Token issuance in PoS Networks: where Security meets Economic Sustainability

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SNS Pisa, DeFi & Crypto, 27 Jan ‘26

Algorand

All opinions are my own and do not necessarily reflect the views of Algorand Foundation

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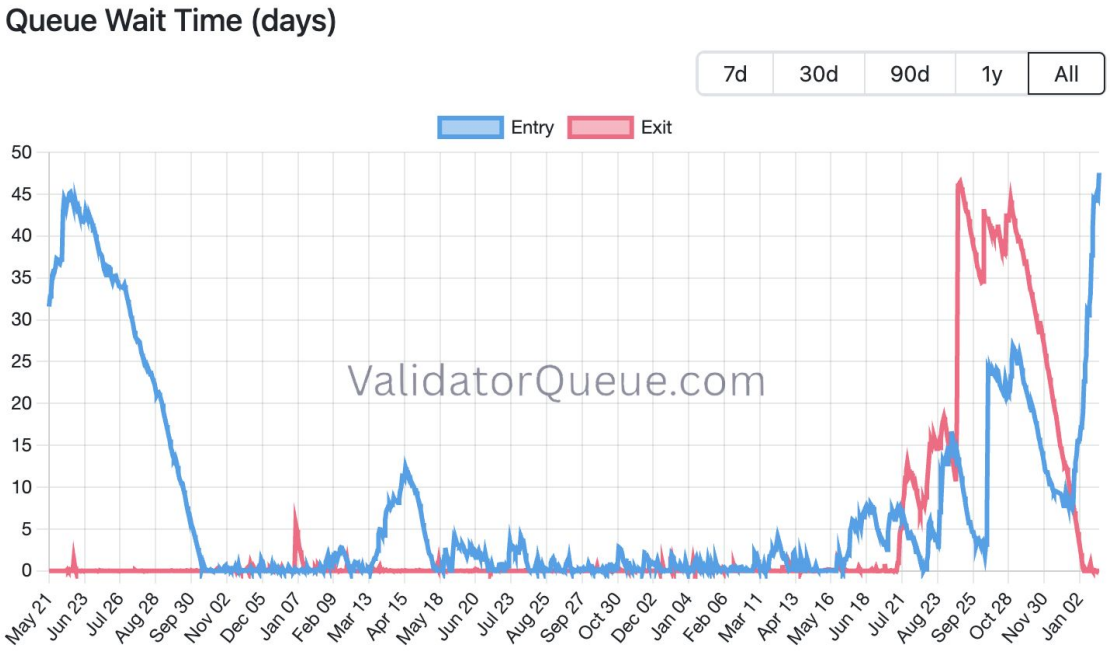
Ethereum Stake Model

- 120M current Circ Supply (steady)
- APR: 3% with 35M staked (fraction of the online stake: 28%, 100B$!)
- 1M validators (caveat: not entities!)
- Centralization: Lido is 25%! (but with Govs)
- The rigidity of the consensus protocol forces a choice of the validation quantum: 32 Eth. Side effect: higher threshold for entering in the validation game.(Vitalik explanation)
- Slashing (around 3%) is present, but rarely happens (here)
- STAKE: Deposit → Activation queue (varies) → Active & Earning
- UNSTAKE: Voluntary exit → Exit queue (varies) → +256 epochs (~27.3 h) → Withdrawal sweep (~16 withdrawals/slot; ~9 days to sweep all validators)

Time Scales for Ethereum Staking



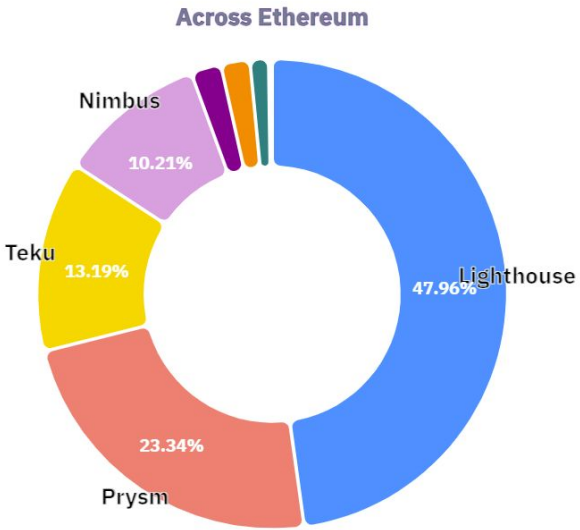
/ Sep 16: Ethereum Staking Exit Queue parabolic: 45 days!
/ **Huge** Speed bumps in on/off ramps!
/ solo staking? **150$/month!**
/ 5% only of solo stakers!

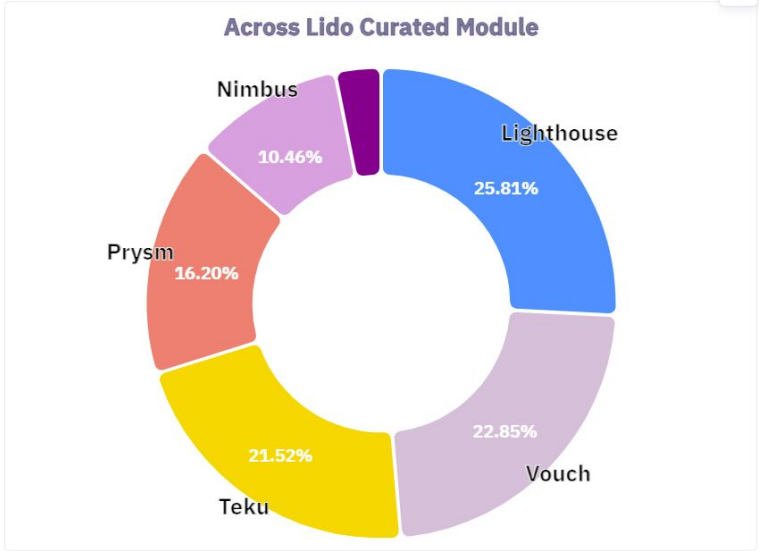
Why not Liquid Staking?

Lido: Liquidity for Staked Assets

APR 2.6% but Effective Governance for Diversity and effective performance monitoring

Consensus Layer





Source: https://clientdiversity.org/

Is Liquid Staking the solution?

Liquid Staking remove the entry barrier and (tries to) manage node efficiency in exchange for a fraction of the rewards, but introduces several potential issues:

Possible downsides for the chain
/ Centralization of stake & influence
/ Leverage & reflexivity
/ Exit-queue amplification

Possible downsides for the user
/ Depeg risk
/ Fee drag & reward variance
/ Slashing is socialized
/ Smart-contract & oracle risk

Wait!

“Blockchain, thanks to decentralization and trustlessness, will remove inefficiencies and middlemen!”

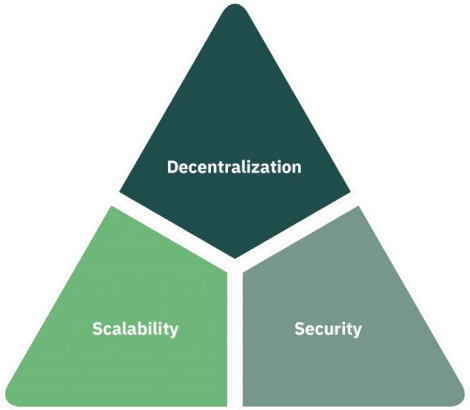
Solana Stake Model

- 600M current CircSupply with current 4.1% Token Issuance
- APR: 6% with 400M staked (fraction of the online stake: 66%, 50B$!)
- 930 stable validators
- Centralization: Liquid Staking (Jito + others) is 15%!
- Theoretically minimum stake is 1Sol but 7k Sol (1M$) are needed for breakeven
- Technical specs for a validator node are very high!
- Slashing is absent
- STAKE: Activation typically 1 epoch (~2 days);
- UNSTAKE: typically 1 epoch. Stake movement is rate-limited to ~25% of total active stake per epoch → large migrations can span multiple epochs.

Solana is not decentralizable!

Cost of running a validator node in Solana:

- / 1500$/month hardware & bandwidth, very high requirements (512G Ram)
- / Around 40-60 Sol/month (12k$/month) for voting



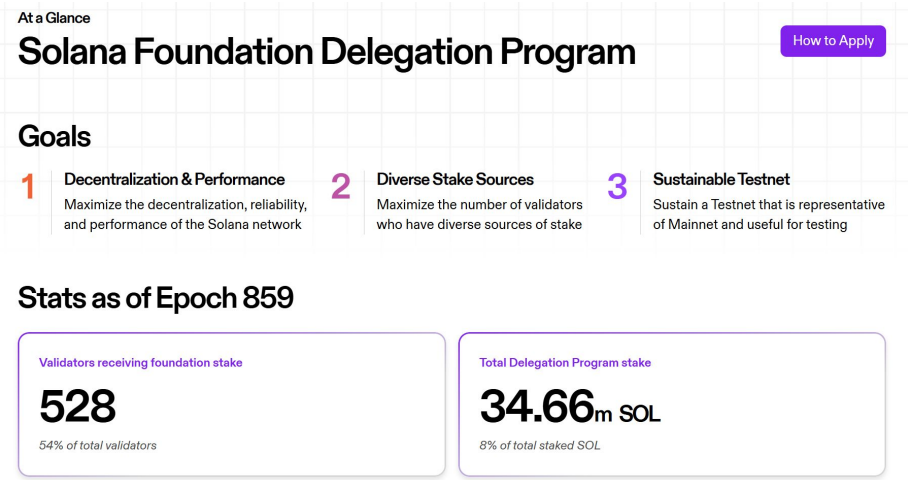
Problem:

Minimum capital for breakeven:

/ 7K Sol (1M$)

Solution: ask Solana Foundation!

(In 2024 100m Sol to 1k Validators)



Algorand Stake Model

- 8.4B current Circ Supply with a total of 10B
- APR: 6% with 1.9Bstaked (fraction of the online stake: 22%)
- 1800 stable validators
- Centralization: Algorand Foundation is 20%!
- Theoretically minimum stake is 1A but 30kA (4.5k$) are needed to receive rewards
- Technical specs for a validator node are minimal: 30$/month VPS is perfect!
- Slashing is absent
- STAKE: Activation typically 320 blocks (~15 mins);
- UNSTAKE: **instantaneous! You can spend half of your Algo and the rest will keep on participating in consensus & earning rewards!**

Does Ethereum achieve self sustainability?

Proposal: a protocol is self sustainable if is able to economically sustain a sufficient security level without eroding (too much) value to the token.

Yes: the security level is more than adequate (28% online stake, 30B$ attack cost) and currently the Circulating Supply is at equilibrium: minted Eth = Fee burned, statistically!

Evolution from Bitcoin paradigm of “written in stone” maximum supply, rather a target!

Ethereum’s L1 aims for sustainability through scarcity: it sells premium settlement blockspace, where demand creates persistent rent; that rent supports security both directly (tips/MEV + PoS issuance to validators) and indirectly (base-fee burn strengthening ETH as collateral).

- Limited x TPS max, not compatible with world financial system
- Limited validator participation due to technical constraints
- Huge Market Risk: 45 days of exit time
- Liquid Staking removes some barriers but introduces friction and “middlemen”

Current Scaling Potentials

Visa claims 10,200 TPS during last 12 months, see here

Network	Avg TPS / UOPS	Window	Max TPS / UOPS	Window
Ethereum	15.45	real-time (last ~1h)	62.34	best 100-block window
Solana	767.7	real-time (last ~1h)	4,709	best 100-block window
Algorand	8.68	real-time (last ~1h)	5,716	best 100-block window

Solana's raw TPS includes validator vote transactions: upper-bound for user activity
Algorand not includes inner txns

Source: https://chainspect.app/

Does Solana achieve self sustainability?

Yes & No:

- The security level is perceived as too high (66% online stake, 24B$ attack), too much capital is locked and not available for value-adding (and riskier) activities
- Decentralization COULD collapse under hardware cost pressure & voting costs
- Currently the Token Issuance is at 4.2%: is the Consensus “too expensive”?

Algorand does not achieve self sustainability!

- Current level of “Token Issuance” is around 9A per block, roughly 1% yearly
- It attracts 20% of CircSupply, too risky!
- Fees are “too low”: 1mA per txn (0.02c): average of 0.08A per block!
- FCFS batch: currently no MEV is possible!

Is it fair to compare APR only?

A validator is attracted by an APR which:

- / Remunerates properly for work: different protocols require different hardware and capital requirements
- / Compensates adequately for the risks associated: slashing risk, smart contract risk and counterparty risk for Liquid Staking.
- / Locking Period plays a crucial (overlooked) role: Market Risk is huge!

A user can decide where to stake: is Validation Market an Efficient Market?

Ingredients for funding Security

Block Validators can be rewards with these three main sources:

- **Fees collected in the block**
- **MEV remuneration shared with block producers**
- **Token Issuance**

Fees as a source for sustainability

Sustainability Perspective: **Fees * txns per block = (first level) security budget**

User Perspective:

- They represent a deterrent for exploiting finite resources
- They should represent a fair compensation for **scarce common resources consumed**:
  - Limited space in the next block
  - Limited computational resources available

Protocol Perspective:

- They represent a **transfer of value** from who is consuming resources (txn sender) to who is contributing to the security of the protocol (validators)

Congestion management: should be **just** a deterrent for overloading but

- **A Blessing is a curse and vice versa!**

MEV as a source for Security Budget

MEV is extracted through txn reordering by validators, maximizing the collected tips from users

Priority Gas auctions are needed when congestion is high (Ethereum).

High throughput (Solana) changes the game: from gas bidding to bundles construction.

Jito business model:

- A modified Solana client which allows bundle (atomic groups)
- Jito block engine runs off chain low latency bundles auctions to compete for inclusion
- Validator receive additional MEV related rewards plus priority fees
- JitoSol liquid staking allows to socialize MEV extraction between validators and stakers

How relevant is the market for MEV in high throughput protocols?

Solana’s validator revenue streams

Validator Revenue Streams

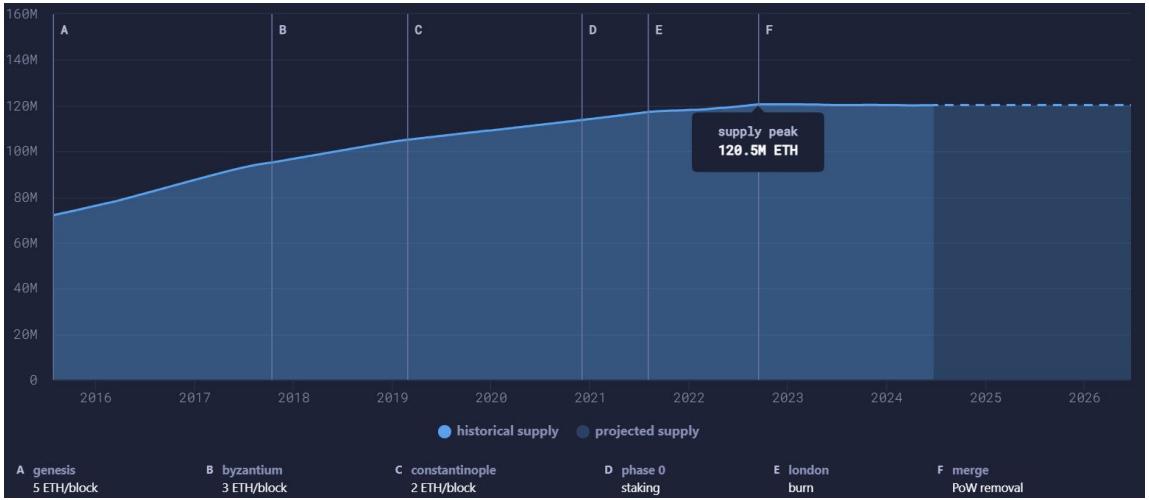
Source	Description	Share of Validator Income (Feb 2025)
Inflationary Rewards	New SOL tokens issued by the protocol, distributed based on stake weight.	76%
Jito MEV Tips	Tips from MEV searchers via Jito's auction system.	14%
Priority Fees	User-defined fees to prioritize transactions.	9%
Base Fees	Fixed per-signature fees (5,000 lamports per signature).	<1%

Source: Blockworks, Feb 2025 blockworks.co +2

Token Issuance: The Last Resort

Ethereum since PoS transition:

- APR is α 1/√N:
  - 500k validators ⇒ 4.15%
  - 1M validators ⇒ 2.94%
- **EIP-1559** introduced fee burn
- net supply growth = issuance – burns – penalties



Token Issuance ⇒ Inflation ?

Solana Token Issuance

- Solana's initial Issuance Rate is 8% annually
- Decreasing by 15% year-over-year
- Reaching a long-term fixed Issuance Rate of 1.5% annually.
- **Currently at 4.1%**

SIMD-0228 — Market-Based Emissions (Stake-Linked)

What it proposed

- Replace exp decay issuance rate with a dynamic model where token issuance adjusts to staking participation (higher issuance when stake share is low; lower when high).
- Goal: align security budget with actual participation; reduce dilution when network is well-staked.

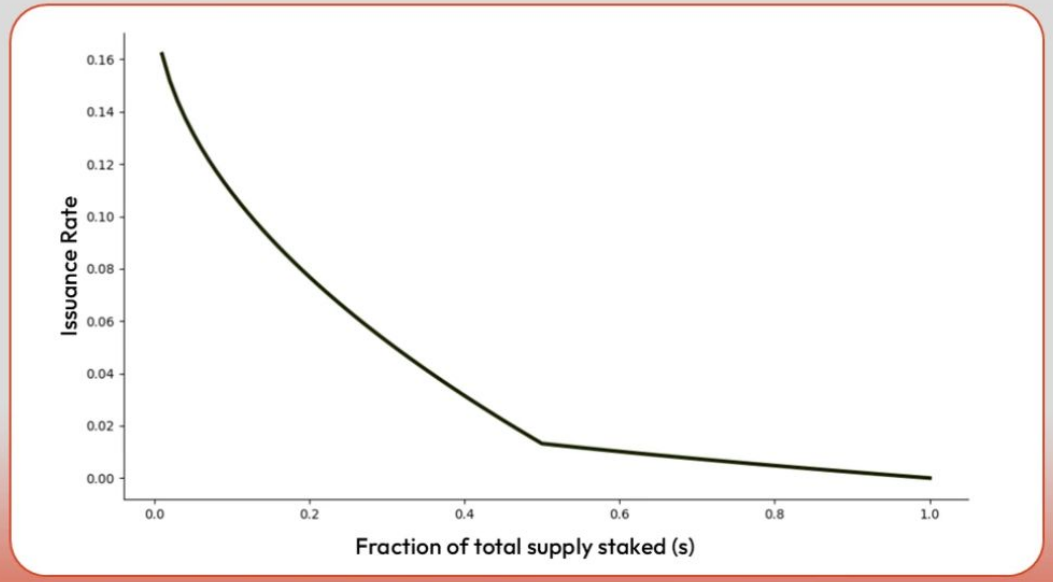
Why it mattered

- Potentially lower Issuance at today's stake levels (various estimates near ~1% vs ~4–5% now).
- Trade-offs: more reward variability; smaller validators worried about covering fixed costs if yields fell.

The vote (on-chain)

- Threshold: 66.67% "Yes" required; result: support was ~60% and short of the supermajority → proposal failed (Mar 14, 2025).
- Community split: stronger support among larger operators; many smaller validators voted "No".

SIMD-228 Issuance Rate Curve



Source: Solana Forums

HELIUS

Potential flaw of SIMD-228 proposal: you have to make a strong assumption about the desired APR!

Proposal: We declare the desired security level (i.e. 40% of online stake) and we let the Token Issuance Rate adjust in order to target the desired level: No assumption on the APR!

Analogous problem in Lending Markets

There is a Target Utilization (TU=90%) of the pool capital

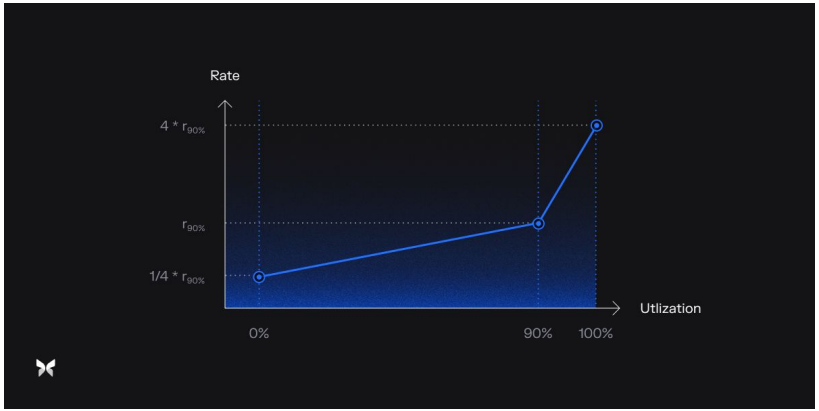
The Borrow Rate is used as a “knob”:

Utilization Rate is **lower than TU** :

decrease the Borrow Rate to incentivize utilization

Utilization Rate is **higher than TU:**

increase the Borrow Rate to incentivize loan repayment

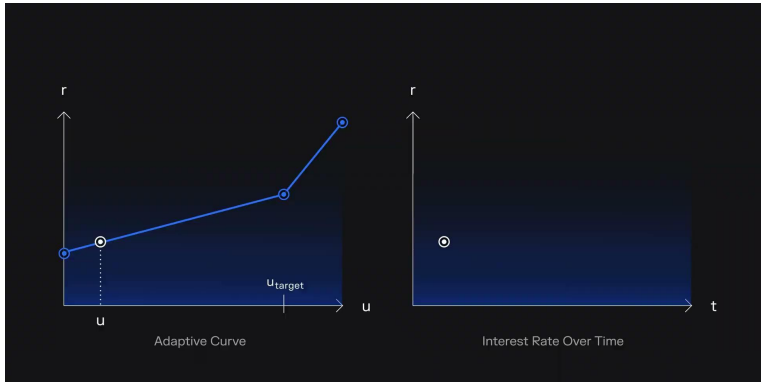


Morpho Adaptive Curve: Proportional Integral (PI) Controller

/If the utilization remains at 45%, it will progressively decrease until it is divided by 2 after 10 days.

/If the utilization remains at 95%, it will progressively increase until it doubles after 10 days.

/If the utilization remains at 100%, it will progressively increase until it doubles after 5 days. This is the maximum speed at which it can move.



Morpho White Paper: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4802776

Link

A Fully dynamical Token Issuance Model

Basic Ingredients:

/ **Dynamic Issuance Rate within Bounds:** The annual issuance rate R should vary in response to staking participation, but remain bounded between a minimum of 0% and a maximum of 8% per year.

/ **Feedback-Controlled Adjustment:** The model should increase R when actual stake participation S (fraction of supply staked) is below 0.40, and decrease R when S exceeds 0.40. Moreover, the adjustment should account not only for the current deviation (how far S is from 40%) but also for the duration of the deviation (how long it has been above or below target). This calls for a Proportional–Integral (PI) control mechanism.

/ **APR agnostic:** the model does not need to specify the ideal rate.

/ **Governance can decide "higher level" topics:** is 40% sufficiently high as security level? Are we comfortable with [0%,8%] range?

Final proposal

A long term sustainable model should rely on these 3 funding sources:

- **Fee collected in the block, based on the principle of fair charging**
- **Socialization of the MEV extraction**
- **The minimal Token Issuance (or burning) necessary to reach a desired security level**

The final sustainable state can be achieved through Protocol Governance, which decides on the “high level” parameters in order to improve and adapt to different market conditions

Conclusions

/ Sustainability is inherently intertwined with Security and Decentralization of the protocol

/ Technological features of the Consensus Protocol shape strongly the sustainability profile: sustainability through scarcity or abundance

/ The market is not (currently) efficient in benchmarking APRs

/ Long Term Economic Sustainability can be achieved by leveraging different revenue sources:

- / Fair charging of the Fees
- / Socialization of MEV extraction rewards
- / Token issuance as a last resort to ensure sufficient level of security

/ Algorithmic Token Issuance can be the new “Bitcoin halving mechanism”

Fee Model Design

/ **Necessary trade off between maximizing security budget and avoid stifling adoption**

/ **The holy grail for Fee design: Fee elasticity of current txn volume!**

- / **Proposal:** the sender is happy with at most X% of the “value” of the txn
- / **Issue:** sometimes the “value” is not clearly measurable: note writers!

/ A fully dynamic Fee model can lose predictability (computation in particular):

- / **Issue: User Experience disruption!**
- / **Proposal:** Gradual implementation with tiered structure