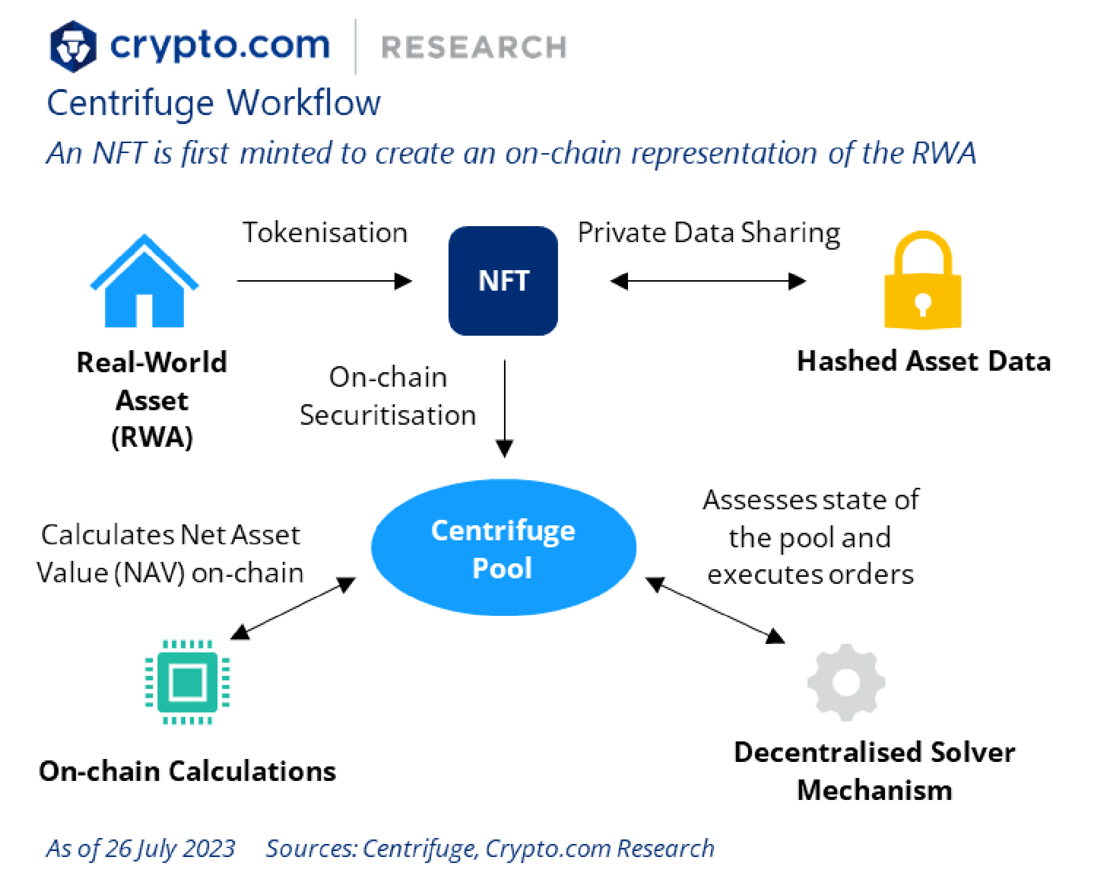
In the following sections, we first investigate Centrifuge, the protocol that supports the tokenisation of structured credit. Then we dive into the representatives of the top asset classes: Ondo Finance, Tangible, and Toucan.

2.1 Centrifuge

Centrifuge is an on-chain ecosystem for **structured credit** that helps to bring real-world assets on-chain. The concept of structured credit involves pooling similar debt obligations, securitising them, and selling the resulting cash flows. Centrifuge uses the resulting securities as collateral, allowing borrowers to obtain crypto-denominated debt.

Assets on Centrifuge are held in custody via a real-world legal structure, where each pool is associated with a legal entity known as a special purpose vehicle (SPV). The SPV is responsible for keeping the asset originator's business separate from the financing activity underlying the pool, ensuring that the assets within the pool remain protected from any bankruptcy affecting the asset originator.

Asset pools on Centrifuge are fully collateralised, and the protocol is asset-class agnostic, with pools for a diverse range of assets from mortgages, invoices, microlending, and consumer finance. Centrifuge has a TVL of US$232 million and is the top protocol in the category of RWA lending.



In general, the workflow and key features of Centrifuge are as follows:

- **Tokenisation**
    - Each borrower mints an NFT to create an on-chain representation of the off-chain RWA.
    - The NFT contains information needed for pricing, financing, and valuation; it can be locked into pools on the Centrifuge protocol, serving as a representation of the collateral used for financing.
- **Private Data Sharing**
    - The Private Data Layer of the Centrifuge protocol enables issuers and traders to access asset data securely and privately.
    - The asset data is hashed, and the resulting hash is anchored on-chain and added to the NFT's metadata. This creates a verifiable link to the NFT without revealing the actual data to the public.
- **On-Chain Securitisation**

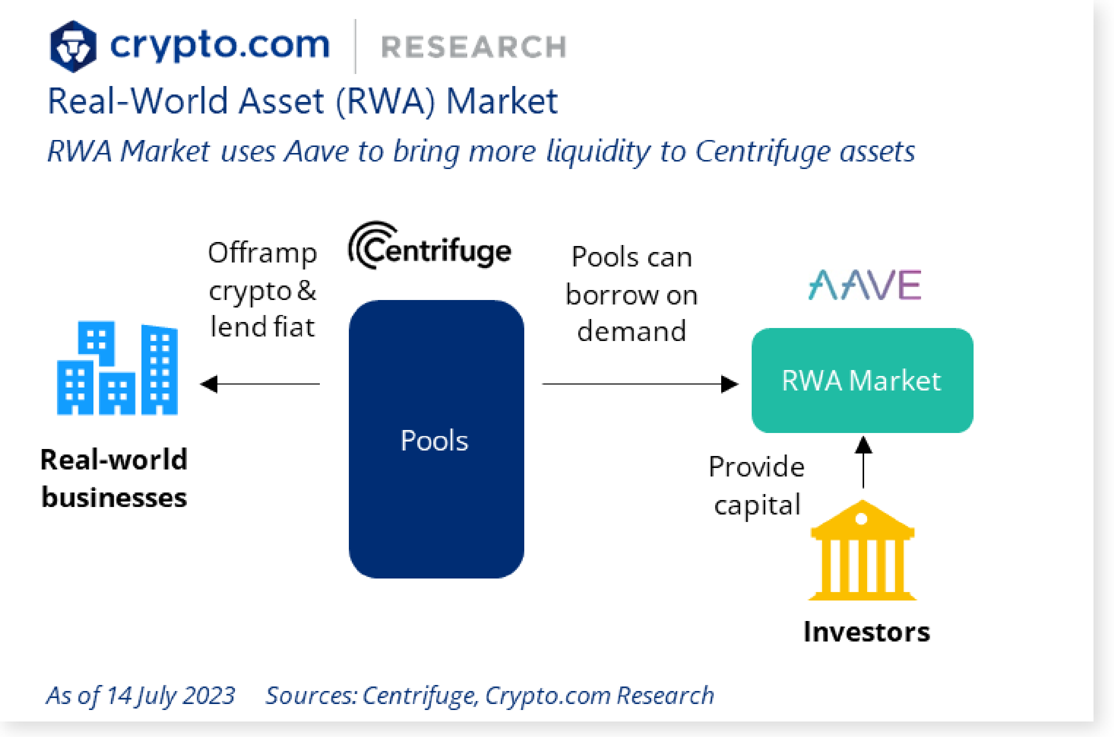
  - Multiple assets are pooled together, enabling traders to provide financing for the entire pool rather than for each asset separately.
  - The asset's value is determined through the pool, and the issuer can borrow liquidity from that pool. Over time, the issuer has to repay the debt accrued per asset, which includes both interest payments and principal repayments.

- **Epoch Mechanism**
  - Each pool on Centrifuge uses ‘epochs’, which are designated sessions with a fixed minimum time duration (e.g., 24 hours) during which investment and redemption orders can be submitted.
  - Upon the completion of each epoch, Centrifuge’s decentralised solver mechanism assesses the current state of the pool and executes the orders based on the seniority of the tranches (e.g., senior tranche redemptions take precedence over junior tranche redemptions) and availability of liquidity.

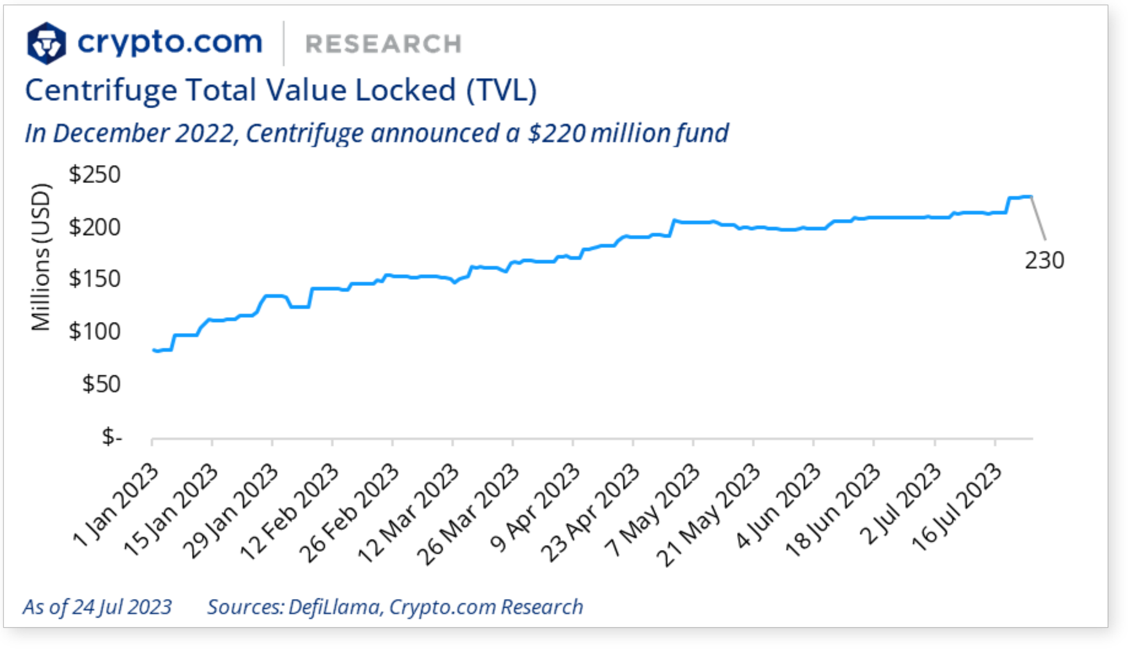
- **On-Chain Net Asset Value (NAV)**
  - Centrifuge calculates NAV on-chain on an ongoing basis, accounting for different kinds of loans in order to ensure accurate pricing.
  - In its NAV calculations, Centrifuge also accounts for defaults of assets, through on-chain representations of write-offs of assets.

An example of an application built using Centrifuge is the Real World Asset (RWA) Market, which launched in December 2021. Built on Centrifuge and Aave, it was the first diversified real-world asset market on the Aave protocol, helping to bridge DeFi to the real world.

The process on the RWA market involves issuers first creating pools for their assets. Traders are then able to purchase tokens from these pools by depositing stablecoins into them. The issuers can subsequently borrow stablecoins against these assets and convert them into fiat currency for real-world borrowers.



In December 2022, Centrifuge announced a US$220 million fund, representing the largest on-chain investment in real-world assets at that point in time. This was achieved through a collaboration with MakerDAO and crypto investment firm BlockTower Credit. Through this partnership, BlockTower Credit became the first institutional credit fund to bring its collateralised lending operations on-chain.



2.2 Ondo Finance

Ondo Finance is a real-world asset platform that creates institutional-grade financial products and services. The main fund products of Ondo Finance provide exposure to US money markets, T-bills, and high-yield corporate bonds. Ondo Finance also provides cash management advisory services to help entities build well-allocated cash management portfolios, which can include on-chain assets like stablecoins and Ondo Finance's fund products. With a TVL of US$152 million, Ondo Finance is one of the top protocols in the category of RWAs.

Ondo Finance uses qualified custodians to custody the assets in the fund. A qualified custodian refers to an institution authorised by regulators to hold assets on behalf of clients. These qualified custodians are required to keep client funds in distinct accounts for each client, ensuring that each account is under the client's name.

The primary aim of Ondo Finance is to facilitate and establish connections amongst different participants within the rapidly growing DeFi ecosystem by providing on-chain services. These participants range from DAOs to institutional and mainstream retail investors.

Ondo Finance offers its tokenised treasury products on the Ethereum blockchain and has recently expanded its products to the Polygon network. Ondo Finance has also developed Flux Finance, which is a fork of Compound V2 and governed by the Ondo DAO. Flux Finance has launched a decentralised lending protocol that enables users to deposit USDC or DAI into Flux's protocol, which is backed by OUSG, and in return receive the derivative tokens fUSDC or fDAI, respectively.

The main products Ondo Finance provides are listed below:

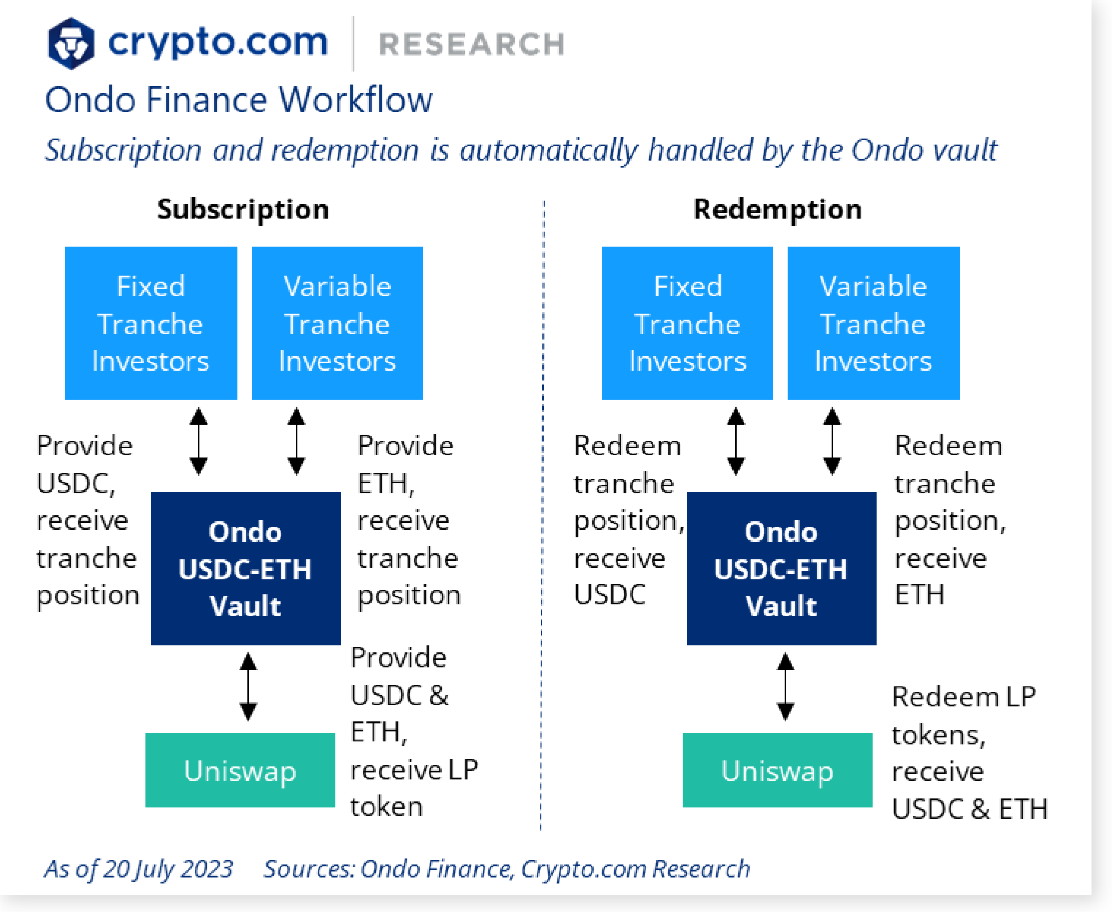
- OMMF (US Money Markets)
    - Provides liquid exposure to **US Money Markets** via US government money market funds (MMFs) that offer low-risk investment with stable and predictable returns, in addition to deep liquidity.
    - The majority of the portfolio consists of an MMF, with a small portion allocated to US dollars and USDC for liquidity purposes.
    - Daily distributions in the form of new tokens are airdropped to token holders. Tokens can be purchased and redeemed for a fixed value of US$1.
- OUSG (Ondo Short-Term US Government Bond Fund)

  - Provides liquid exposure to an **ETF of short-term US Treasuries (T-bills)** that are widely recognised as the lowest-risk and most liquid investment options.
  - The majority of the portfolio consists of the iShares Short Treasury Bond ETF (NASDAQ: SHV) issued by BlackRock. A small portion of USDC and US dollars is allocated for liquidity purposes.

- OHYG (Ondo High Yield Corporate Bond Fund)
  - Designed to track the investment performance of an index consisting of **US dollar-denominated, high-yield corporate bonds**.
  - The majority of the portfolio is allocated to the iShares iBoxx $ High Yield Corporate Bond ETF (NYSE: HYG) issued by BlackRock. A small portion of USDC and US dollars is held for liquidity requirements.
  - Distributions are automatically reinvested in the underlying fund assets, allowing for investment compounding.

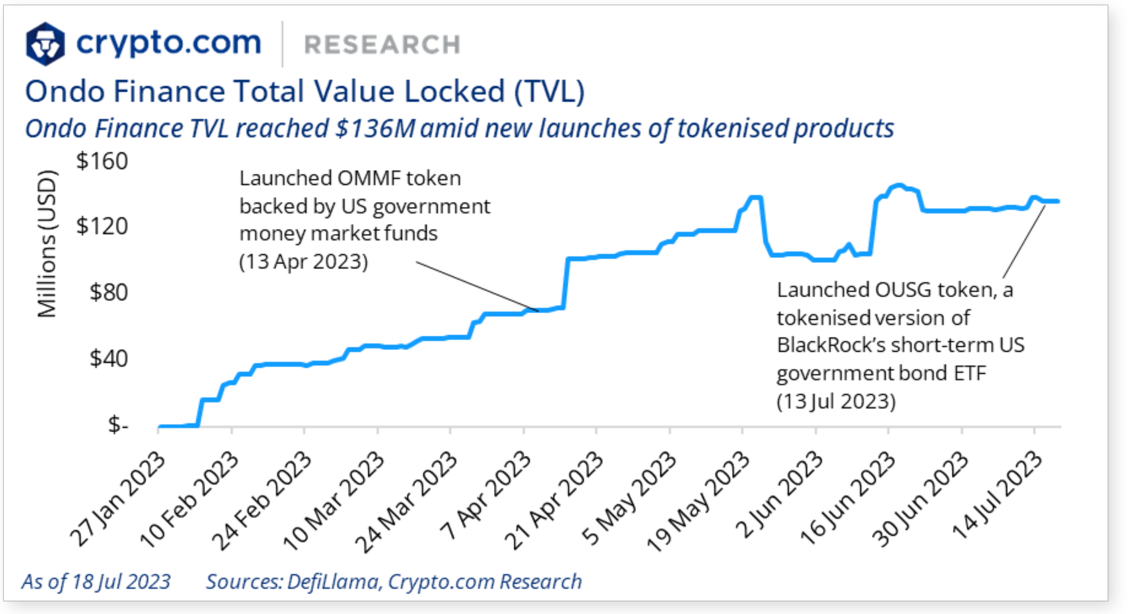
Ondo Finance's investment banking services and products are all powered by smart contracts. Moreover, Ondo Finance is designed to be highly interoperable with other existing DeFi protocols, such as Uniswap. This allows for smooth onboarding experiences within its ecosystem.

The general workflow of Ondo Finance's vaults is as follows:



- **Deposit (Subscription):** Each investor of the respective tranches deposits their assets (e.g., USDC and ETH) into the vault.
- **LP Invest:** The Ondo vault automatically deposits both USDC and ETH to Uniswap (or another DEX) and receives USDC/ETH LP tokens.
- **Tranches distribution:** Each investor has their respective tranches; for example, Junior Tranche (variable rate of return) or Senior Tranche (fixed rate of return).
- **Subscribing:** Each vault has its own fixed duration (e.g., 30 days or more), and investors have to wait until the end of the subscription period.
- **Redemption:** Upon reaching the redemption date, the vault reclaims USDC and ETH from Uniswap, and swaps USDC and ETH if required to redeem the rewards to the respective investors.

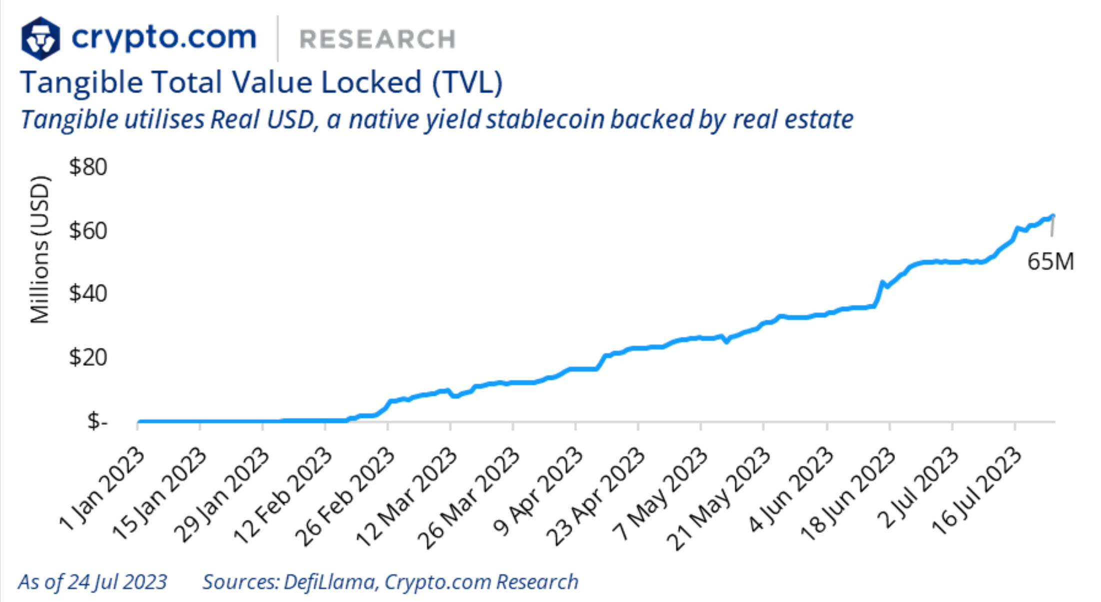
The TVL of Ondo Finance significantly surged by 92% amid new launches of tokenised products as mentioned above.



2.3 Tangible

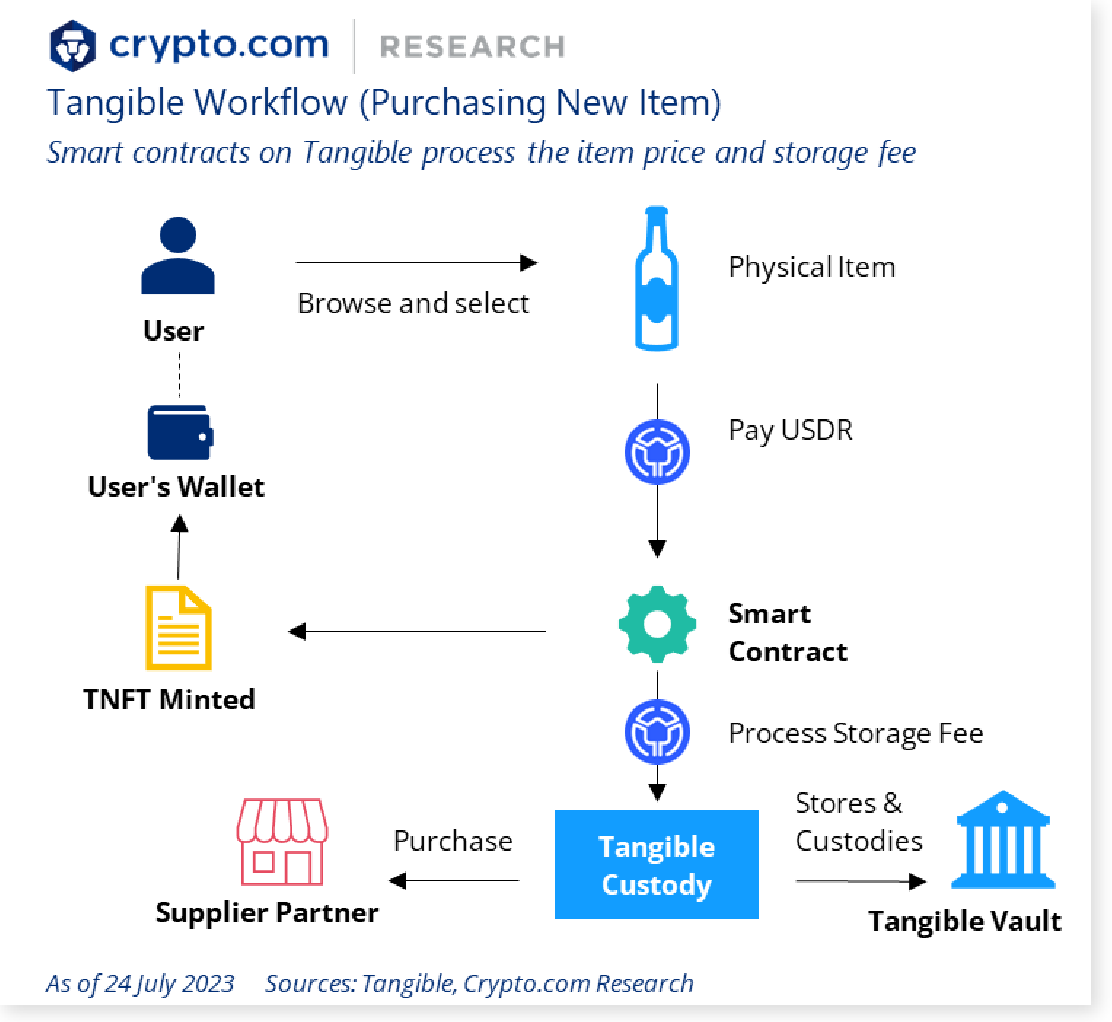
Tangible is an ecosystem designed for tokenising tangible assets like real estate, gold bars, and fine wine. It has a relatively high TVL of US$67 million.

Tangible enables individuals to utilise Real USD (USDR), a stablecoin backed by real estate, for acquiring valuable physical goods from top suppliers worldwide. **Each purchase made on Tangible results in the creation of a TNFT (Tangible non-fungible token) that acts as a representation of the purchased physical item.** Following the transaction, the physical item is securely dispatched to one of Tangible's insured storage facilities, while the TNFT is transferred to the buyer's digital wallet. At any given moment, the owner of the TNFT has the option to redeem it for the physical item, transfer it to another wallet, or sell it on Tangible's marketplace. In other words, the TNFT is a liquid, tradable, and redeemable asset, represented by an on-chain NFT.



When a user buys an item from another user on Tangible's marketplace, the general process is as follows:

- The Buyer explores and makes a purchase on Tangible's marketplace.
- The existing TNFT is transferred to the Buyer's wallet.
- At the same time, USDC tokens are transferred from the Buyer's wallet to the Seller's wallet. Smart contracts handle the various fees (trading, item purchase, and storage), if applicable. The physical item remains in storage until the Buyer chooses to redeem it.
- Out of the Tangible DAO fees, 33.33% is allocated for purchasing and burning its native governance token (TNGBL), while the remaining 66.66% is distributed in USDC to Tangible 3,3+ NFT stakers. Tangible 3,3+ NFTs are non-fungible tokens that represent a holder's position and allow the holder to claim TNGBL and USDC rewards.



2.4 Toucan Protocol

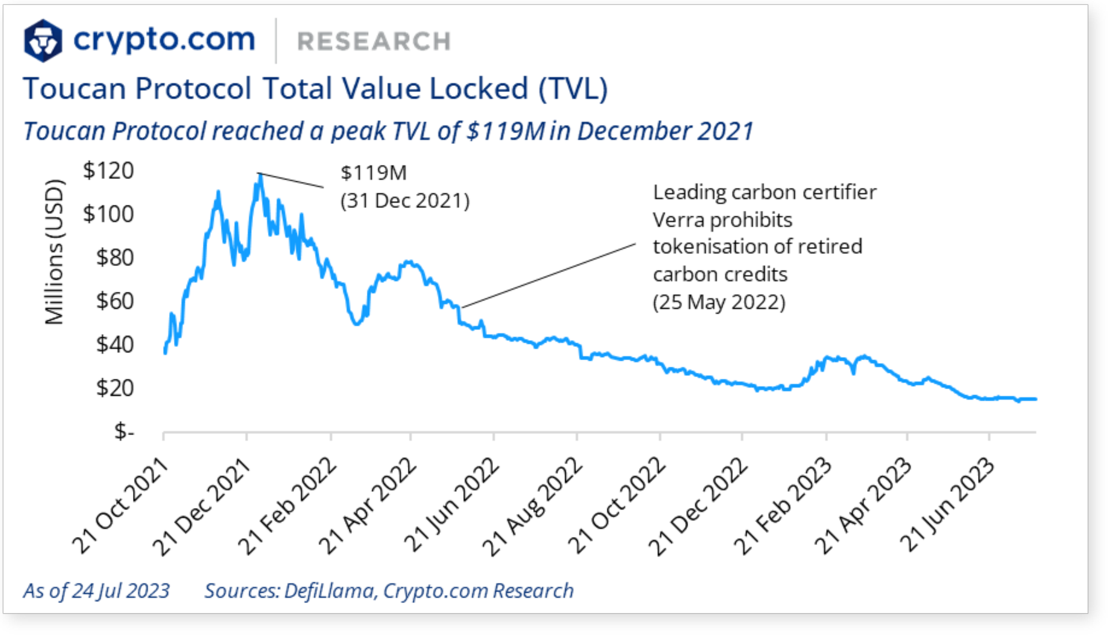
[Toucan Protocol] is a platform that tokenises [carbon credits], which are permits that allow the owner to emit a certain amount of carbon dioxide or other greenhouse gases. After being tokenised, the carbon credits are transferred to the Open Climate Registry, which operates on energy-efficient blockchains, specifically **Polygon** and **Celo** at present. Toucan Protocol has a TVL of US$15 million and is one of the top protocols in the category of Carbon Markets.

The general process of carbon credit tokenisation by the Toucan Protocol is as follows:

- The Toucan Carbon Bridge is linked to registries operated by reputable standards bodies, ensuring that only credits sourced from reliable origins are converted into tokens.

- The carbon credit tokens are then transferred to the Open Climate Registry.
- **After a carbon credit is transferred to the Open Climate Registry, it becomes a TCO2 carbon token**, which contains the relevant carbon credit data, including details about the project, the year of the climate impact, the issuer, and more.
- **To counterbalance the environmental footprint, owners have the option to retire these TCO2 tokens**, which permanently removes them from circulation, marking a planet-positive action in the process.
- TCO2 tokens can also be deposited into two carbon pools:
  - **Base Carbon Pool**, which was designed by Klima DAO to accommodate a diverse range of carbon credits.
  - **Nature Carbon Pool**, which only accepts TCO2 tokens linked to nature-based projects.

Toucan Protocol reached a TVL of US$119 million at its peak in December 2021. However, in May 2022, it was adversely affected by a decision by Verra, a leading carbon crediting programme, to prohibit the creation of tokens based on retired carbon credits. Verra's main rationale behind the decision was that tokenising retired carbon credits may lead to market confusion regarding their true consumption. In other words, tokenising retired carbon credits might create the impression that the environmental benefit remains unconsumed and therefore is not retired.



3. Conclusion

Real-world assets (RWAs) are a transformative use case of blockchain technology, though they are still at the nascent stage and not quite at mass adoption yet. The potential of RWAs is limitless, as theoretically almost anything can be tokenised — from artwork, real estate, and carbon credits to financial instruments like bonds and stocks.

There are various challenges in the process of implementing RWAs, which include legal and regulatory compliance, valuation and auditing, custody and security, governance and trust, as well as interoperability and scalability concerns. Overcoming these obstacles requires significant collaboration amongst all stakeholders, including asset originators, token issuers, service providers, regulatory bodies, and traders.

Overall, the outlook for RWAs is promising. According to a Citi report, the tokenisation of financial and real-world assets has the potential to become the game-changing use case that drives blockchain breakthroughs. Citi suggests that tokenisation could grow by a factor of 80 times in private markets, potentially reaching a value of nearly US$4 trillion by the year 2030.

As blockchain technology continues to mature, and regulations evolve, it is likely there will be increased adoption and integration of RWAs into the crypto space. While challenges persist, the potential benefits make RWAs an exciting frontier in the crypto landscape.

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