

StakeWise 3D: Litepaper

29 September, 2022

Introduction

As an active staking ecosystem participant, StakeWise has observed first-hand the detrimental effect that stake centralization has on competition and the risk it poses for Ethereum's security and health. In response to these challenges, StakeWise DAO is developing StakeWise V3, a decentralized staking protocol where:

1. anyone can join as a node operator without permission or collateral, including solo stakers;
2. solo stakers can mint liquid osETH tokens against their own node;
3. ordinary stakers can freely allocate ETH to specific node operators of their liking, including solo nodes;
4. DeFi users can stake by holding a liquid osETH token protected against penalties and slashing; and
5. institutions & crypto exchanges can create private mini-pools with access controls and the ability to tap into a liquid osETH token ecosystem.

Our goal for StakeWise V3 is to reduce the degree of stake centralization on Ethereum by i) making solo staking more appealing, ii) putting the choice of node operator(s) into the user's hands, and iii) offering a new, less risky staked Ether token standard as an alternative to prevailing models.

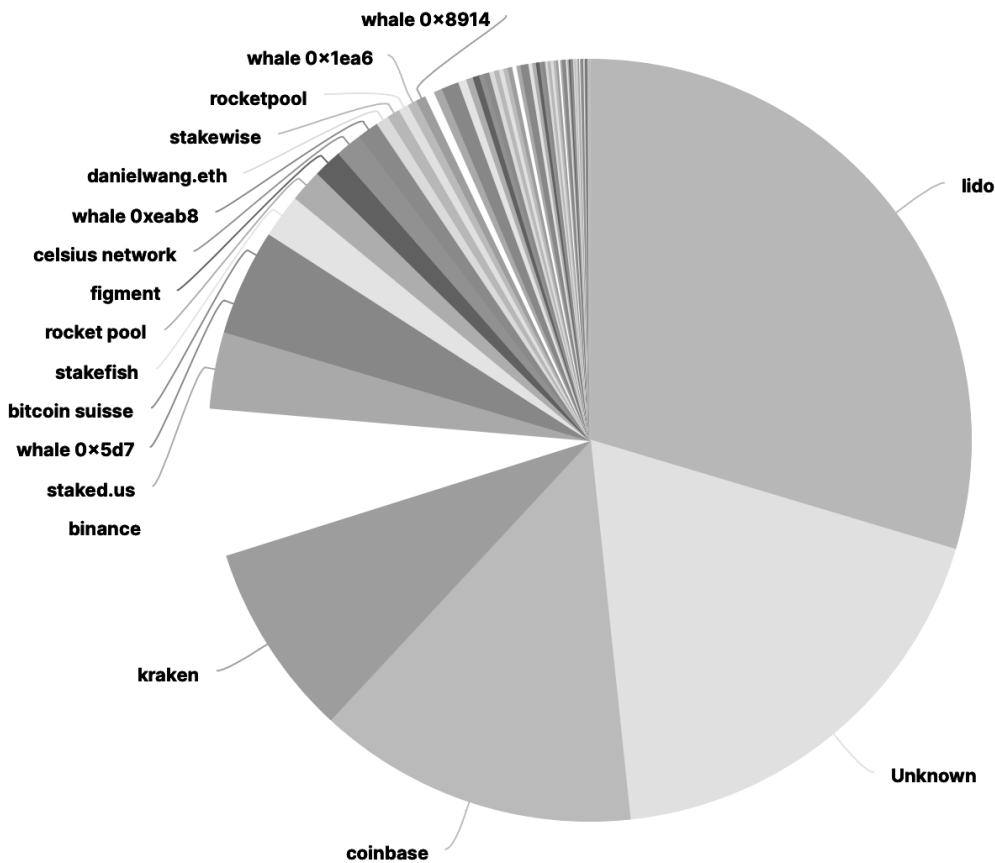
In this litepaper we will explore the pre-conditions for developing StakeWise V3, offer a high-level overview of its architecture and features, and illustrate its differences with existing staking pool models through a few use-cases.

Current state of the network

We became accustomed to thinking of Ethereum as a decentralized network, but the data from the Beacon Chain deposits clearly shows a worrying centralization trend. At most 18% of the network - some 2.5 million Ether - is controlled by solo stakers running nodes at home¹. In comparison, the share of the network controlled by the four major players - Coinbase, Kraken, Binance and Lido - is around 60%, and growing². As individuals outsource increasingly more Proof-of-Stake consensus work to just a few companies, one can't help but wonder if this is the start of an identity crisis for the Ethereum network.

¹ https://beaconcha.in/charts/pools_distribution

² <https://dune.com/hildobby/ETH2-Deposits>



Distribution of staked Ether, data courtesy of Beaconcha.in

The demise of solo staking has been driven in large part by the popularity of delegated staking, particularly liquid staking services. The rate of inflows into Lido, arguably the leading liquid staking protocol on Ethereum, has at times exceeded 70% of the total monthly Beacon Chain deposits³. These numbers tell a story: the absence of technical or capital requirements, the ability to momentarily exit from staking, and the increased efficiency of staked capital resonate with depositors so much that they no longer consider solo contributions to network security attractive. The ethos of decentralization is waning by the day.

The key implication from more deposits piling into the same staking services is the rising concentration of network security in the hands of just a dozen commercial node operators (teams). Factual and anecdotal evidence suggests that the top 10 operators in the industry - Coinbase Cloud, Staked, ConsenSys, Blockdaemon, Figment, stakefish and others - control over 50% of the Beacon Chain⁴, courtesy of delegations from centralized

³ <https://messari.io/report/liquid-staking-with-lido>

⁴ https://beaconcha.in/charts/pools_distribution

exchanges, Lido and their own services. While the emergence of specialist firms that run nodes for a living is a welcome sign of industry maturation, the rising concentration of capital staked with just a handful of providers increases the likelihood of censorship and network downtime. The sad inevitability of this outcome is the reason we put financial assets on a *decentralized* network in the first place.

The users of the leading (liquid) staking services unwittingly accept this costly trade-off, but there is yet another often overlooked consequence - the systemic risk that such services introduce to the DeFi ecosystem. Many protocols have integrated Lido's stETH, a liquid staked Ether token, to the point where it is quickly becoming an interest-bearing replacement for Ether. However, unlike Ether, the underlying value of stETH depends on the absence of slashing events within Lido's validator set. Diversified between 30 operators on paper, it suffers from a similar concentration issue as the Ethereum network itself. Its top 10 node operators account for 57% of all Ether staked in Lido⁵ and over 30% of the Beacon Chain⁶, big enough to cause over 70,000 ETH in correlated slashing losses for stETH holders in case of failure⁷. In such circumstances, risk spillover into DeFi may resemble the contagion of June 2022, when a rapid decline in stETH value caused mass deleveraging and liquidations across the board, bringing down asset prices and bankrupting investment funds.

Simply offering more liquid staking options does not seem to fix the issue of centralization. A recently launched liquid staked Ether token from Coinbase, cbETH, quickly became the second largest token of its kind by outstanding supply⁸, yet it has a blacklisting functionality and a completely opaque validator set⁹. Anecdotal evidence points to the majority of Coinbase's validators being run by Coinbase Cloud, making it highly centralized and susceptible to the same, if not higher risks than stETH. If the stakers entering post-Merge prioritize using a delegated (liquid) staking service, the industry should come up with an stETH alternative that makes the ecosystem more robust, not fragile.

One such option is Rocket Pool - a protocol that promotes solo staking and is the most decentralized alternative to Lido to date. Its key innovation is allowing solo stakers to host validators for others, submitting 16 Ether and at least 1.6 Ether worth of RPL, the protocol's governance token, per validator as a "bond" against malicious actions. It makes solo stakers the guarantors of rETH, the liquid staked Ether token that the protocol's users receive as a representation of staked capital. Whilst rETH is a de-facto "unslashable"

⁵ <https://www.rated.network/o/Lido>

⁶ <https://etherscan.io/dashboards/beacon-depositors>

⁷ Estimated cumulative loss from an operator like stakefish slashing all of its validators (3.58% of the network, according to Beaconcha.in)

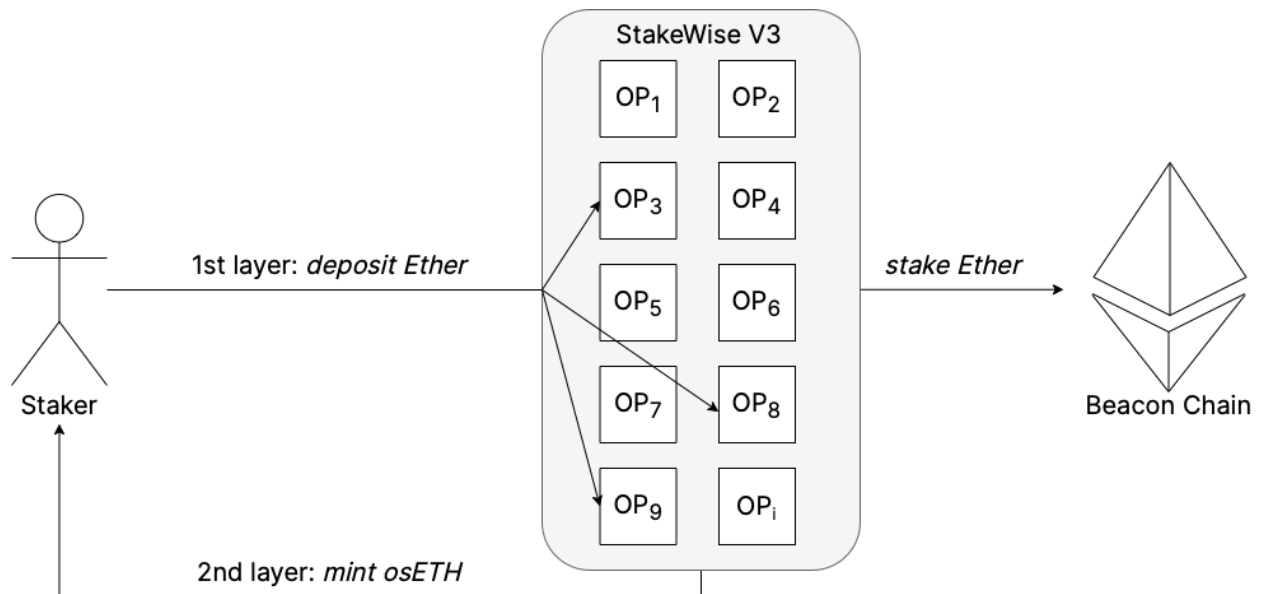
⁸ <https://dune.com/Marcov/coinbase-wrapped-staked-eth>

⁹ https://twitter.com/bantg/status/1562534990323146755?s=20&t=_V-rbAADGdcE9idA44jXCA

token that could meaningfully replace or complement stETH usage in DeFi, it comes at the expense of solo staker's capital efficiency and requires holding RPL, a token subject to high price volatility. After strong initial growth, the protocol ran into a shortage of solo "hosts" that has so far stopped rETH from going after Lido at scale¹⁰. Ironically, the biggest host on Rocket Pool is Allnodes, a major node operator that already maintains 14% of the protocol's validator set using delegated capital¹¹. It seems that for whatever operational or economic reason (or both), running nodes at home simply remains less attractive than delegating Ether to the top-10 node operators using a liquid staking service.

And so Ethereum drifts towards the antithesis of its own mission: to build a permissionless, censorship-resistant and financially robust network for value exchange. Too few people seem to care. Solo staking represents a progressively smaller share of Ethereum's security budget as users prefer to delegate their coins to (liquid) staking services such as Coinbase, Lido, Binance and Kraken. The network effect such services enjoy has had a centralizing effect on block production, which risks undermining the stability of both the Ethereum network and its DeFi ecosystem. Emerging alternatives like Rocket Pool have not been effective at counteracting this centralization trend so far. The capture of block production by the largest of node operators continues unabated.

Introducing StakeWise V3



High-level user journey in StakeWise V3

¹⁰

<https://unchainedpodcast.com/post-merge-if-lido-becomes-dominant-what-does-that-mean-for-ethereum-ep-372/>

¹¹ Estimate using data from <https://www.allnodes.com/rpl/staking>

In response to centralization pressures, StakeWise DAO aims to help Ethereum change its course by introducing StakeWise V3, a permissionless and decentralized staking protocol with a novel staked Ether token type called osETH.

StakeWise V3 pioneers the concept of *layered staking*, allowing users i) to delegate Ether to the node operator(s) of their liking (1st layer), and ii) giving them the option to mint osETH to represent their stake (2nd layer).

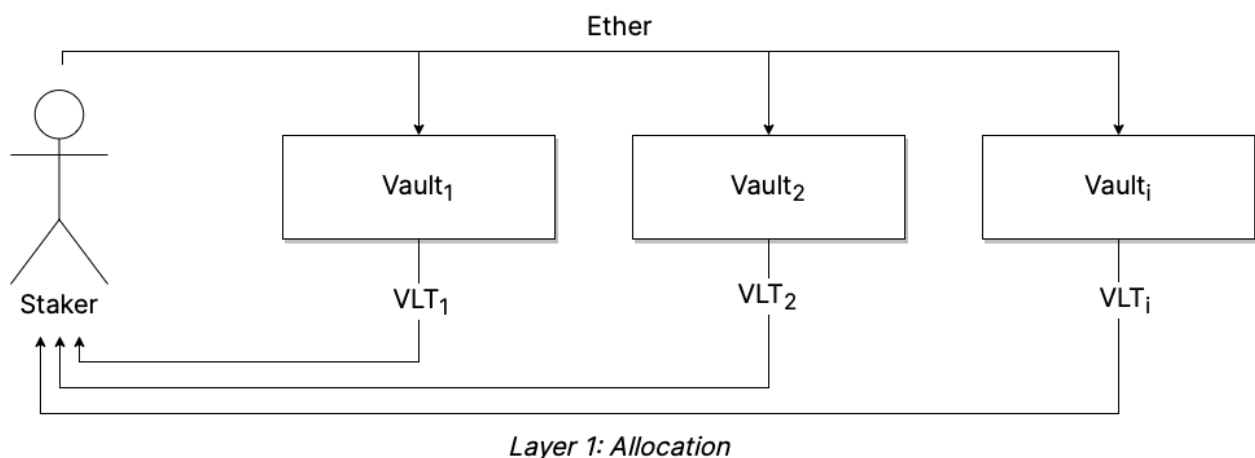
This protocol design enables anyone to join as a solo staker who can mint osETH tokens against their node, or delegate Ether to smaller nodes to counteract network concentration. V3 also produces a slashing-resistant staked Ether token, osETH, that does not introduce systemic risk when integrated into the ecosystem at large scale.

Below we will explore each component of StakeWise V3 in more detail.

Layer 1: Vaults

The 1st layer of staking in StakeWise V3 relies on the concept of Vaults - a network of permissionless minipools that can receive Ether delegations on their nodes. It offers users the freedom to stake with whatever Vault (minipool) they want, choosing between Vaults run by solo stakers, node operator companies, and groups of solo/commercial operators.

How it works



Anyone willing to run nodes for others can create their own Vault and start accepting deposits from the Allocators, i.e. StakeWise users who choose specific Vault(s) in which to stake. For every 32 Ether of deposits accumulated in a Vault, the Vault operator(s) registers an Ethereum validator in the Beacon Chain and starts staking. The staking

rewards belong to the Allocators, net of the staking fee charged by the Vault. Every Vault can set its own staking fee.

Upon deposit, Allocators receive Vault Tokens (VLTs) - an ERC-20 repricing token that represents the Ether staked in the Vault. Every Vault has its own set of VLTs that reflect only the capital specific to that Vault. VLTs do not rebalance to reflect staking rewards & MEV accrual - instead, their redemption value goes up, where 1 VLT token could be worth 1 Ether in year 0 and 1.1 Ether in year 1 (at 10% APR). VLTs can be redeemed for the underlying Ether by exiting the validators that stake it and withdrawing the funds, burning the VLTs upon redemption.

Vaults collect their staking fee in VLTs. The VLT accrual address is set by the Vault Operator (VO) that can be an independent node operator controlling the Vault alone, or a Gnosis Safe multisig created by a group of node runners to set up a joint Vault. Vault Operators can allocate the validators' keys, choose the node runners within the Vault, the staking fee, and the maximum amount of Ether that the Vault can accept from depositors. It may also elect to choose a DVT setup like Obol or SSV. Once set, the Vault parameters become immutable, except the validator keys that can be added/removed dynamically.

In addition, Vault Operators can set their Vault to a private setting that allows deposits only from the addresses that have been whitelisted by the Vault Operator itself. It enables use cases like solo stakers depositing Ether into their own Vault and not accepting deposits from anybody else, for example, or compliance-sensitive organizations creating a Vault to enable staking for only a limited number of KYC'd participants.

Vault Operators can also deposit Ether collateral to serve as the junior tranche insurance against slashing losses. If the Vault validators are slashed, the amount of Ether lost will first be deducted from any collateral deposited by the Vault Operator. Once this Ether is exhausted, slashing losses will be absorbed by the stakers in the Vault, reducing the redemption value of their VLTs proportionally to the size of losses. This makes Allocators responsible for their own delegation decisions as a poor choice of Vault(s) may result in capital loss.

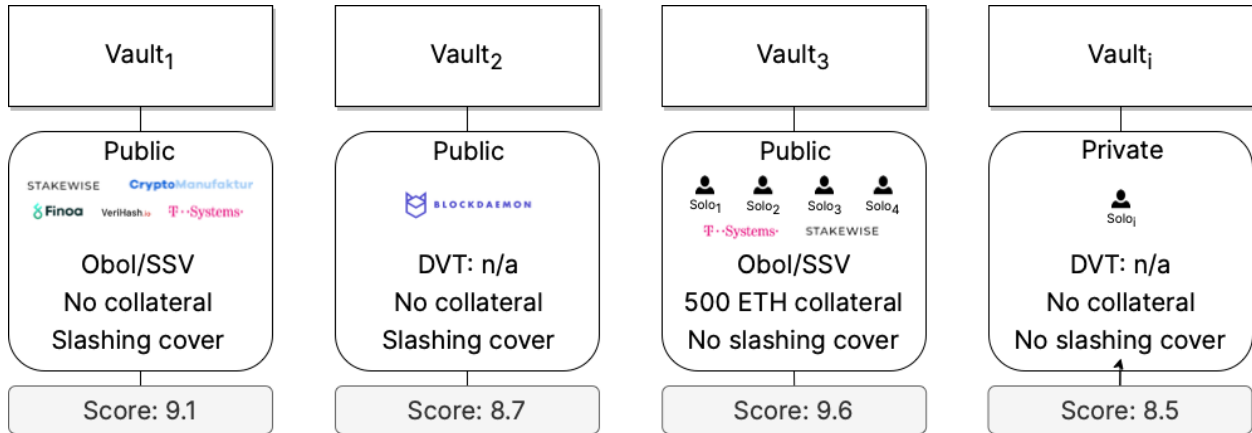
Vault Scoring System

To assist Allocators with choosing the least risky Vaults, StakeWise DAO will automatically assign and periodically update a Vault Score for every active Vault in existence. The Score will be based on a publicly available formula that considers the operational performance of the Vault and some additional safety criteria like:

- presence of slashing insurance from on-chain providers;
- amount of Ether and/or SWISE collateral submitted by the Vault Operator;

- usage of Distributed Validator Technology within the Vault (Obol/SSV);
- Vault size relative to other Vaults;
- share of the Beacon Chain validators already run by the operator(s); and other.

The goal of the Vault Scoring System is to reflect the riskiness of the Vaults according to the implicit slashing risk they carry and encouraging decentralisation of the network.

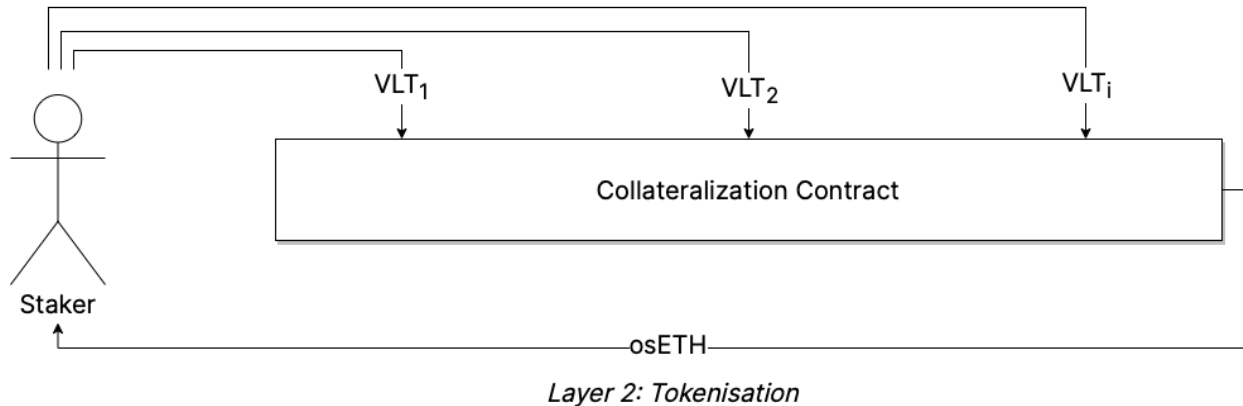


Example of StakeWise V3 Vaults

The Vault Scoring System will form an integral part of the ETH staking ecosystem by providing the foundation for ranking operators. We invite the wider Ethereum community to contribute to this scoring system and assist the StakeWise DAO in establishing the different components that should be included and discuss the optimal weights. A working group to kick-start this discussion will be set up shortly.

Layer 2: osETH Token

osETH, an overcollateralized staked Ether token, is a liquid ERC-20 token representation of staked capital that uses Vault Token(s) as collateral. It can be minted by anyone who has staked Ether into the Vault(s) - including the solo stakers - or it can be bought/sold on decentralized exchanges.



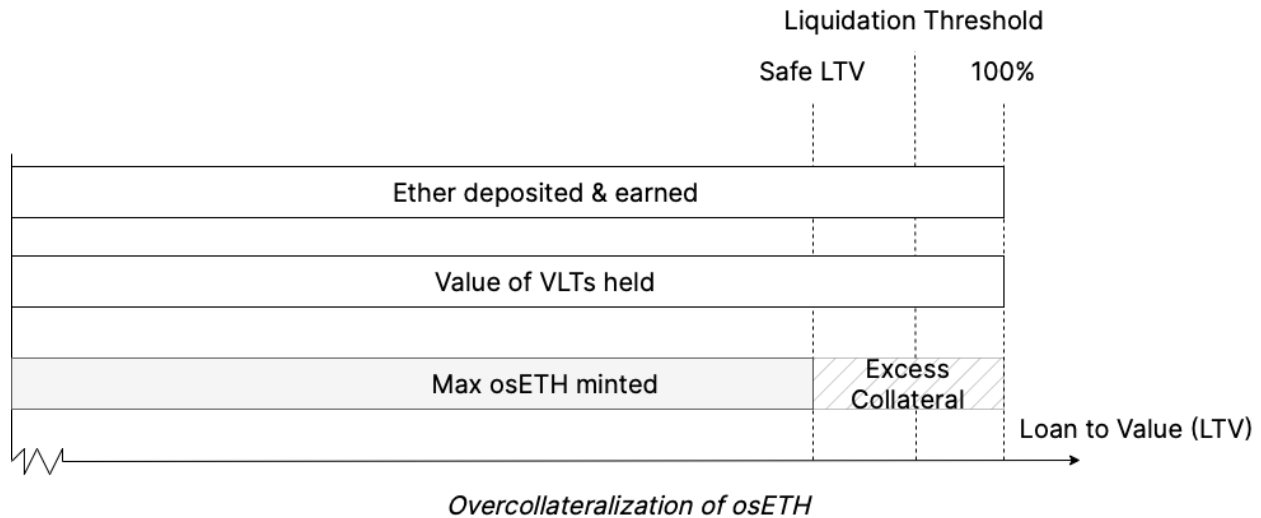
osETH represents a new type of liquid staked Ether token that has its value pegged to staked Ether 1:1, but that does not pass on the slashing losses to holders. It receives all of the upside from staking and none of the downside (risk of slashing) thanks to overcollateralization. Whenever slashing happens, osETH holders are not affected as the loss is absorbed by the stakers that posted collateral to have osETH minted.

Allocators can mint osETH using VLTs from the Vault(s) in which they deposited Ether. The maximum amount of osETH they can mint is set below the value of their VLTs to keep a buffer against potential slashing losses in the Vault(s). This isolates the capital losses and protects osETH holders (users and protocols) from slashing. Instead, any slashing penalties are borne by the Allocators who are the holders of VLT tokens.

Similarly to the Vault Tokens, osETH value increases over time to reflect the accrual of staking rewards & MEV, net of the stability fee charged by the StakeWise DAO. After the Shanghai fork, the token can be redeemed for Ether in the validators or in the Peg Stability Module (PSM), a special ETH reservoir, at a 1:1 ratio. When going through the PSM, a small redemption fee will be applied. Before withdrawals become possible, osETH can be redeemed for VLTs at a 1:1 ratio. Whenever necessary, osETH can also be sold for Ether at a market price in an AMM.

Collateralization Parameters

Each Allocator that mints osETH will have a unique Individual Loan-to-Value metric, or LTV_i , to reflect the utilization of VLT collateral in minting osETH. This parameter is dynamic, changing whenever an Allocator mints or burns osETH, and whenever the Vault receives penalties, underperforms, or gets slashed.



Maintaining an Individual LTV is very similar to maintaining a collateralization ratio/health factor in Maker or Aave. The golden rule is that the level of LTV should remain below a certain threshold to avoid having the position closed (in other words, liquidated).

StakeWise V3 uses a parameter called the Liquidation Threshold as a measure for deciding when a position should be liquidated to ensure a safe level of collateralization across total osETH supply.

To preserve collateral through any slashing event or penalties earned by the Vault(s), Allocators must maintain Individual LTVs below the Liquidation Threshold. If they fail to do so, their positions will be subject to the liquidations process described below.

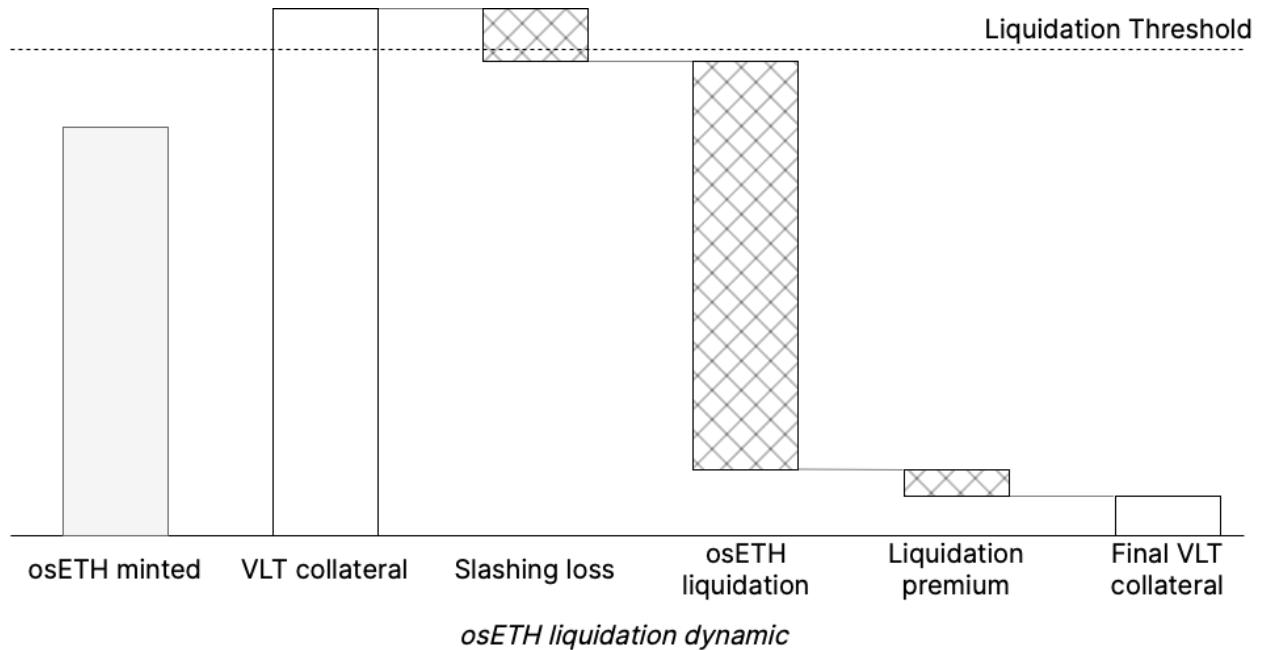
Liquidations Mechanism & Threshold

In case Individual LTVs exceed the Liquidation Threshold, Allocators' positions are at risk of liquidation. It means their outstanding osETH position can be closed down, with osETH burned for VLTs by any third party in return for a liquidation premium. Liquidations are necessary in order to reduce the osETH supply and to keep the overall system healthy, for example, in response to a decline in VLT value after a slashing event.

StakeWise V3 uses the estimated size of the slashing loss in order to determine the Liquidation Threshold. It is calculated as $\text{safe LTV} + \frac{\text{estimated size of the slashing loss}}{32}$. The Liquidation Threshold is applied to the value of VLT collateral to determine the maximum value of osETH position that can be held against the VLTs. If the Liquidation Threshold is breached, the osETH position of an Allocator can be liquidated.

Anyone can become a Liquidator by returning the outstanding osETH amount to the system and claiming the VLT tokens of the Allocator. The amount of VLT tokens claimed is

equal to the value of osETH returned plus the reward for liquidating the position, known as the Liquidation Premium. It is deducted from the total VLT collateral of the Allocator to incentivize liquidations and careful management of Individual LTVs. After receiving the VLTs, the liquidator has the option to mint osETH against them, or redeem them for ETH in the validators (post-Shanghai).



During the liquidation, Allocators are at risk of losing capital from the liquidation premium and the slashing penalty, but they still maintain control of any osETH originally minted.

Estimating Safe LTV

Safe LTV is a key parameter in the StakeWise V3 system because it determines the maximum amount of osETH that can be minted against an Allocator's VLTs. It is set by the following formula:

$$Safe\ LTV = \frac{Current\ expected\ slashing\ loss\ per\ validator + Liquidation\ Premium + Arbitrary\ buffer}{32}$$

The maximum amount of osETH that can be minted based on the VLT value is equal to:

$$Maximum\ osETH\ minted = VLT\ value * Safe\ LTV$$

Safe LTV is meant to be a relatively static parameter but will rise and fall in response to the changes within its components. The key component for determining safe LTV is the 'Current expected slashing loss per validator'. This loss can be estimated at any point in

time by monitoring the network conditions. The potential loss is calculated using the following formula¹²:

$$\text{Estimated slashing loss} = \text{Initial slashing penalty} + \text{Halfway slashing loss} + \text{Inactivity penalty}$$

where

$$\text{Initial slashing penalty} = 1 \text{ Ether}$$

$$\text{Halfway slashing loss} = \frac{\min(32 * \# \text{ of validators slashed in the prev. 36 days} * 3, \text{Total active validator balance in the network}) * 32}{\text{Total active validator balance in the network}}$$

$$\text{Inactivity penalty} = 8192 * \text{Base reward in ETH} * 3$$

As a precaution, the StakeWise DAO plans to use the *expected* number of validators that could simultaneously experience slashing during the next 36-day period, based on the share of the network that the Vault operators control within *and outside* of StakeWise V3.

The size of the liquidation premium and the extra capital buffer are the two other factors StakeWise V3 considers for calculating safe LTV. As these two numbers are set arbitrarily and depend on the risk aversion of the members of the StakeWise DAO as well as the wider staking community, we invite interested individuals to express their opinion about the recommended value of these parameters. A working group to kick-start this discussion will be set up shortly.

Maximizing osETH yield

The staking yield derived from holding osETH token relies on the consistently strong operational performance of Vault operators and their choice of relays for Maximal Extractable Value (MEV) generation.

To combat osETH yield dilution stemming from stakers who collateralize osETH with VLTs with subpar yield, StakeWise V3 will deduct an extra fee from their VLTs to compensate all osETH holders. The extra fee is applied to the minters of osETH in the bottom 20% of Vaults, measured based on the 14-day average APR.

Case Studies

The goal of StakeWise V3 is to enable liquid staking for a permissionless set of participants and create a staked Ether token resilient to slashing. The system is designed

¹² <https://eth2book.info/altair/annotated-spec>

to be sufficiently flexible to accommodate for the needs of all sorts of users - liquid staking protocol depositors, solo node runners, DeFi degens, commercial node operators, exchanges, funds and other organizations.

Below we illustrate how StakeWise V3 can handle the different use cases that such users have for a staking platform.

Solo stakers

Individuals staking solo from home value the non-custodial nature of running a node independently and often attach high significance to keeping Ethereum decentralized. However, they lack tokenization opportunities to access DeFi with their stake, and often underutilize their infrastructure investment by running fewer validators than their machine is capable of hosting.

StakeWise V3 allows solo stakers to mint osETH tokens against their node(s) to access DeFi even as they continue running in a non-custodial setting. Solo stakers not interested in accepting external capital can set up a private Vault and whitelist their own address to deposit Ether onto their node. They then have the ability to mint osETH based on the VLT tokens they receive.

It also allows solo operators to host validators for other stakers and earn additional revenues. Solo stakers willing to accept delegations can set up a public Vault and look to maximise their Score by developing a history of strong operational performance, depositing Ether collateral, buying slashing insurance for their nodes, and/or teaming up with other operators using Distributed Validator Technology (DVT) which reduces the slashing risk. They then have the ability to mint osETH based on the VLT tokens they receive.

Liquid Staking & DeFi Power Users

The users of liquid staking protocols seek out stable yields from holding a staked Ether token that they can instantaneously sell back into Ether or apply in DeFi for additional revenue.

The benefit that StakeWise V3 can offer to such stakers is the osETH token that can be bought and sold from the market, or minted by allocating Ether in the Vaults. In contrast to most existing alternatives, osETH has slashing protection embedded in its design, making liquid staking safer for both users and protocols that build products on top of it. Its goal is to protect the Ether principal that users commit to staking, which is a good fit for those who cannot afford to lose capital to possible slashing losses.

Beyond simply avoiding the slashing risk, StakeWise V3 gives stakers the opportunity to influence the degree of network decentralization by offering them a marketplace of staking providers. Stakers that are more discerning and risk-averse finally have the means to choose the specific operators that they consider less risky than the large staking providers, and in doing so can help the network decentralize.

Commercial Node Operators

Dozens of commercial node operators offer non-liquid Ethereum staking to their customers by simply running nodes on their behalf. Most of these services are custodial in nature and lack the ability to offer liquid staking to users based on the heightened capital and coordination requirements. They are also subject to a permissioned process to join a liquid staking protocol, which often requires waiting until the protocol's DAO starts accepting new operators into its validator set.

In StakeWise V3, such operators can open new Vaults, both independently and/or in partnership with other staking companies and solo node runners, to start accepting delegations that depositors can tokenize into osETH. Operators can decide to keep the Vault private or public, choose their desired DVT technology, demonstrate strong operational performance, post collateral or buy slashing insurance to reduce the risk and improve their Vault Score. They can also migrate the existing users into their Vault in StakeWise V3 once changing validator credentials becomes possible.

In any instance, staking with their previously custodial service becomes liquid and non-custodial, reducing the risk for both the customer and the operator.

Institutions & Exchanges

Financial organizations like fintechs, crypto exchanges and investment funds prefer to work directly with staking service providers, choosing just a handful that have successfully passed the due diligence process and offered the best terms. Whenever they also enable staking to customers downstream, they prefer to limit service access to only the clients they know, abiding by the Anti-Money Laundering (AML) regulations. Liquid staking is usually not available outside of such organizations' own ecosystems, limiting users' access to liquidity and the additional utility for staked capital that is available in DeFi.

StakeWise V3 allows institutions & exchanges to work only with the node operators and staking clients of their choice by creating their own private Vaults. In this case, the VLT tokens produced by staking into the Vault act as representations of staked Ether for which the organization can itself enable liquidity & utility within its ecosystem. In case the

organization wants to access the wider DeFi market and enjoy more liquidity & utility for staked capital, it can mint, or allow its customers to mint, osETH tokens to do so.

Conclusion

The only way to reverse the centralization trend that liquid staking services bring to Ethereum is by proactively encouraging the reallocation of new Ether inflows towards smaller but quality operators, and increasing the participation of solo operators in the network. StakeWise V3 aims to achieve both. With the V3 concept, we enable liquid staking for solo operators, and create a node operator marketplace to help discerning and mission-driven users to choose their own staking providers. The new 2-layer architecture introduced by StakeWise allows individuals and organizations to mint osETH, a liquid staked Ether token, based on their own nodes. They can do so without jeopardizing the safety of the DeFi ecosystem, thanks to the overcollateralized nature of osETH.

We hope to see the Ethereum community rally behind the new concept and assist StakeWise DAO with finalizing the core components of the new product.