eth2 Validator Economics

Trust-less 2020

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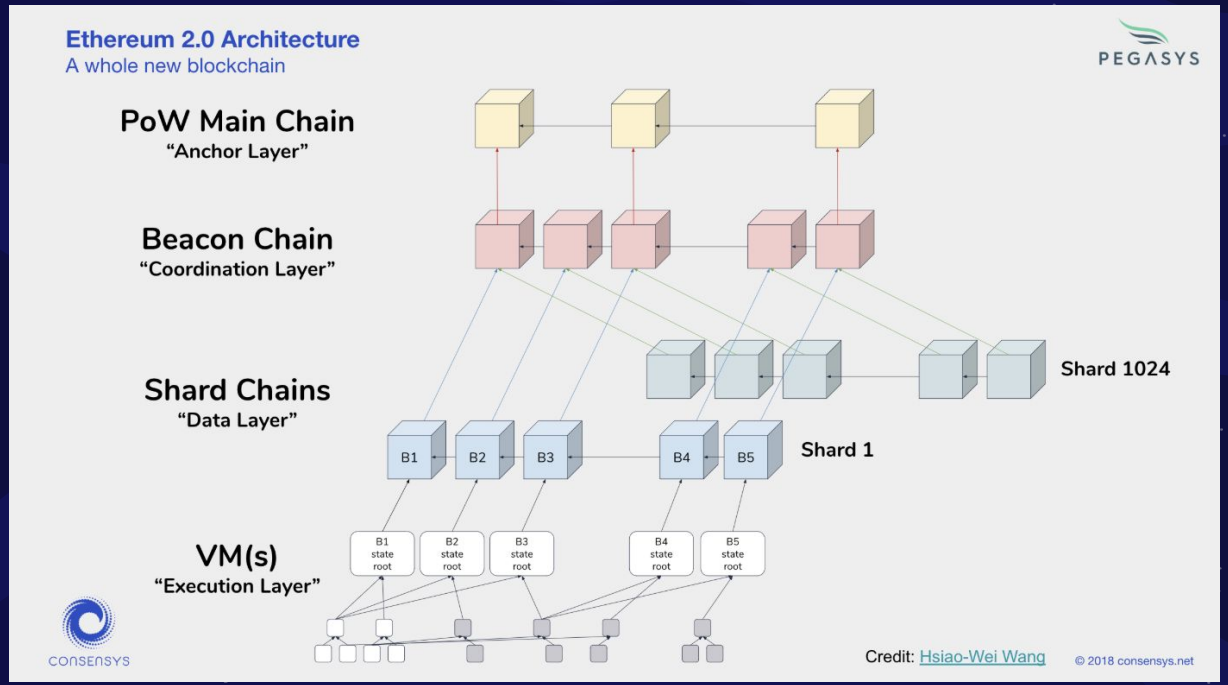
eth2 Validator Economics

- What is the Beacon Chain?
- Validator Requirements
- Validator Responsibilities
- Validator Fun Facts
- Validator Rewards
- Anticipated Phase 0 Rewards
- Eth2Calculator

eth2


Ethereum 2.0 Architecture
A whole new blockchain
PEGASYS
PoW Main Chain
"Anchor Layer"
Beacon Chain
"Coordination Layer"
Shard Chains
"Data Layer"
Shard 1024
Shard 1
B1
B2
B3
B4
B5
VM(s)
"Execution Layer"
B1 state root
B2 state root
B3 state root
B4 state root
B5 state root
CONSENSYS
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Beacon Chain

eth2 Coordination Layer

- Tracks state of Validators and Shards
- Manages the registry of Validators
- Provides Randomness (RANDAO)
- Assign Validators to Committees
- Block Proposal
- Rewards and Penalties
- Crosslink Processing (Shards)

eth2 Phase 0

- **Phase 0 - Bootstrapping the Beacon Chain**
  - eth2 Launchpad to deposit eth1 for eth2 (bETH)
    - Anticipated for 2Q20
  - 16,384 (~525,288 Ether Staked) required to hit genesis
  - Applying Consensus Rules (Casper FFG)
  - Managing Validators & Stakes
  - Rewarding and Penalizing/Slashing
  - Organizing and electing committees and proposers (RANDAO)

- Out of Scope
  - No Token Transfers
  - No Withdraws
  - No Two-Way Bridge
  - No EVM
  - No Smart Contracts
  - No Accounts

eth2 Validator Requirements

- Deposit 32 ETH to Eth1 Chain
  - Generate key pair
  - Wait to be added to queue
- Beacon Node (Laptop, Desktop, or VPS)
  - Maintains view of beacon chain (Eth1 Full Node)
- ETH 2.0 Validator Client of Choice
  - Handle the logic of a single validator

eth2 Validator Responsibilities

- **Create Attestations** (Votes on head of chain) -
  - Sign new blocks
  - Once per epoch (~6.5 minutes)
- **Aggregating Attestations** from Validators in same committee
  - Happens occasionally
- **Propose New Blocks**
  - Happens infrequently

eth2 Economics Fun Facts

- eth2 is pure proof of stake (no delegation function)
- eth2 is designed to accommodate hundreds of thousands or even millions of validators
- Rewards (- penalties) are transferred to validators every epoch (384 seconds ~6.5 minutes or so)
- Rewards are calculated based on the state of the network upon epoch completion
- Rewards will be highly variable in eth2 by design
  - Validator rewards are proportional to the square root of the total amount of ETH staked

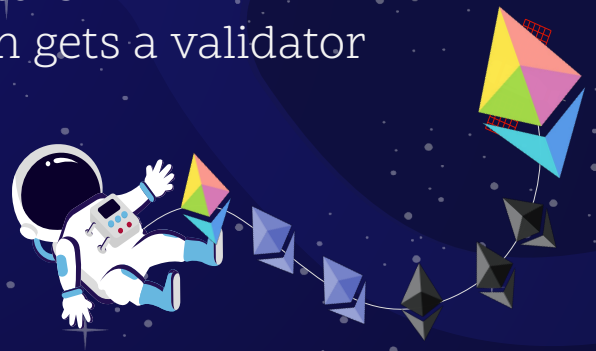

eth2 Phase 0
Reward Types
Proposer
Reward
Whistleblower
Reward
Attestor Reward

eth2 - Phase 0

Reward Type #1

- **Attester Reward**
  - Signs New Blocks
  - Happens every epoch (~6.5 minutes)

- Actions Required
  - Include new attestations from other Validators
  - Include a proof from a whistleblower, which gets a validator slashed



eth2 - Phase 0

Reward Type #2

- **Proposer Reward**
  - Proposers are in charge of block production
  - Happens infrequently

- 5 Actions Required for base reward
  - Getting attestation on chain
  - Agreeing on history of the chain
  - Agreeing on head of chain
  - Getting attestation on chain quickly
  - Pointing to correct block in assigned shard (Phase 1 only)

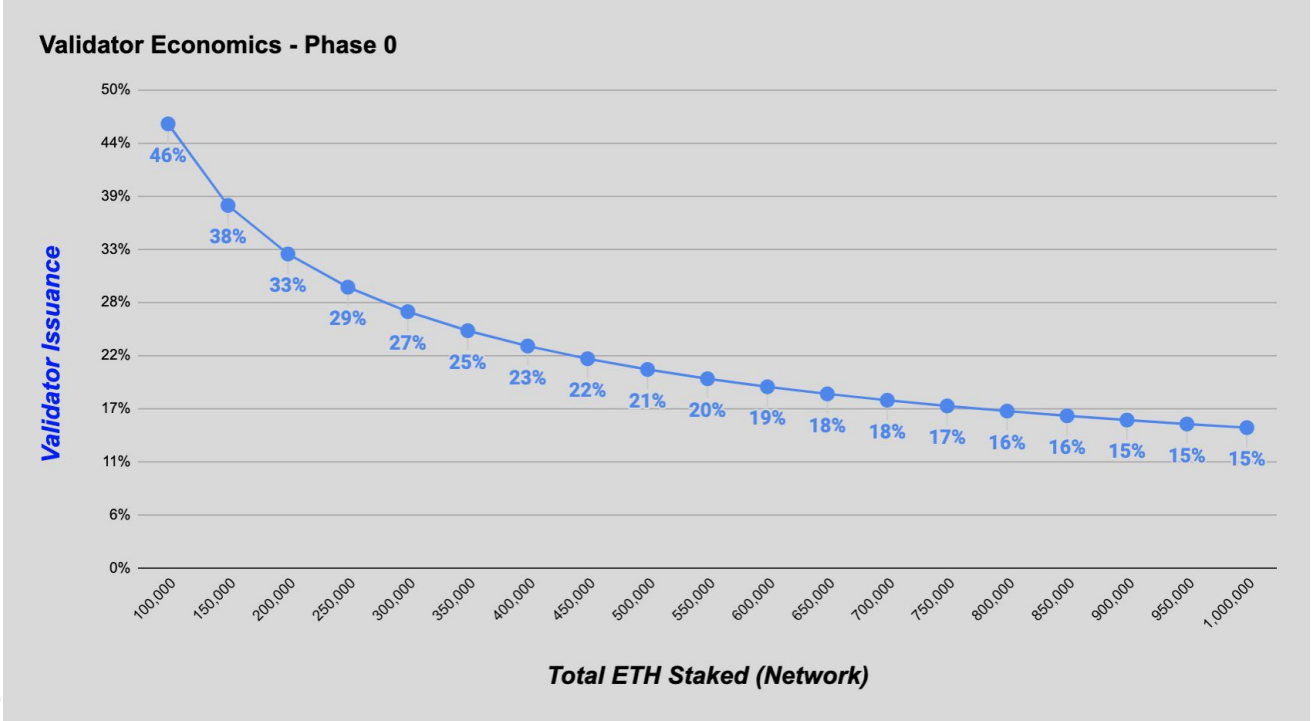
eth2 - Phase 0

Reward Type #3

- **Whistleblower Reward**
  - Providing proof that a validator has acted maliciously
  - Hopefully happens infrequently


eth2 Phase 0
Reward Drivers
Total ETH at stake
Base Reward Factor
Average Network % online

Total ETH at Stake



Average Network % Online

Gross Validator Issuance (Phase 0)

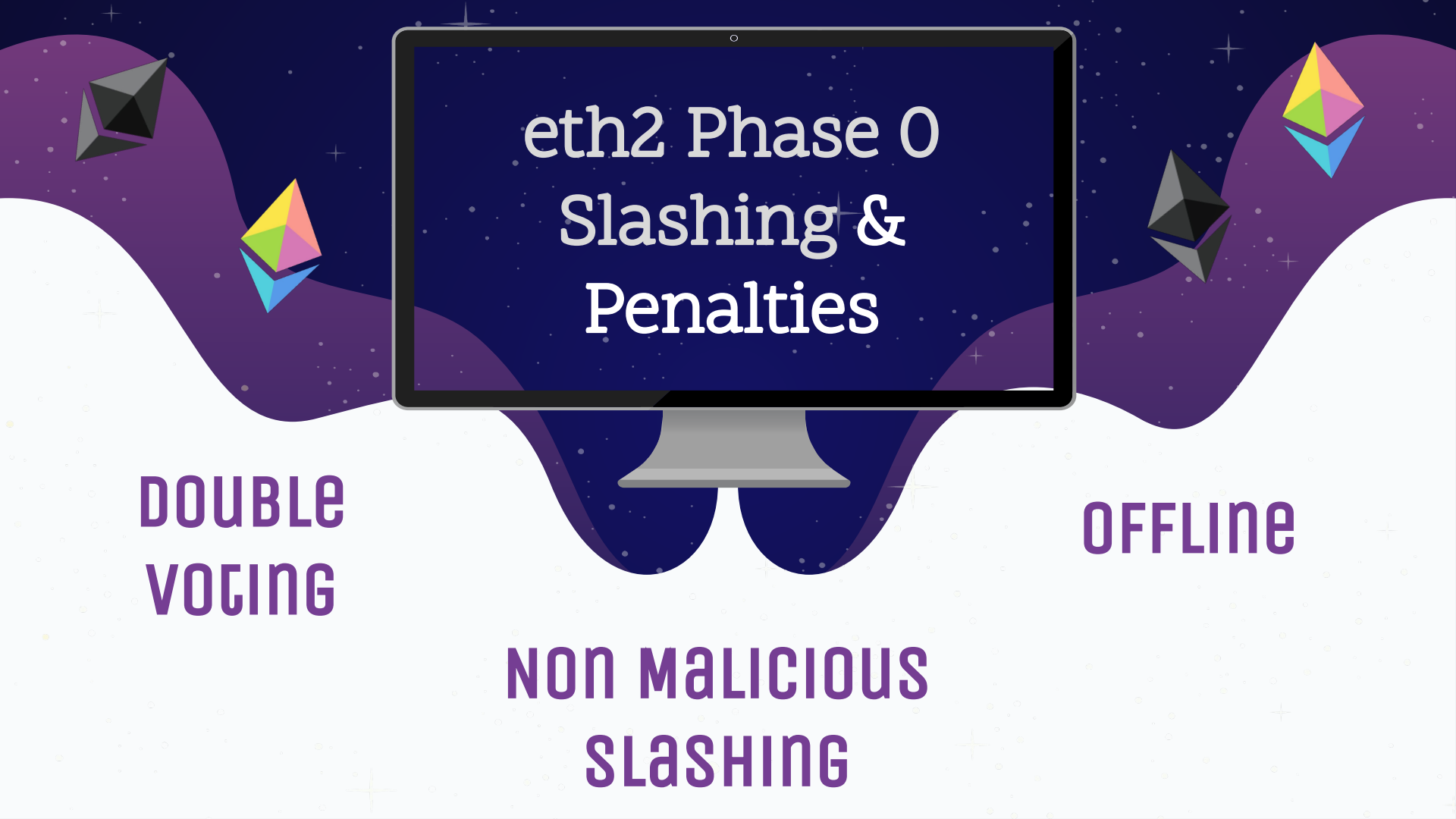
Base Reward = 64

Total ETH Staked (Network)	Average Network % Online									
	70%	75%	80%	85%	90%	92%	94%	96%	98%	100%
100,000	38.0%	40.2%	42.3%	44.4%	46.4%	47.2%	48.1%	48.9%	49.7%	50.5%
150,000	31.1%	32.8%	34.5%	36.2%	37.9%	38.6%	39.2%	39.9%	40.6%	41.2%
200,000	26.9%	28.4%	29.9%	31.4%	32.8%	33.4%	34.0%	34.6%	35.1%	35.7%
250,000	24.1%	25.4%	26.8%	28.1%	29.4%	29.9%	30.4%	30.9%	31.4%	31.9%
300,000	22.0%	23.2%	24.4%	25.6%	26.8%	27.3%	27.7%	28.2%	28.7%	29.2%
350,000	20.3%	21.5%	22.6%	23.7%	24.8%	25.3%	25.7%	26.1%	26.6%	27.0%
400,000	19.0%	20.1%	21.2%	22.2%	23.2%	23.6%	24.0%	24.4%	24.8%	25.2%
450,000	17.9%	18.9%	19.9%	20.9%	21.9%	22.3%	22.7%	23.0%	23.4%	23.8%
500,000	17.0%	18.0%	18.9%	19.8%	20.8%	21.1%	21.5%	21.9%	22.2%	22.6%
550,000	16.2%	17.1%	18.0%	18.9%	19.8%	20.1%	20.5%	20.8%	21.2%	21.5%
600,000	15.5%	16.4%	17.3%	18.1%	19.0%	19.3%	19.6%	20.0%	20.3%	20.6%
650,000	14.9%	15.8%	16.6%	17.4%	18.2%	18.5%	18.9%	19.2%	19.5%	19.8%
700,000	14.4%	15.2%	16.0%	16.8%	17.6%	17.9%	18.2%	18.5%	18.8%	19.1%
750,000	13.9%	14.7%	15.4%	16.2%	17.0%	17.3%	17.5%	17.8%	18.1%	18.4%
800,000	13.5%	14.2%	15.0%	15.7%	16.4%	16.7%	17.0%	17.3%	17.6%	17.9%
850,000	13.1%	13.8%	14.5%	15.2%	15.9%	16.2%	16.5%	16.8%	17.0%	17.3%
900,000	12.7%	13.4%	14.1%	14.8%	15.5%	15.7%	16.0%	16.3%	16.6%	16.8%
950,000	12.3%	13.0%	13.7%	14.4%	15.1%	15.3%	15.6%	15.9%	16.1%	16.4%
1,000,000	12.0%	12.7%	13.4%	14.0%	14.7%	14.9%	15.2%	15.5%	15.7%	16.0%

Base Reward Factor

Gross Validator Issuance (Phase 0)

Total ETH Staked (Network) \ Base Reward Factor	64	74	84	94	104	114	124
100,000	46%	54%	61%	68%	75%	83%	90%
150,000	38%	44%	50%	56%	62%	68%	73%
200,000	33%	38%	43%	48%	53%	58%	64%
250,000	29%	34%	39%	43%	48%	52%	57%
300,000	27%	31%	35%	39%	44%	48%	52%
350,000	25%	29%	33%	36%	40%	44%	48%
400,000	23%	27%	30%	34%	38%	41%	45%
450,000	22%	25%	29%	32%	36%	39%	42%
500,000	21%	24%	27%	30%	34%	37%	40%
550,000	20%	23%	26%	29%	32%	35%	38%
600,000	19%	22%	25%	28%	31%	34%	37%
650,000	18%	21%	24%	27%	30%	32%	35%
700,000	18%	20%	23%	26%	29%	31%	34%
750,000	17%	20%	22%	25%	28%	30%	33%
800,000	16%	19%	22%	24%	27%	29%	32%
850,000	16%	18%	21%	23%	26%	28%	31%
900,000	15%	18%	20%	23%	25%	28%	30%
950,000	15%	17%	20%	22%	24%	27%	29%
1,000,000	15%	17%	19%	22%	24%	26%	28%


eth2 Phase 0
Slashing &
Penalties
DOUBLE
VOTING
OFFLINE
NON MALICIOUS
SLASHING

eth2 - Phase 0

Slashing

- **Double Vote**
  - Validator votes for two different blocks in the same epoch
    - POS Version of a Double Spend
- **Surround Vote**
  - Validator votes for multiple versions of the truth at the same time, in a way that doesn't make clear that they still believe in the first version of truth

eth2 - Phase 0

Slashing

- **Non Malicious Slashing**
  - Can occur due to a bug or a mistake
  - Penalized lightly if done by a small number of validators
  - The amount of stake slashed is proportional to the amount of validators that were slashed around the same time
  - Minimum of 1 Eth
  - However, if there are a large number of validators slashed at the same time penalties can be up to a validators full stake
  - If malicious then validator is slashed and forcibly exited

eth2 - Phase 0

Offline

- **Offline**
  - Validators 32Eth staked is not penalized in the event of downtime
  - The validator will only miss out on potential rewards
  - Punishment will increase if more than ⅓ of validators go offline
  - This where inactivity leak enters
    - This will reduce the balances of the offline nodes over time so that the ratio of online validators to total validators can once again exceed ⅔ so eth2 can continue to produce finality

Phase 0 Rewards

Model Assumptions

Network Assumptions

- 100K - 1MM ETH Staked
- Average % Online = 90%
- Base Reward = 64
- No Network Fees

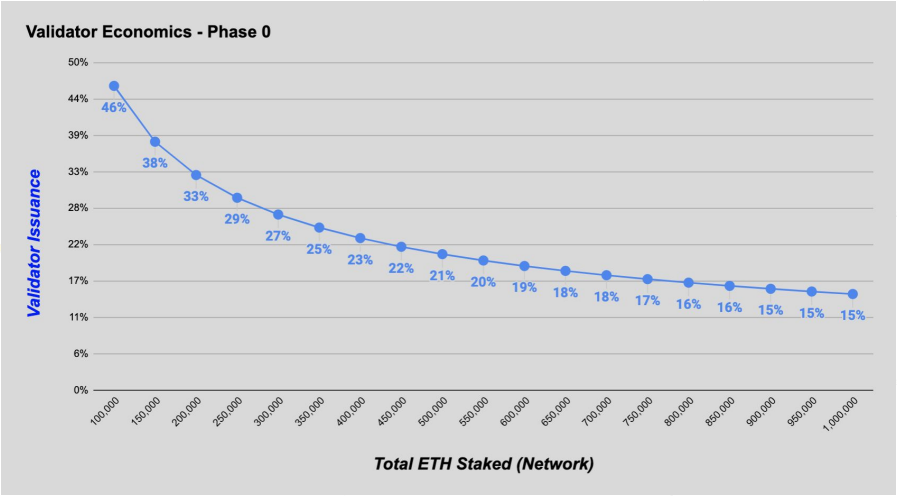
Validator Assumptions

- 32 ETH Staked
- 98% Uptime
- $250 Computer (2.5 Yr Useful Life)
- Sunk Costs (Router & ISP)
- 16 Validators per machine

Validator Issuance - Phase 0

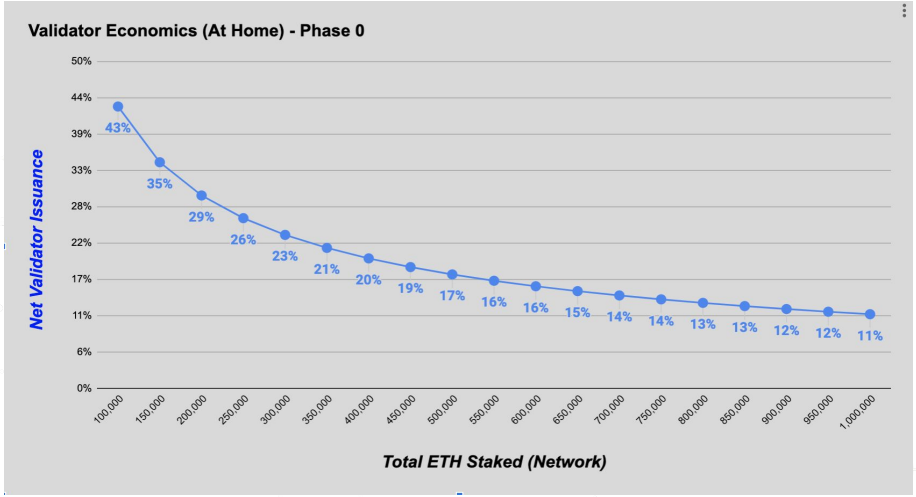
100K ETH Staked: ~46%

1MM ETH Staked: ~15%



100K ETH Staked: ~43%

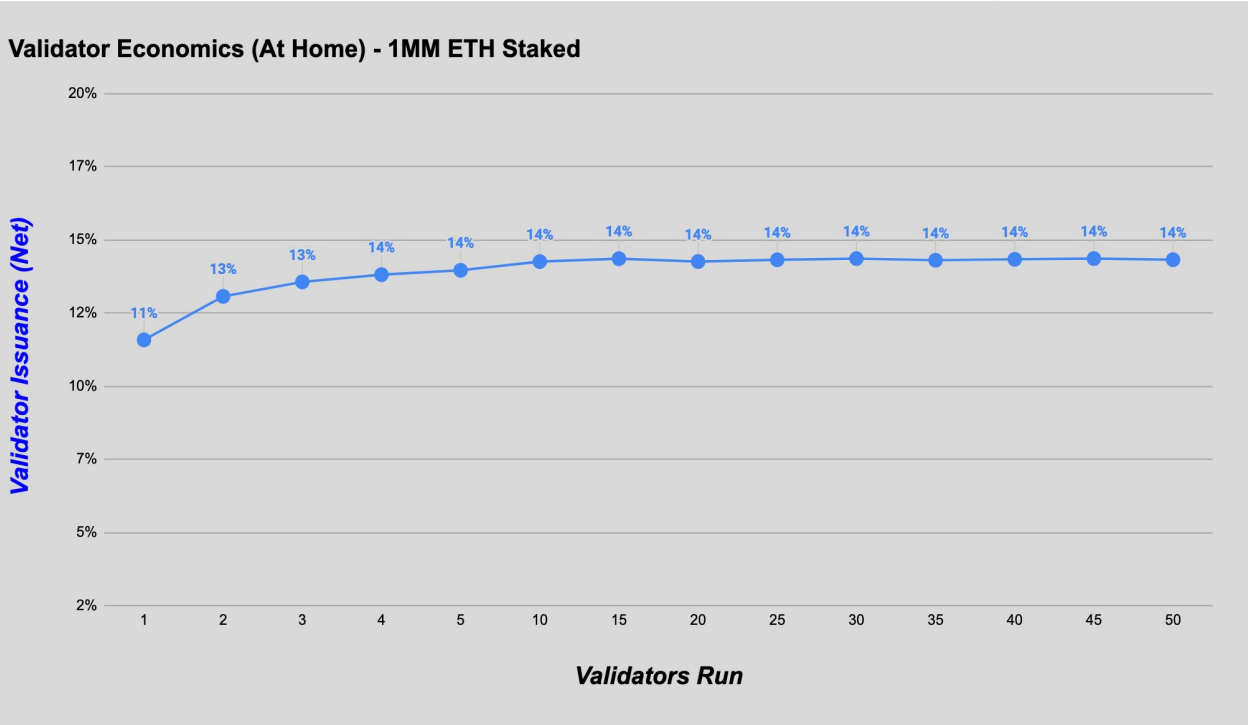
1MM ETH Staked: ~11%



Whale Scale

Assumptions

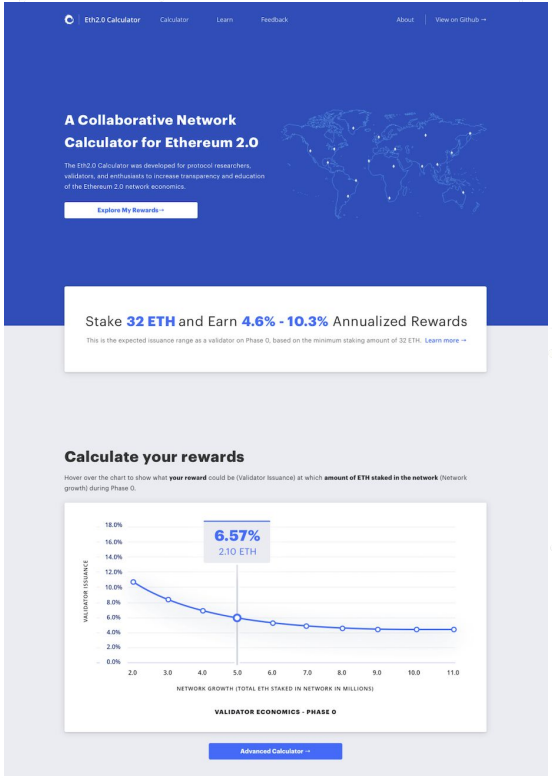
- 1MM ETH Staked
- Average % Online = 90%
- Base Reward = 64
- 1-50 Validators Run
- No Network Fees

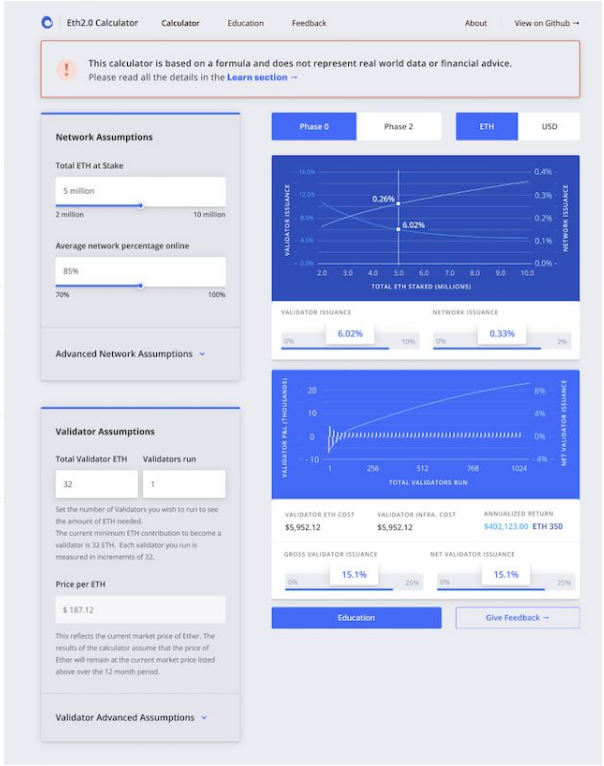


Eth2.0 calculator

Telegram:

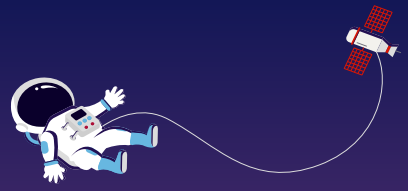
@Eth2calculator





Featuring

Vitalik Buterin
Dankrad Feist
Hsiao-Wei Wang
Carl Beekhuizen
Ben Edgington






Thank You

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