Liquidity Unleashed: A Research-driven Analysis of Post-Shanghai LSDs

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Mingxuan He
mingxuanh.eth

Phoenix graduate scholar (computational economics), University of Chicago
Research fellow, Nethermind

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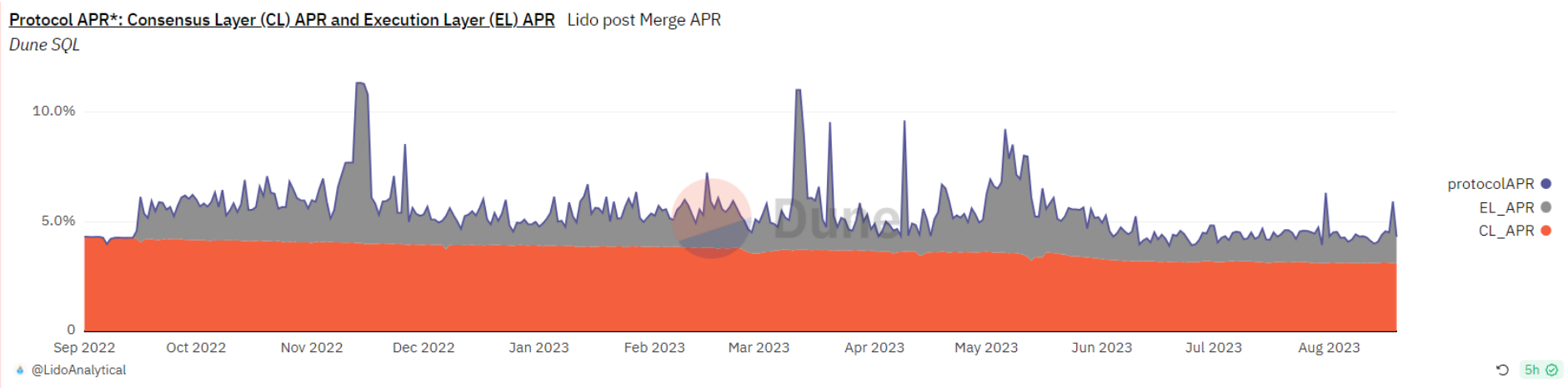
History of Ethereum Staking

- The Merge (Sep 2022): Ethereum migrated from PoW to PoS
  $\Rightarrow$ Now anyone can stake 32Ξ on mainnet and accrue rewards as a validator

- The Shanghai/Capella Upgrade (Apr 2023)
  $\Rightarrow$ Introduced option to withdraw staked ETH (unstake)

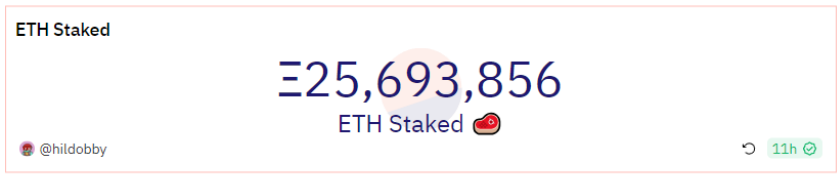
Breakdown of Ethereum Staking Rewards

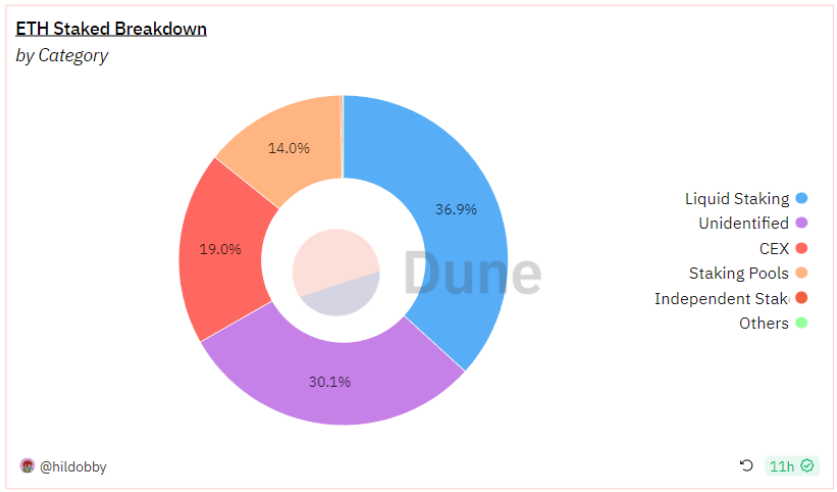
- Consensus layer rewards: Attestation, block proposal, sync committee
- Execution layer rewards: Txn fee (EIP-1559), MEV



source: @LidoAnalytical on Dune

ETH Staking Landscape





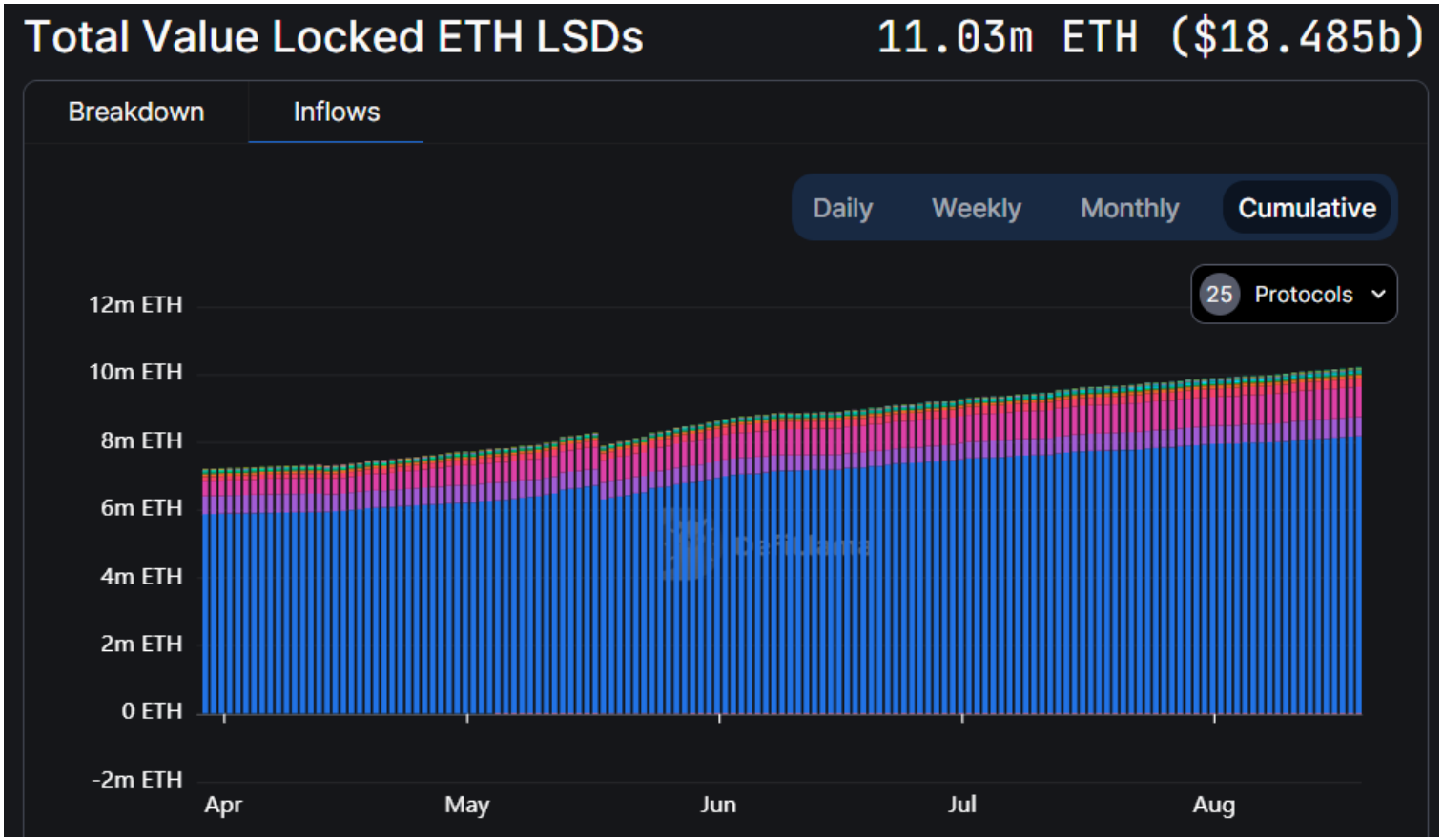
source: @hildobby on Dune

Liquid Staking Derivatives (LSDs)

ERC-20 tokens that represent ETH tokens locked in PoS contracts.

- Benefits of LSD: yields staking rewards & has liquidity
- Liquid use cases: borrowing/lending, trading portfolio collateral, etc.
- LSDs are redeemable for ETH at any time
- Most LSDs accrue rewards automatically i.e. **holding LSDs is equivalent to staking ETH in the pool**

LSDs saw huge growth after Shapella



source: DeFi Llama

Liquid Staking Protocols as Banks

[1]Banks are financial intermediaries which create liquidity by:

- Gathering liquid funds (e.g. customer deposits) as liabilities
- Holding illiquid investment projects (e.g. loans, bonds) as assets

Similarly, LSD protocols create liquidity by:

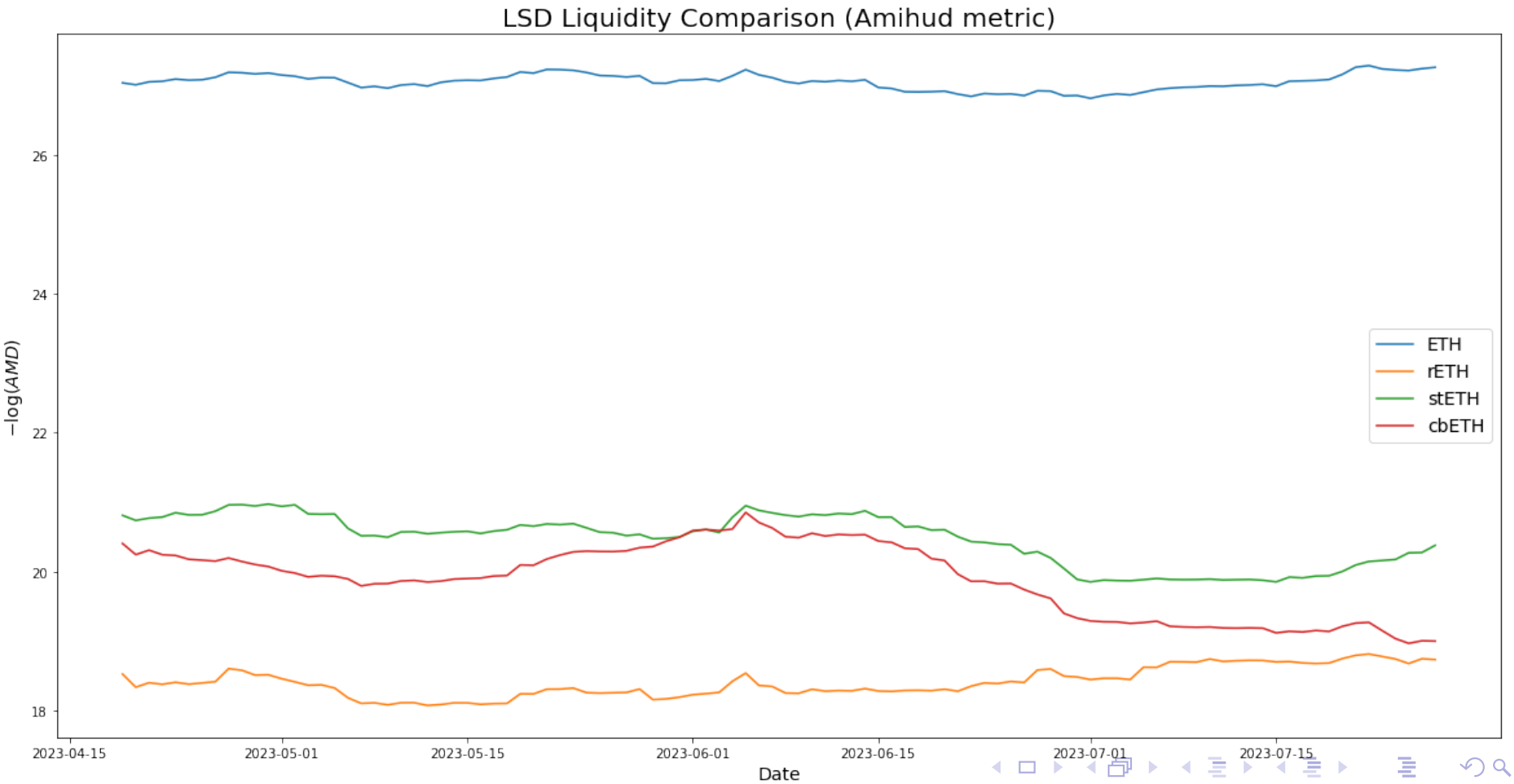
- Gathering liquid funds (ETH) as liabilities
- Holding in illiquid investment projects (Ethereum staking) as assets

[1]Diamond and Dybvig (1983) Theory of Banking

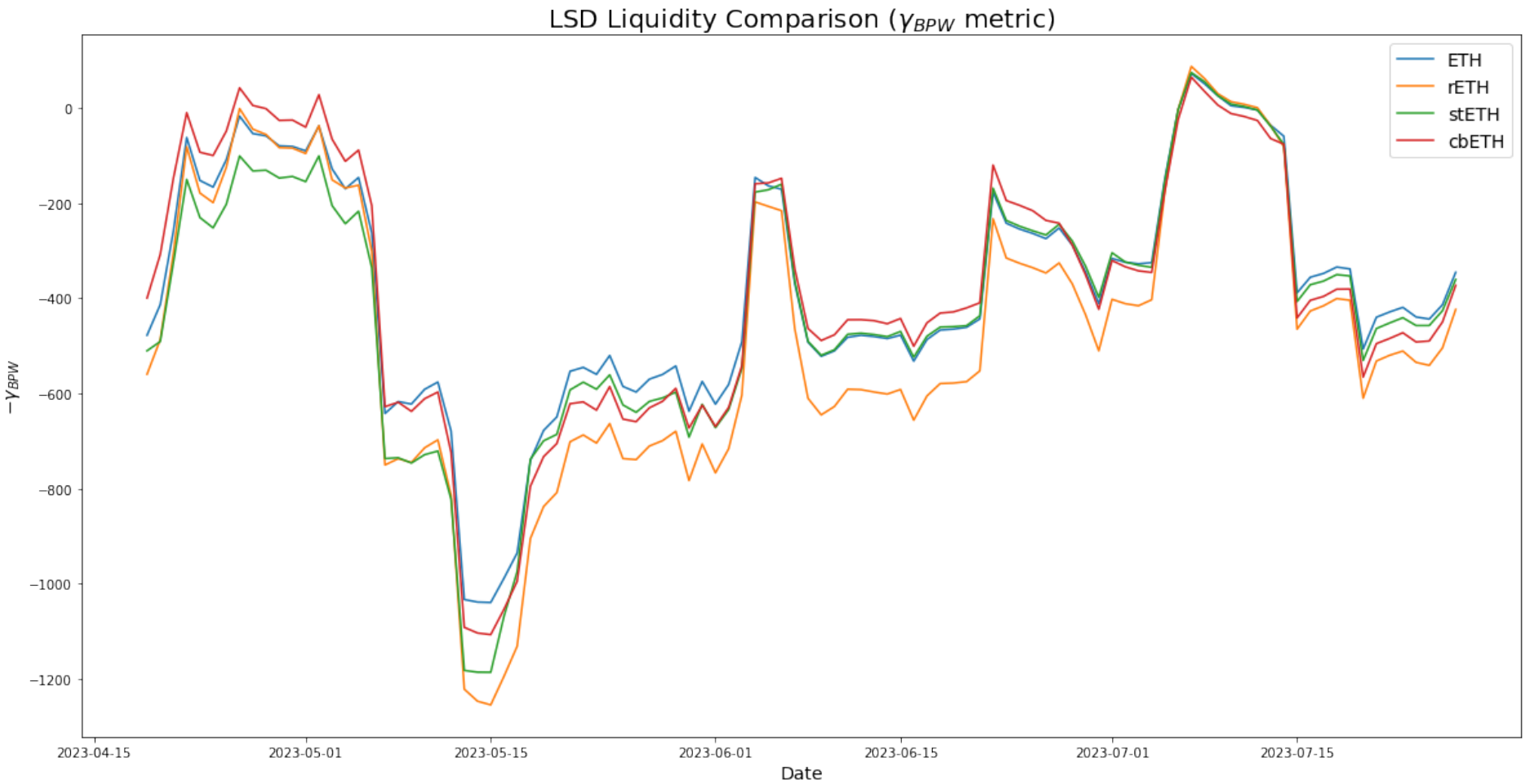
How Much Liquidity do LSDs Provide?

Introducing two quantitative measures of (il)liquidity:

① Amihud (2002): $AMD_{id} = \frac{1}{N_i d} \sum_{t=1}^{N_{id}} \frac{|r_{it}|}{V_t}$



② Bao, Pan, and Wang (2011): $\gamma_i = -Cov(\Delta p_{it}, \Delta p_{it-1})$



Are LSD Bank Runs Possible?

Bank runs are typically triggered by 1. sudden increase in demand for liquidity 2. expectation of protocol insolvency.

- Liquidity shortage: e.g. CRV exploit July 2023 where multiple liquidity pools were drained
- ETH price drop
- Regulatory crackdown: e.g. SEC deems LSDs as securities
- Large-scale slashing or penalty of validators
- Bugs/exploits/hacks stealing protocol funds

During a LSD Bank Run:

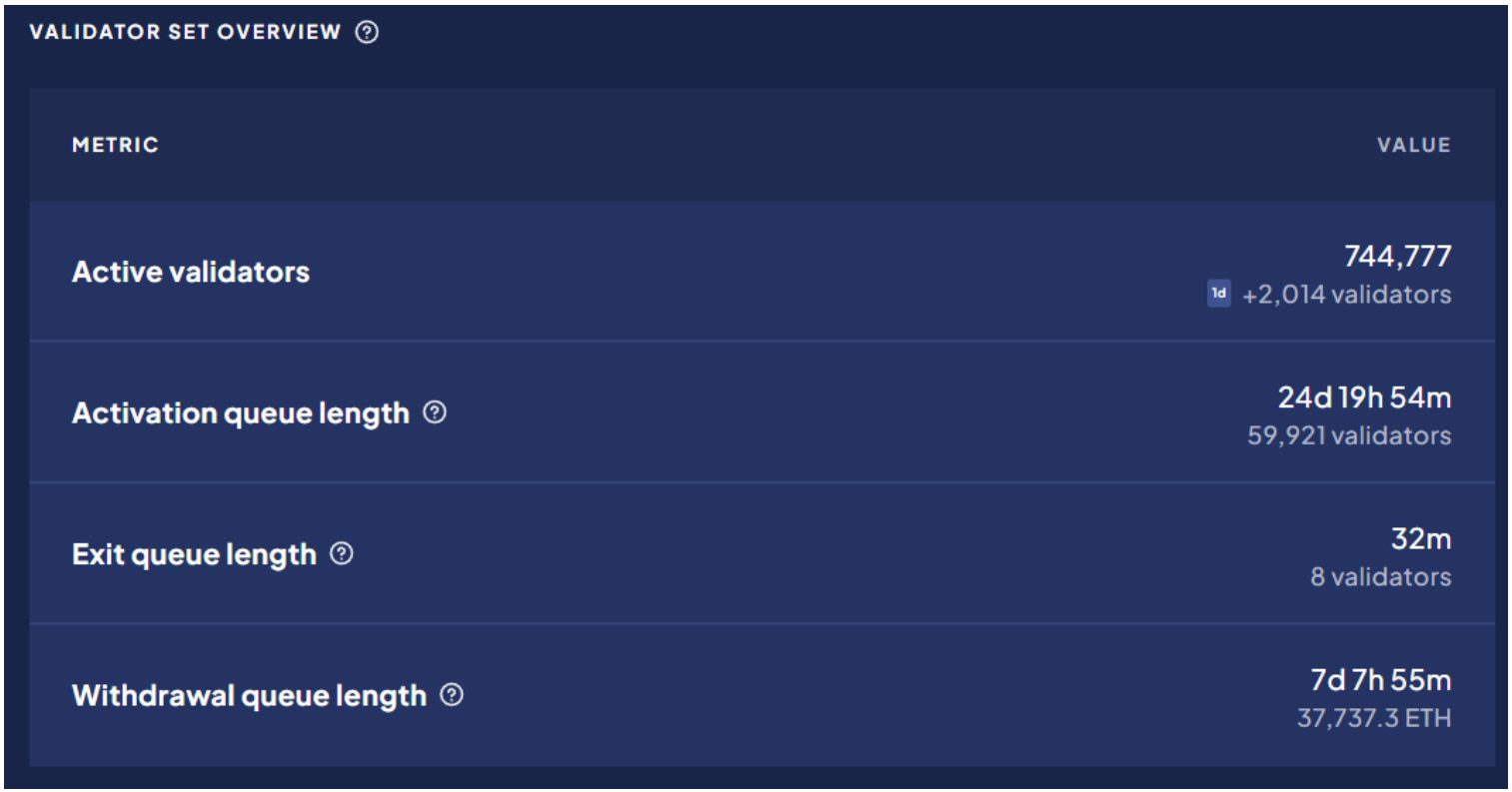
Two main methods of converting LSDs back to ETH:

- Direct redemption from protocol (deposit pool / POL)
- Through DEX pools/aggregators

What happens after these run out?

Withdrawing Staked ETH from Validators

- Step 1: Exit queue – only 10 validators can exit per epoch (≈2225 validators or 0.5% circulating supply per day).
- Step 2: Withdrawl queue – same queue with partial withdrawls but is processed much slower



source: Rated Network

Protocol Response Mechanisms

- Pause withdrawals (e.g. Lido's Bunker Mode)
- Sell protocol assets (e.g. gov tokens) !!Might cause self-fulfilling prophecy!!

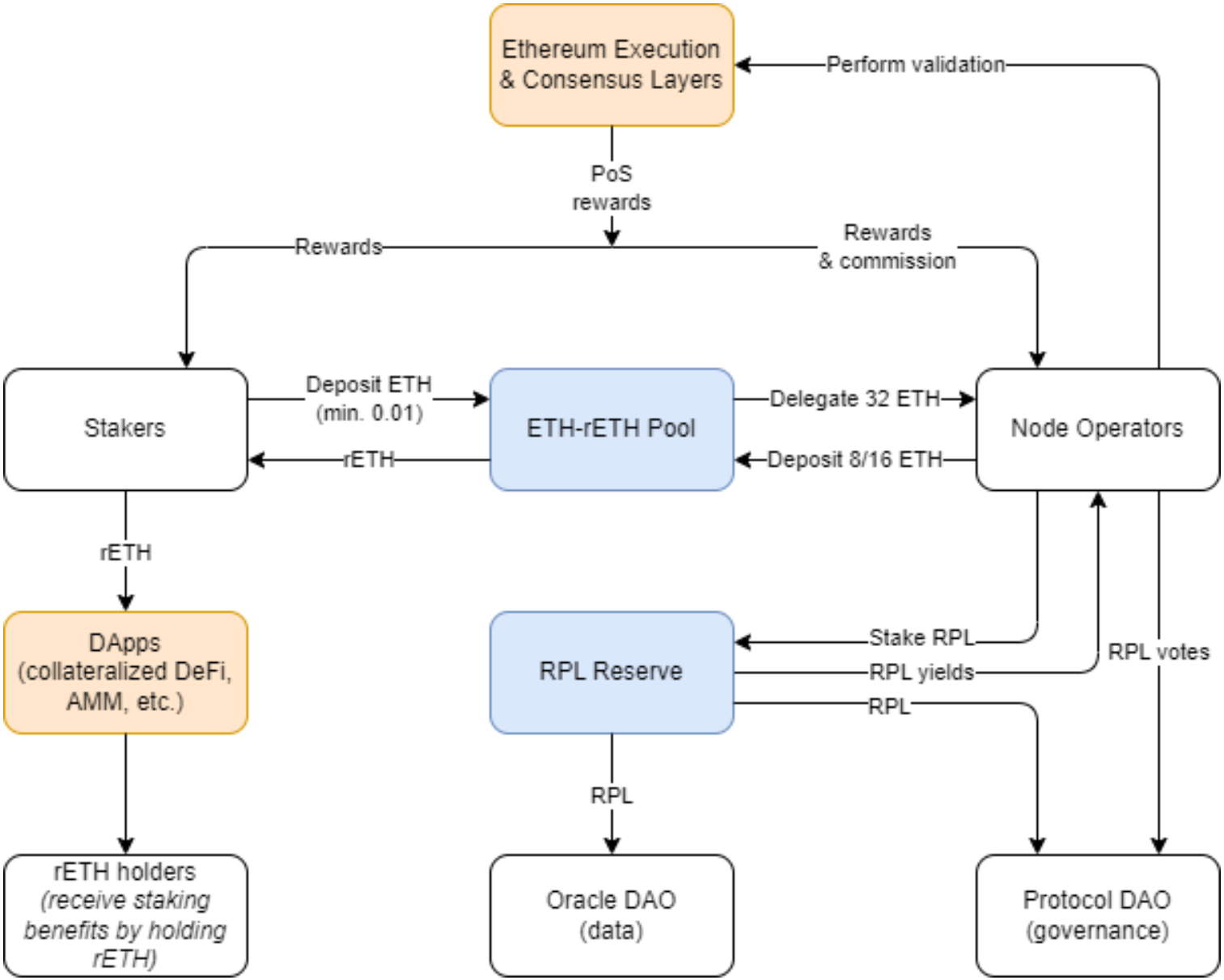
Systemic Risks

- Centralization of stake (esp. Lido): Nethermind Research and Lido are collaborating to solve this! Also DVT
- APR drop from excessive staking (block rewards do not scale linearly with ETH staked)
- ETH supply inflation if staking >> usage (ETH minted >> burned by EIP-1559)

Rocket Pool Agent-Based Model & Simulation

I've been building an agent-based simulation model for Rocket Pool to study and improve their protocol design. Areas I focused on include:

- rETH and RPL tokenomics
- Behavior of node operators
- Response to external risks


Ethereum Execution & Consensus Layers
Perform validation
PoS rewards
Rewards
Rewards & commission
Stakers
Deposit ETH (min. 0.01)
ETH-rETH Pool
Delegate 32 ETH
Node Operators
rETH
Deposit 8/16 ETH
rETH
DApps (collateralized DeFi, AMM, etc.)
RPL Reserve
Stake RPL
RPL votes
RPL yields
RPL
RPL
rETH holders (receive staking benefits by holding rETH)
Oracle DAO (data)
Protocol DAO (governance)

Thank You!

Connect with me on Twitter/Telegram @MingXDynasty, and Linkedin!

- Check out mingxuanhe.xyz for more research in DeFi & cryptoeconomics
- I'm on the job market for 2024!

References I

Amihud, Y. (2002).Illiquidity and stock returns: Cross-section and time-series effects. *Journal of financial markets*, *5*(1), 31–56.

Bao, J., Pan, J., & Wang, J. (2011).The illiquidity of corporate bonds. *The Journal of Finance*, *66*(3), 911–946.

Diamond, D. W. (2007).Banks and liquidity creation: A simple exposition of the diamond-dybvig model. *FRB Richmond Economic Quarterly*, *93*(2), 189–200.

Diamond, D. W., & Dybvig, P. H. (1983).Bank runs, deposit insurance, and liquidity. *Journal of political economy*, *91*(3), 401–419.