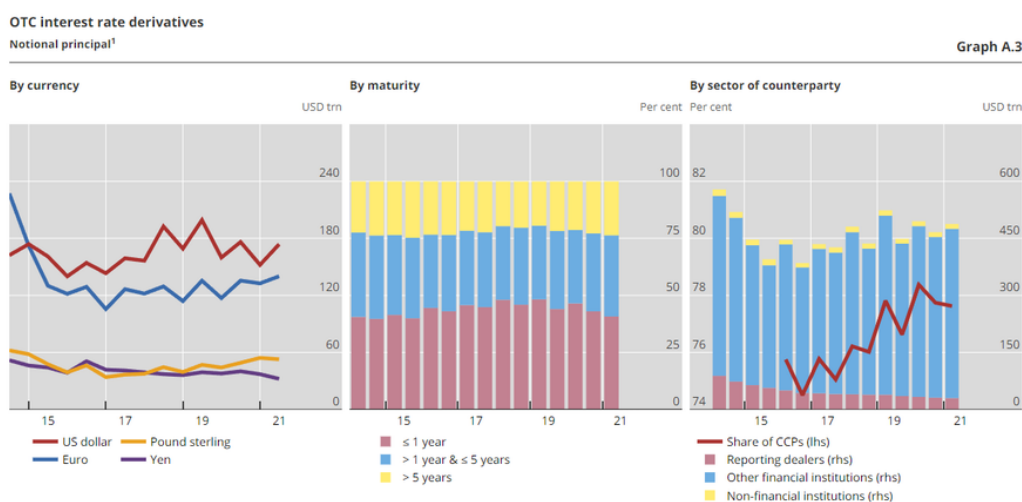


Research Document — Pendle

Market

- Pendle solves this use case in DeFi: trading yield.
- Within DeFi, often time yield farming involves inflationary tokens and risky projects or token volatility where impermanent loss is a large issue, especially for unsophisticated farmers.
 - Prominent projects that offer rates are GMX's GLP and Lido's stETH. Both of these generate "real yield", which is rewards, or interest, paid in a cryptocurrency that is not inflationary. But, both of these instruments generate variable yield
- TradFi interest derivative market (worth over \$400T in notional value) into DeFi, making it accessible to all. Where PT is the equivalent of zero-coupon bonds while YT is the equivalent of coupon payments.



- Global fixed income bond markets totaled \$919 billion in January 2024, and interest rate swaps from variable to fixed rates, or fixed to variable rates, is the largest global derivative market

- Before Pendle, there were different ways to hedge a position through future, options, leverage etc.; But it was impossible to hedge a position against a change in yield
- Regarding fees, trading volume and TVL, Pendle is way ahead of its direct competitors (IPOR and Notion) but still far away from the two giant of derivative market regarding the fees and volumes. However, Pendle is the biggest protocol in term of TVL with more than 1.2B\$ in the platform.

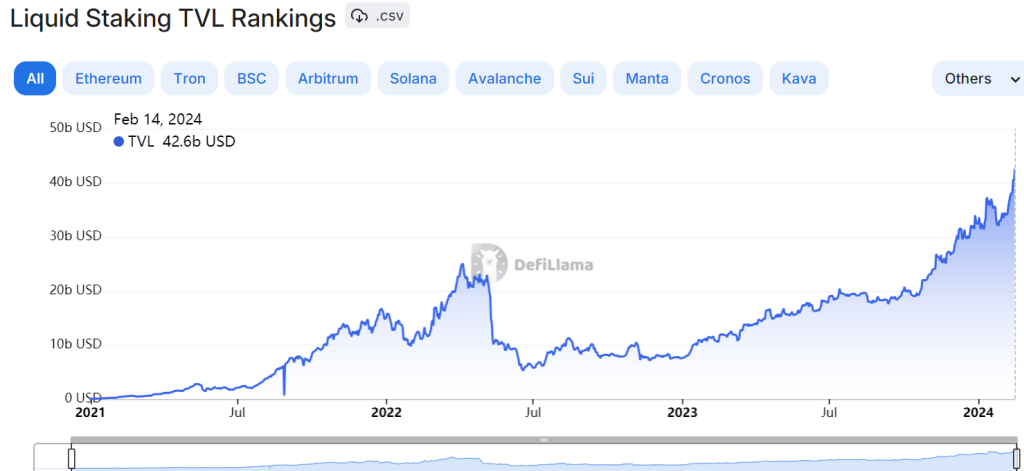
Protocol	Fees (M\$ annualized)	Trading Volume (M\$ 30D)	TVL (M\$)
Pendle	3.61	1710	1296
GMX	133.3	6430	511.22
dYdX	36.71	11780	311.06
IPOR	0.22	50.92	8.17
Notional	0.26	/	19.02

- Pendle's ecosystem:
 - [@Penpiexyz_io](#) the largest pendle liquid wrapper by TVL
 - [@Dolomite_io](#) supports PT-GLP as collateral
 - [@PulsarTrading](#) invests in Pendle
 - [@FactorDAO](#) launches its wstETH auto-compounder
 - [@redactedcartel](#) launches with Pendle as a partner
 - [@TimeswapLabs](#) takes PT-wstETH as collateral
- Pendle's partnership:
 - **LSDFi sector integrations:** Pendle has joined forces with popular DeFi platforms like Lido Finance, Rocket Pool, FRAX, and Ankr. These partnerships enable Pendle users to access and benefit from the yields provided by these platforms.
 - **Perpetual Derivatives:** Pendle has partnered with GMX and Gains Network. This collaboration allows Pendle users to trade the yields from GLP and gDAI.

- **DEX Liquidity:** Pendle has created a yield market for LPs on Balancer, Aura Finance, Stargate, and Camelot.
- **Restaking sector:** etherfi with eETH
- Since the beginning of 2023, Pendle's TVL has increased by 7568% which a very sharp increase since 7th of January



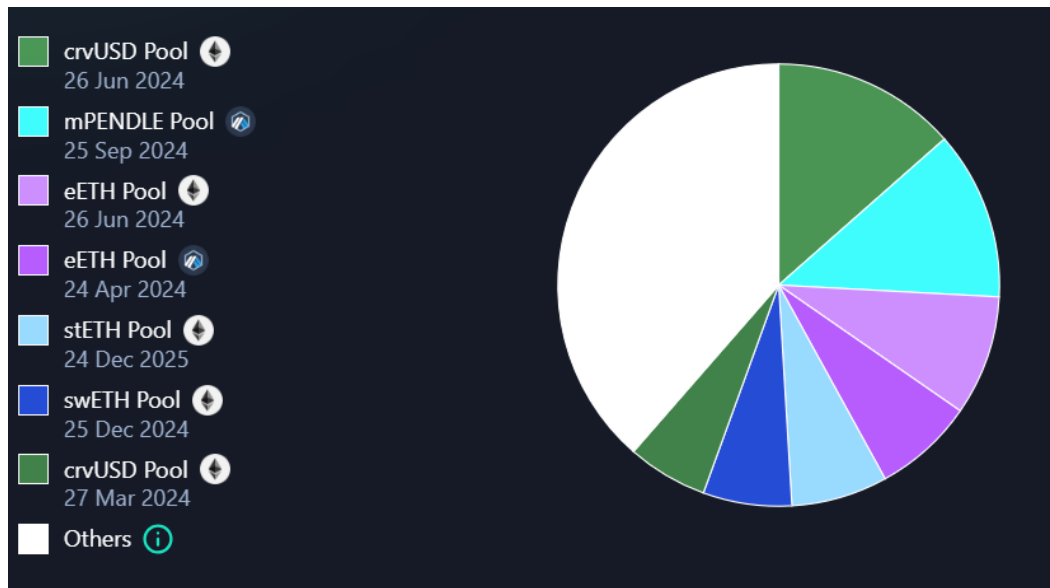
- Defillama data shows that the TVL of the LSD industry has grown to \$42.6 billion, ranking first among all Defi tracks.
 - In an ecosystem that's rocketing to bloom, Pendle is positioned to be a core piece of infrastructure supporting it. It has garnered impressive traction, with recent support from major players like Lido, Frax, Rocketpool, Aura, GMX and Stargate



- <https://chaindebrief.com/pendle-seizes-the-future-of-defi-with-rwa-integration/>
Pendle has integrated support for two titans of the Real-World Assets (RWA) sector: MakerDAO's Boosted Dai Savings (sDAI) and Flux Finance's fUSDC. This strategic move enables users to tap into the booming potential of RWA yields, propelling Pendle into the spotlight as a key player in this fast-growing sector
- vePendle holders: Equilibria is holding 23.48% and Penpie 35.57% of the total pendle stake.

 Penpie (mPENDLE) ↗	11,821,053.81397 vePENDLE (35.57%) Peg for 25k ⬇️: 86.30% via Wombat (on arbitrum) ↗
 Equilibria (ePENDLE) ↗	7,803,379.23801 vePENDLE (23.48%) Peg for 25k ⬇️: 62.47% via Maverick ↗
0x20ea...76a4	1,976,643.04156 vePENDLE (5.95%)
0xa329...bfec	1,345,716.29091 vePENDLE (4.05%)
0x9592...b355	803,566.52027 vePENDLE (2.42%)
 Stake DAO (sdPENDLE) ↗	756,194.10917 vePENDLE (2.28%) Peg for 25k ⬇️: 45.93% via Curve ↗

Penpie and Equilibria are the two protocols that are leading the pendle rewards into Pendle's platform. This is why mPendle and ePendle are the most rewarded pools:



Product & Competition

- Pendle allows splitting yield-bearing tokens (YBT: LPs, Staked tokens, etc) into Principal tokens (PT) and Yield Tokens (YT).
- PT entitles you to the principal of the underlying yield-bearing token, redeemable after maturity.
 - Example: If you own 100 PT-aUSDC with a 1-year maturity, you will be able to redeem 100 aUSDC after 1 year.



- YT entitles you to accrue the yield of the underlying YBT in real-time, and the yield accrued can be manually claimed at any time.

- If you own 100 YT-aUSDC and aUSDC has an average yield of 5% through the year, you will have accrued 5 aUSDC by the end of the year.



- Maturity is the date at which PT becomes fully redeemable for the underlying asset and YT stops accruing yield. So at maturity 1 PT stETH= 1 stETH, and 1 YT stETH = 0.
- <https://medium.com/@BuidlerDAO/the-advancing-path-of-pendle-from-obscurity-to-defi-rising-star-83ecc0869889>

There are then several strategies:

- Long assets at a discount: It's possible to buy an asset at a discount, but it can be redeemed fully against the underlying asset at maturity and is tradable anytime.
- Get a fixed yield: When buying PT, it's effectively locking the APY at the current Implied Yield when it's bought. No matter what will be the yield of underlying tokens, you will get the fixed yield you bought.
- Leverage exposure to future yield streams without the need for collateral: By buying YT, it's betting that the yield of the asset will raise (or that implied APY is undervalued). The returns will be determined by the fluctuations in the underlying APY.
- The yield on Pendle pools comes from 4 streams:
 - Fixed rate from PT
 - Protocol rewards from the underlying token
 - Swap fees
 - PENDLE incentives

- Pendle provides the toolkit for users to enjoy fixed yields via discounted asset purchases, speculate on yield through YT (covered more below), or participate in their pools to earn additional yield through swap fees and rewards
- On the retail access front, Pendle has also done a great job in simplifying the UI/UX for users to engage in various yield strategies
- Use cases on Pendle:
 - Purchase assets at discounted prices
 - Engage in various yield strategies
 - Earn yield by providing liquidity for their pools
- Standardised token standard for yield bearing assets makes it easy to integrate more yield-bearing assets in the future, and it unlocks composability for other DeFi protocols to build upon or integrate with it.
- Pendle's core functions involve yield tokenization and the trading of future yield tokens via AMMs
- Pendle was audited in 2021 by Least Authority, a security consulting company that specializes in web3 protocols. The audit was centered around the protocol's smart contracts, where Least Authority issued a report that encapsulated risk mitigation and remediation instructions.
As of today, Pendle as also been review by Ackee blockchain, Dedaub, Dingbats and some senior devs like cmichel.

<https://docs.pendle.finance/Security#audits>

- ERC-4626 is the new standard for SY token and tackled a significant part of the fragmentation (PT+YT) by standardizing the interfaces for vaults, a major category among various yield generating mechanisms.

<https://eips.ethereum.org/EIPS/eip-5115>

- Competitors are: 8 MPH, Notional, SENSE, and IPOR Labs. TVL here is outdated but the table gives a good overview of the competition

	TVL (DeFiLlama)	Assets offered	Chains offered
Pendle	\$157,746,851	17	4
88MPH	\$479,871	16*	1
Notional	\$24,850,048	4	1
Yield Protocol	\$2,280,000	10	2
Sense	\$554,458	1	1
IPOR Labs	\$13,571,601	3	1

* 88MPH doesn't offer the same features/product as Pendle

- Upgrade of Pendle protocol:
 - In v1, Pendle allowed users to participate in various strategies upon receiving the YT. They could deposit the YT into a liquidity pool (YT-USDC pair) to allow other users to buy or sell the YT against USDC.
 - However, because the value of YT is not constant (due to demand and supply of the token), liquidity providers face impermanent losses from the price fluctuations.
 - in v2, Pendle's new AMM will only allow LPs to provide PTs and the yield bearing token (instead of the YT as in v1) both of which are closely correlated. Now, PTs and YTs can be traded using a single pool of PT liquidity, enabled by utilising **flash swaps**.
- https://medium.com/@_jordan_brewer/bond-stripping-rate-swaps-in-crypto-the-next-defi-bluechip-df1cc803406c
 Pendle's AMM will also be enhanced through two improvements – concentrated liquidity and dynamic curves:
 - Concentrated liquidity: Pendle is able to estimate the rough yield range of an asset to enable concentrated liquidity within a particular range. Inspired by Uniswap v3, this allows for more efficient usage of capital and better liquidity for the AMM.
 - Dynamic curve: AMM curve automatically shifts to factor in the changes in PT and YT prices as they near maturity so that only the interest rate

changes are traded and not the prices of the individual tokens.

- Other improvements to the AMM include:
 - Auto-routing, allowing users to trade or LP for PTs/YTs with any major asset
 - Dynamic fee rate where fees are based on interest rates instead of the absolute amount
 - Gas optimization for better cost efficiency
 - TWAP oracle to ensure composability of fixed-rate products on the platform

Value Creation / Traction

- Be it providing liquidity for traders on GMX/Gains Network or even liquid staking derivatives like Lido, there is no shortage of options for yield chasers. Pendle allows to speculate on yield from this platform

<https://www.kassandra.finance/blog/pendle-finance-explained>

- In Pendle v2, the major innovation is in the design and construction of an AMM trading platform designed for yield trading. Users will be able to trade between SY, PT & YT with little to no impermanent loss.

<https://www.signum.capital/uncategorized/why-we-are-excited-about-pendle-finance-v2/>

- Greater capital efficiency is another feature of Pendle's v2 AMM. With the introduction of flash swaps. LPs can earn fees from both PT and YT swaps within a single liquidity provision, while traders can enjoy greater liquidity and therefore lower slippage.

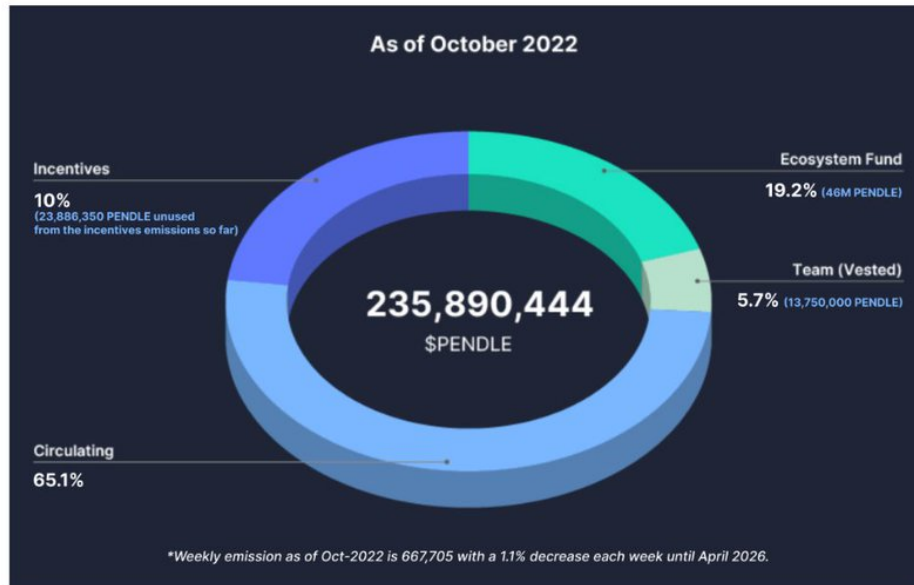
<https://www.signum.capital/uncategorized/why-we-are-excited-about-pendle-finance-v2/>

- By using a discount, Pendle avoid to use inflation to directly incentivize the yield bearing token so PENDLE holders are not suffering from dilution by the increase of circulating supply

Token: Value Capture & Accrual

- <https://docs.pendle.finance/ProtocolMechanics/Mechanisms/Tokenomics>
To receive boosted APY, the user can lock PENDLE into vePENDLE (max lock 2 years). Besides that, vePendle is also entitled to:
 - Share of protocol revenue
 - Vote for pools to channel incentives
 - Receive swap fees from voted pools
- Like CRV, with this mechanism comes wars over the voting power: Penpie and Equilibria.fi are fighting for locked PENDLE and incentivizing their pools. Penpie already has 30m TVL!
- <https://docs.pendle.finance/ProtocolMechanics/Mechanisms/Tokenomics>
PENDLE operates like any other currency. PENDLE has about 270 million coins with 92% in circulation, and 19% in an ecosystem fund. PENDLE began emitting rewards in October 2022 with an initial weekly emission of 677 thousand on a 1.1% decrease weekly, which will continue until April 2026 where PENDLE will allow for a terminal inflation rate of 2% per fiscal year. The inflation rate this year is roughly 22%.

Tokenomics

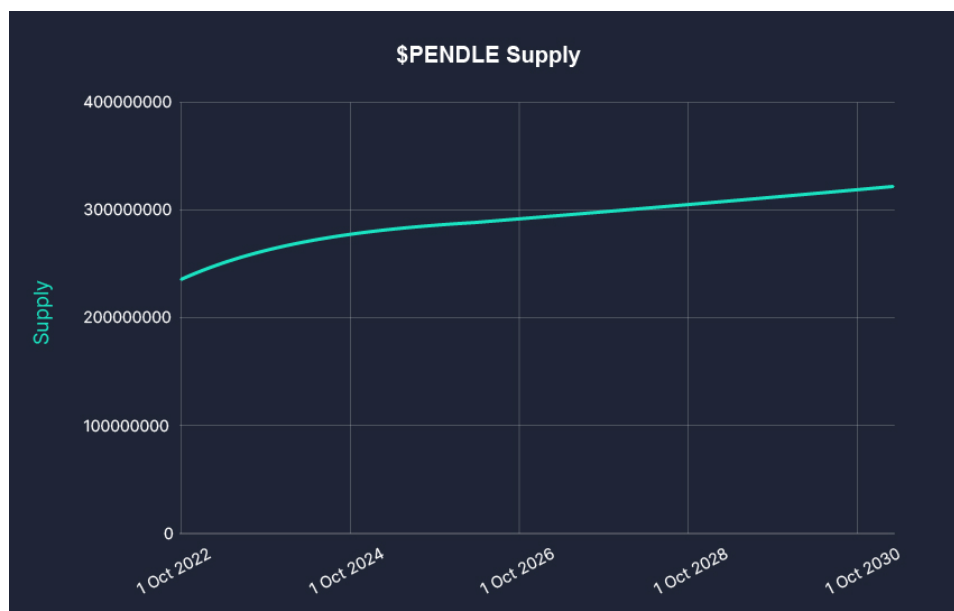


PENDLE distribution as of Oct-2022

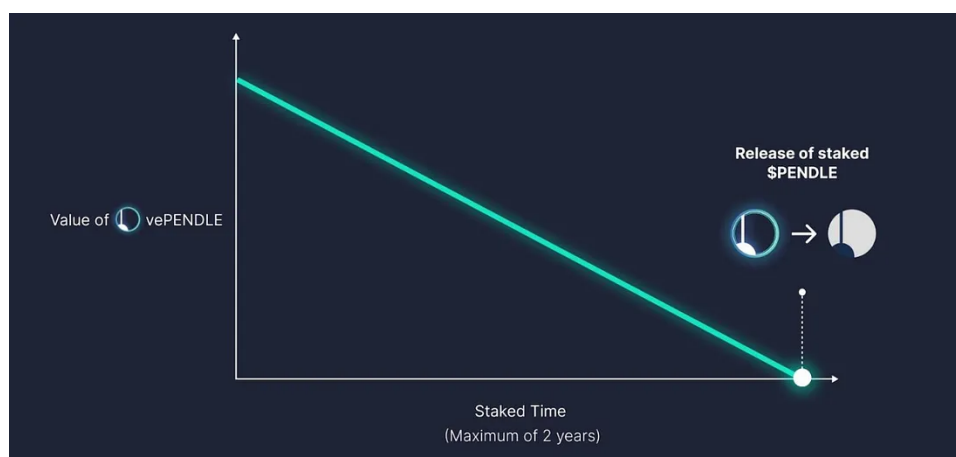
Team tokens vest up to April 2023. Beyond this, any increase to circulating supply will be contributed by incentives and ecosystem building.

Weekly emission as of Oct-2022 is 667,705 with a 1.1% decrease each week until April 2026. At this point, the current tokenomics allow for a terminal inflation rate of 2% per annum for incentives.

As the industry matures, governance may propose changes based on the evolution of ecosystem best practices.



- There are four protocol revenue streams in PendleV2:
 - YT fees: Pendle takes 3% of all yields generated from YT.
 - Swap fees: Pendle takes 0.1% of value transacted, which goes down as the time to maturity is shorter, and vice versa.
 - 20% of the fees above go towards liquidity providers, and the remainder will be distributed to \$vePendle holders. On top of that, yields from PT that have matured will also be proportionally distributed.
 - vePendle token holders will get 80% of the fees and can get also direct Pendle rewards to liquidity pools on a weekly basis based on their vote weight, and receive boosted rewards (up to 2.5x) on any Pendle pool that they have provided liquidity in.
- vePendle decreases linearly over 2 years, after which the underlying Pendle will be released



Team / Community

- TN Lee is the co-founder, and CEO of Pendle Finance. TN Lee started his web3 journey at a crypto trading hub, Kyber in 2016, where he became the head of business. He then co-founded a semiconductor manufacturer called Dana Labs. In 2020 Tn Lee co-founded Pendle Finance. According to PitchBook, Pendle has 13 employees. Pendle is privately backed, and has raised 3.7 million, with their largest backer being VC firm Binance Labs. TN Lee has 8 years experience in the web3 world building and creating value with

different protocols which makes him a veteran in the space and more than capable of creating the next bluechip.

- The Team is mainly composed by Asian people and students.

<https://www.linkedin.com/company/pendlefinance/people/>

- For the moment, the DAO is only used for voting on which pools in the AMM the vePENDLE rewards are gonna be distributed

<https://snapshot.org/#/sdpendle.eth>

- Roadmap:
 - Pendle aims to deploy on the Mantle network at some time in the future, and possibly on Base once it gets a bit bigger. Pendle aims to continue its position in the LSDfi space and integrate real world assets (RWAs). Also a part of this LSDfi and RWA push is more exposure to the OKX exchange for integration. More of these types of integrations are in the pipeline.
 - Pendle also is also focusing on the trading experience for institutional investors, and they see limit orders as the first step to that. Current TVL is currently 20% composed of institutional investors, but the team sees that increasing to 50% by EOY. The regional focus for Pendle will be centered around China, Vietnam, and South Korea.
- https://tracxn.com/d/companies/pendle/_xRr_PBH5nTFW7hsedkR-sGn_5BXeOJARc8_GUDoHSw/funding-and-investors
Raising: Pendle has totally raised 3.5M\$ through the last seed round leads by Binance. The amount of the others Serie A rounds lead by Spartan and Mechanism Capital haven't been disclosed