Whitepaper

mUSD Token

The Core Rebase Token of the Molecula Platform

Version 1.0 — April 2025

The source code is available on GitHub: https://github.com/molecula-fi/molecula-public.

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Introduction

Background

While there is substantial USDT liquidity in circulation, particularly on the TRON network [1], effectively leveraging decentralized finance (DeFi) opportunities remain challenging for many users. Engaging with yield-generating protocols often requires technical expertise [2], access to trusted infrastructure, and continuous fund management—barriers that hinder broader user participation in DeFi.

Molecula addresses this inefficiency by offering a streamlined, non-custodial solution that automates the process of converting idle stablecoin holdings into productive assets. Users can deposit their USDT tokens via the Ethereum and TRON networks, while Molecula handles the end-to-end process of reallocating those assets into a curated set of yield-generating protocols.

The automated rebalancing strategy allows users to benefit from consistent on-chain returns without managing wallets, directly interacting with protocols, or monitoring markets. In exchange, Molecula retains a portion of the yield as an infrastructure fee.

At the core of the Molecula ecosystem is the **mUSD** (Molecula USD) token, deployed at the Ethereum address **0x86c4D4E958BaF7E911C05f3772066C30ba2d4618**.

Purpose

mUSD is the fungible liquid token of the Molecula platform, representing user deposits and the yield they generate. Unlike traditional stablecoins, which remain static in user wallets, mUSD is a rebase token—its balance adjusts dynamically to reflect the user's share of the platform's total value locked (TVL). This design simplifies balance tracking and fund management while preserving full liquidity and transparency.

Objectives

The primary objectives of mUSD are to:

- Facilitate deposits and redemptions.
- Ensure accurate balance representation.

Key Features

The token's key features are the following:

Feature	Description
Rebase Model	The number of mUSD tokens in a user's wallet adjusts dynamically.
1:1 Peg to USDT	Users can get and redeem mUSD at parity with USDT.
Collateral Basis	Backed by crypto assets held in the Molecula liquidity pool, including the user deposits, the accrued yield, and a stablecoin liquidity reserve.
Security	Built on audited smart contracts within the Molecula ecosystem.

Use Cases

The token enables the following use cases:

Use Case	Description
Deposits & Withdrawals	Users deposit ERC-20 and TRC-20 USDT tokens to receive mUSD, and can later redeem mUSD to retrieve USDT assets and accrued returns at a fixed 1:1 ratio.
Balance Representation	The rebase model ensures that mUSD accurately reflects each user's share of the TVL at Molecula.
DeFi Integrations	mUSD can be used in various DeFi protocols beyond Molecula (e.g., Curve).

Technical Overview

Token Architecture

The token's key architectural aspects are the following:

Aspect	Description
Token Standard	mUSD is always issued as an ERC-20 token, regardless of whether users deposit via the Ethereum or TRON network.

Aspect	Description
Rebase Model	Instead of price fluctuations, the number of mUSD tokens in a wallet changes to reflect a user's share in the Molecula liquidity pool. The token amount is dynamically calculated with the formula: $$B = \frac{PS}{T}$$ Where: • **B**: The user's mUSD balance. • **P**: Total USDT token amount deposited in the Molecula liquidity pool. • **S**: Number of shares owned by the user, each representing their proportional claim on the pool. • **T**: Total number of shares in the pool.
Supply Adjustment	mUSD is minted when users deposit USDT and burnt upon redemption, while the token's total supply expands or contracts accordingly.

Minting & Burning

The mUSD token lifecycle runs through the three stages:

1. Deposit to mUSD.
2. Rebalancing.
3. mUSD redemption.

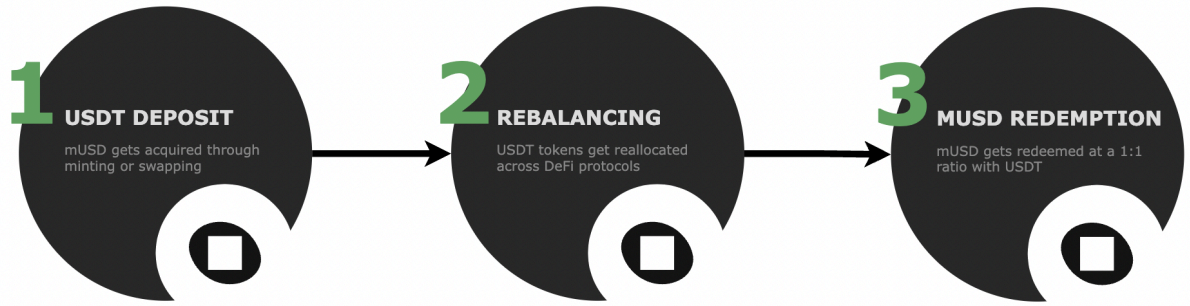

Image 1: mUSD Lifecycle

Deposit to mUSD

The mUSD gets acquired through one of two ways:

- **Minting**:
    1. The user initiates a USDT deposit on the Molecula platform via the TRON or Ethereum network, accounting for potential slippage.
    2. Molecula transfers the deposited funds to the Molecula liquidity pool.
    3. The deposited assets undergo an AML-compliance check performed by Molecula. If approved, Molecula mints mUSD tokens on Ethereum and credits them to the user.
- **Swapping**: Instead of minting, the user can exchange their deposit for preminted mUSD through liquid pools (e.g., via Curve) that facilitate mUSD swaps, assuming any associated risks on their side.

Rebalancing

mUSD itself does not generate yield but acts as a representation of the user's deposited assets and their share of the accrued yield within the Molecula platform.

During the rebalancing stage, Molecula reallocates capital across integrated DeFi protocols to optimize returns while preserving fund safety. As this process occurs, mUSD dynamically updates its value to reflect the user's proportional share of the platform's TVL.

mUSD Redemption

Users redeem their mUSD for USDT through the following process:

1. The user requests redemption of a specific mUSD amount, accounting for potential slippage.
2. Molecula:
    2.1. Burns the specified amount of the user's mUSD on Ethereum to maintain token supply accuracy.
    2.2. Releases the corresponding USDT amount from leveraged liquidity sub-pools.
    2.3. Retains 20% of the generated yield as an infrastructure fee to support the ecosystem and its future development.
    2.4. Transfers the unstaked USDT, including the original deposit and 80% of the generated yield, to the user via the network leveraged during the deposit.

Yield Generation Strategy

Source of Yield

Molecula allocates USDT assets across multiple DeFi protocols on Ethereum, classified as low-risk and high-liquidity by its internal risk framework. The Molecula liquidity pool consists of the following sub-pools:

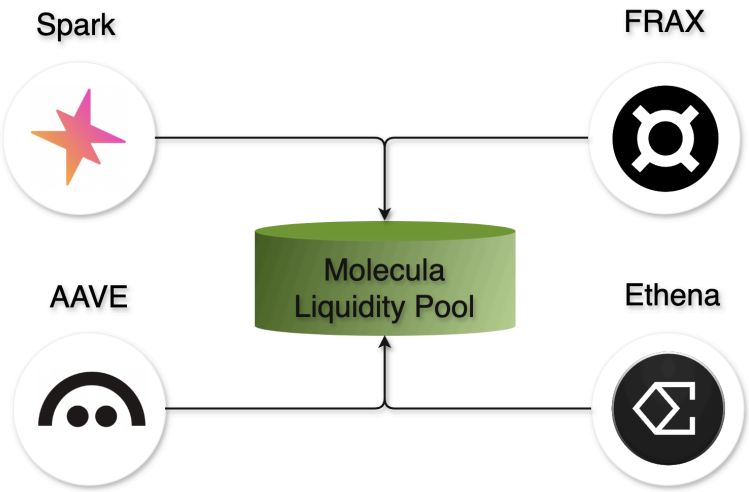

Image 2: Molecula Sub-Pools

Sub-Pool	Description
Spark	A DeFi infrastructure provider within the Sky ecosystem, offering various services [3], enabling users to earn returns on stablecoins through the Sky Savings Rate, borrowing USDS via overcollateralized lending, and deploying liquidity across multiple chains using its automated Liquidity Layer [4]. Spark emphasizes security through non-custodial smart contracts, multiple audits, and a substantial bug bounty program, ensuring transparency and trust in its operations [5].
Ethena	An issuer of synthetic USDe dollars, fully backed by BTC and ETH [6]. The protocol's stable profitability is ensured through delta hedging BTC and ETH on major exchanges. Funds are securely stored with top providers like Copper and CEFFU [7].
AAVE	A decentralized, non-custodial liquidity protocol enabling users to supply and borrow crypto assets across multiple networks. It operates through open-source smart contracts, allowing users to earn interest or access liquidity by providing overcollateralized positions [8]. The protocol emphasizes security with multiple audits, formal verification, and a bug bounty program. As of April 2025, AAVE's total market size exceeds $22 billion [9].
Frax Finance	A decentralized protocol offering a suite of financial services, including lending, automated market-making, and liquid staking. Its FRAX stablecoin has transitioned to being fully collateral-backed, ensuring user funds' protection [10]. The protocol's ecosystem features components like Fraxlend for lending, Fraxswap for trading, and frxETH for liquid staking, all designed to optimize yield and maintain robust collateralization [11].

Asset distribution across multiple sub-pools is managed by an internal rebalancer, designed to maintain yield stability while minimizing risk exposure.

Distribution Model

Molecula distributes yield from its liquidity sub-pools according to a fixed revenue-sharing model:

- 80% is credited to users—this is reflected in their mUSD balance, net of fees.
- 20% is allocated to Molecula as an infrastructure fee—this supports operational costs, security measures, and future platform development.

Risk Management

Several risk management mechanisms are in place to maintain the integrity of mUSD's value and liquidity.

Collateralization and Valuation

The mUSD token is fully backed by the TVL within the Molecula liquidity pool. This pool includes all user deposits in TRC-20 and ERC-20 USDT, along with the returns accumulated through the sub-pools.

The internal oracle mechanism tracks the TVL of the Molecula platform and the number of minted shares, each representing a proportional claim of a user on the liquidity pool. This facilitates precise mUSD price calculation using the formula:

$$P = \frac{M}{S}$$

Where:

- **P**: mUSD token price.
- **M:** TVL backing mUSD.
- **S:** Number of minted shares distributed to users.

The following mechanism guarantees that mUSD remains a precise and transparent representation of user holdings in the platform, ensuring accurate balance updates across the Ethereum and TRON networks, and fair redemption value calculation.

Risk Control Classification

Molecula distributes deposited user funds across the sub-pools, each assessed through a structured risk classification system. The DeFi protocols leveraged by the sub-pools are grouped into three classes based on criteria such as TVL, operational history, audit status, and institutional backing:

Tier	Criteria	Allocation Limits
Class A (Highest Tier)	$5B+ TVL and 3+ years of secure uptime (e.g., Spark).	Up to 40% exposure per protocol.
Class B (Mid Tier)	Either $5B+ in TVL or 3+ years of uptime with $1B+ TVL (e.g., Ethena).	Up to 20% exposure per protocol.
Class C (Emerging Tier)	$50M+ TVL, completed audits by tier-1 security auditors, and credible backing.	A combined 10% limit for all protocols of this tier, each capped at 5% per asset.

Safe Allocation Strategy

Higher-class (A) assets should form the core of the portfolio due to their uptime and robust financial indicators, while Class B and C can be used in smaller proportions. If possible, multiple protocols within one tier should be leveraged at once to reduce reliance on a single protocol (e.g., use both Spark and FRAX in Class A rather than just one).

A diversified allocation instance of the Molecula liquidity pool may include:

- **Class A** (e.g., Spark, AAVE): Up to 70-80%.
- **Class B** (e.g., Ethena): Up to 20-30%.
- **Class C**: Up to 10%.

Based on this model, a token allocation example may be:

- **Class A**: 35% to sDAI, 35% to sFRAX → **70% total.**
- **Class B**: 20% to sUSDe, 10% to aEthUSDT → **30% total.**
- **Class C**: none.

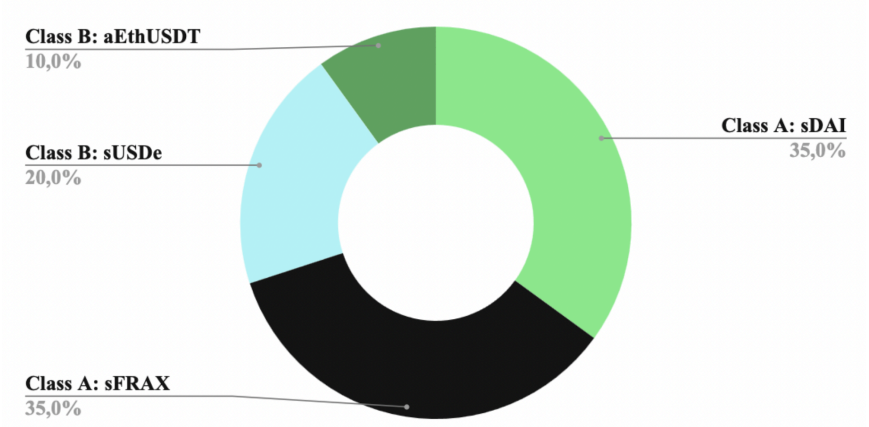

Image 3: Token Allocation Example

No single new allocation should violate the class concentration limits. If an asset's growth, due to higher yield or price changes, causes it to exceed its allowed percentage, the excess should be trimmed during rebalancing.

Allocation Frequency

The rebalancer service adjusts allocations on a scheduled basis (e.g., monthly or quarterly) or in response to market conditions, such as yield volatility or emerging opportunities in higher-tier protocols, based on the discretionary assessment of Molecula.

Transaction Cost Efficiency

Before reallocating funds, Molecula evaluates swap inefficiencies to avoid unnecessary transaction losses by following the steps:

1. **One-Time Swap Cost Estimation.**
   As the stablecoin value may deviate from $1, swapping large amounts can result in losses.

   Example common for all the scenarios below:
   *Swapping $1,000,000 at $0.995 per $1 (0.5% slippage) results in a **$5,000 loss**.*
   *Calculation: $1,000,000 × 0.005 = **$5,000***

2. **Calculation of Yield Gain from Reallocation.**
   The calculations are done with the formula:

$$G = P \times (Y_2 - Y_1)$$

   Where:

   - **G**: Gain from reallocation, in USDT.
   - **P**: Reallocation amount, in USDT.
   - **Y_1**: Current yield, in %.
   - **Y_2**: Target yield, in %.

   Below are the example calculations for different scenarios:

Scenario	P ($)	Y_1(%)	Y_2(%)	Gain ($)
High Jump	1,000,000	5.0	8.0	30,000/year
Medium Jump			6.0	10,000/year
Low Jump			5.25	2,500/year

3. **Break-Even Time Calculation.**
The step calculates how long it will take to recover the one-time swap cost using the extra annual yield from rebalancing with the formula:

$$T = \frac{C}{P \times (Y_2 - Y_1)}$$

Where:

- **T**: Break-even time, in months.
- **C**: Swap cost, in USDT.
- **P**: Reallocation amount, in USDT.
- **Y_1**: Current yield, in %.
- **Y_2**: Target yield, in %.

Below are the example calculations for different scenarios:

Scenario	Swap Cost ($)	Gain ($)	T (years)	T (months)
High Jump	5,000	30,000/year	0.167	≈ 2
Medium Jump		10,000/year	0.5	≈ 6
Low Jump		2,500/year	2	≈ 24

4. **Result Interpretation.**
The shorter the time horizon **T**, the faster the swap pays off. The longer it is, the higher the risk and the less likely the swap is worthwhile.

Below are the example calculations for different scenarios:

Break-Even Time	Meaning
≤ 2 months	Fast recovery, swap is likely worth it.
~6 months	Acceptable, moderate risk.
≥ 2 years	Too slow, high risk of yield changes.

Liquidity Reserve Management

To ensure instant mUSD redemptions without interrupting long-term capital deployment, Molecula maintains a configurable stablecoin liquidity reserve, typically set between 5–10% of the total portfolio. This reserve is held in liquid stablecoins (e.g., USDT) and is excluded from rebalancing and risk scoring.

At each rebalancing cycle, Molecula:

- Sets aside the reserve before allocating the capital into the sub-pools.
- Distributes the remaining portfolio based on risk-adjusted allocation limits.

Security & Audits

mUSD must ensure that deposits, redemptions, and balance tracking remain fully protected from vulnerabilities and external threats, like smart contract exploits, unauthorized access, cross-chain internal message failures, or malicious efforts targeting protocol logic or liquidity flows. To achieve this, Molecula implements multiple layers of security to safeguard the ecosystem integrity.

The smart contracts are designed with the following protection measures:

Measure	Description
Independent Security Audits	All Molecula smart contracts, including those interacting with mUSD, undergo regular third-party security audits to identify and resolve potential vulnerabilities before deployment. Recently, Molecula completed a security audit conducted by Hallborn, a top-tier blockchain security auditor [12]. The full report is available via the provided link.
Formal Verification	Mathematical proofs are employed to ensure that the contract logic executes per the internal development specification that aligns with the platform behavior publicly described by Molecula through its official materials and communications. Pruvendo, an external smart contract auditor, recently conducted a formal verification audit for Molecula. The full report is available via the provided link.
Strict Access Controls	Critical functions are restricted from unauthorized access, preventing modifications that could impact mUSD supply, balance tracking, or overall safety of user funds.
On-Chain Monitoring	Continuous tracking of transactions and contract interactions allows for the early detection of anomalies or suspicious activity.
Immutable Protocol Logic	The core mUSD contract logic is fixed after deployment, preventing unauthorized changes to token supply mechanics.

Legal Framework & Compliance

Entity Information

Molecula Labs Ltd, a company incorporated in the British Virgin Islands under registration number 2148778, with its registered office at Geneva Place, 2nd Floor, #333, Waterfront Drive, Road Town, Tortola, is the organization behind the Molecula platform, which operates the mUSD token as its core utility instrument.

Terms of Use and Privacy Policy

By accessing or interacting with the Molecula platform and using its core token, mUSD, users agree to abide by the platform's applicable Terms of Use, which govern eligibility, responsibilities, usage restrictions, and platform interactions.

Any personal data collected during user interaction with the platform is processed under the Privacy Policy, which defines how information is gathered, stored, and used when applicable.

Anti-Money Laundering (AML)

Compliance measures implemented by Molecula ensure that mUSD issuance aligns with Anti-Money Laundering (AML) standards [13] without requiring direct Know Your Customer (KYC) verification for users. The AML-compliant verification is enforced at the point of the mUSD token acquisition. Since AML verification is performed before mUSD issuance, no additional KYC requirements are enforced at the token level. However, users interacting with regulated financial entities (e.g., centralized exchanges) to swap their tokens for mUSD may be subject to external KYC requirements imposed by those platforms.

Conclusion

The mUSD token represents a foundational component of the Molecula platform, delivering a seamless, secure, and transparent mechanism for participating in DeFi yield generation through a rebase-based, non-custodial model. Designed to support a wide array of DeFi use cases, composability, compliance, and capital efficiency, mUSD transforms idle stablecoin holdings into productive assets without imposing the technical and operational burdens traditionally associated with decentralized finance.

Through its ERC-20 rebase architecture, dynamic balance updates, and integration with trusted DeFi protocols, mUSD offers users a reliable, 1:1 USDT-pegged asset that evolves in value to reflect a share of the Molecula liquidity pool. The platform's internal allocation framework—backed by multiple layers of protection, structured risk classification, automated rebalancing, and rigorous transaction cost analysis, ensures optimized performance.

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