POLYMESH

V3

Polymesh Tokenomics for Node Operators

As a node operator, you'll manage and run authoring nodes that keep the Polymesh blockchain secure and operational at all times.

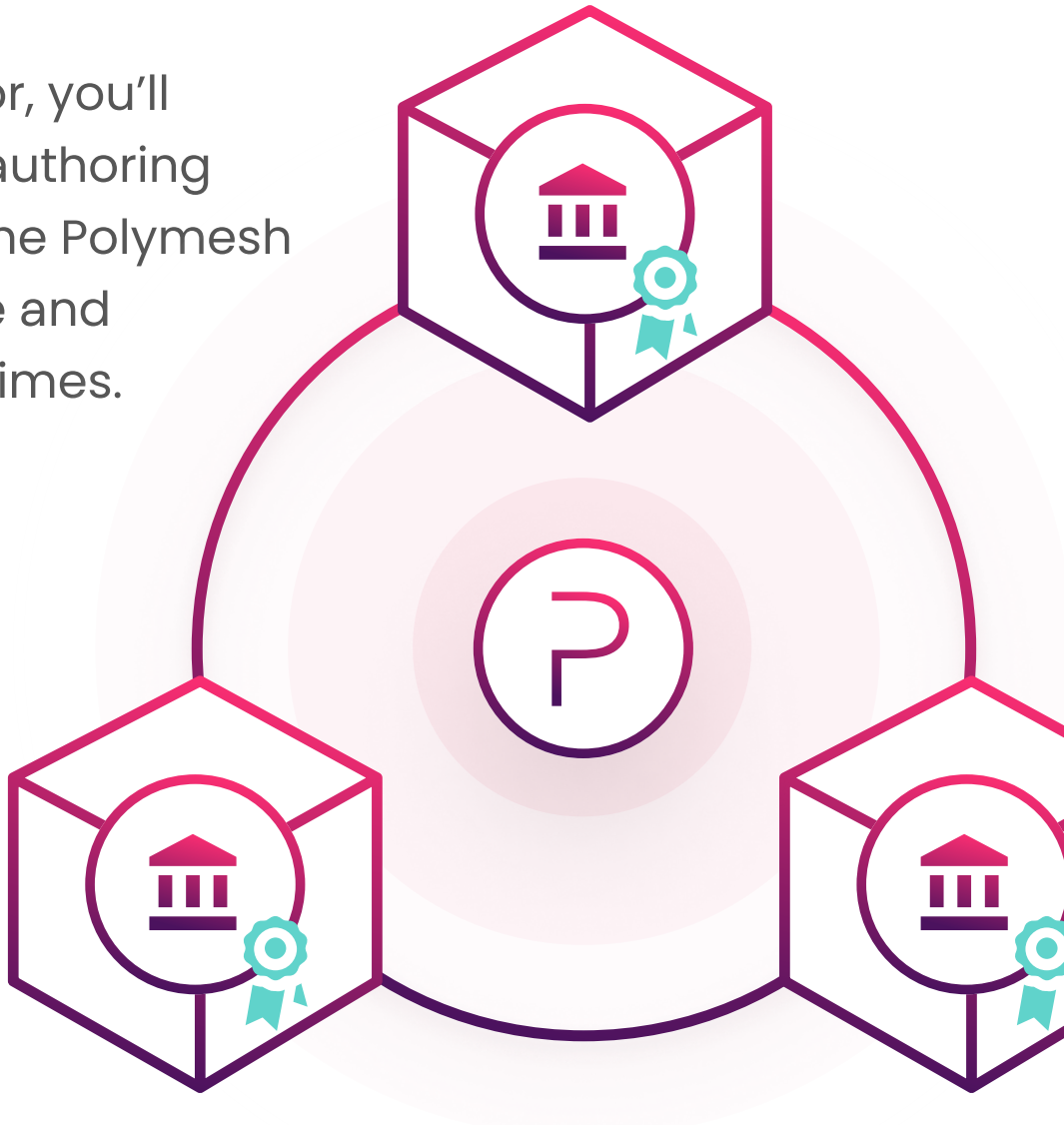


Table of Contents

Introduction

This guide provides a high level introduction to tokenomics for entities running operator nodes on Polymesh.

Node operators on Polymesh must be licensed financial entities. Node operators manage and run one or more authoring nodes that keep the Polymesh blockchain secure and operational at all times.

To align node operators' interest in ensuring the security and availability of the blockchain, node operators are incentivized through two main sources of income in the form of Polymesh's native utility token POLYX:

1. Fees for authoring new blocks
2. Staking rewards

Fees for authoring new blocks

Node operators receive 100% of all block fees for the blocks they author. This includes standard transaction fees and protocol fees[1] when applicable.

For each new block there is a probabilistic component as to which node operator authors the block. The probability of a node operator authoring a block may be impacted depending on factors such as hardware performance and network connectivity. Well-behaving node operators should generally average out to have a similar number of blocks authored over a large number of eras[2].

Block authoring fees economically align node operators' interests with the desire to maintain high chain uptime and chain security, as well as promote adoption of the Polymesh blockchain, as increased activity will result in higher returns from fees.

Staking rewards

Staking rewards are paid to node operators and nominators from newly minted tokens. The amount of newly minted tokens per era is variable, determined by the lower of:

(a) The amount calculated by the Inflation curve (see **Figure 1**) based on the percentage of the total POLYX supply staked

(b) A maximum annual increase of 140 million, divided by the number of eras per year.

The total era rewards are then divided across the nodes based on the number of era points that node earned. Era points are directly related to the number of blocks a node operator authors.

As mentioned above, there is a probabilistic element as to which node operator authors a block and hence who receives the associated points. ***All else being equal, it is expected that over a sufficiently long period, all correctly performing nodes should receive similar rewards, irrespective of tokens nominated.*** In practice there may be some variability due to differences in node performance.

1. Protocol fees are charged for certain types of native functions (e.g. registering a ticker, 1000 POLYX). Protocol fees are set by the Polymesh Governing Council and may be subject to change.

2. Era: a period in which an active set of node operators is elected; equal to 24 hours on Polymesh mainnet.

A node operator takes a portion of the rewards allocated to their node in two ways: commission and stake based rewards. A node operators' total staking related rewards for the era are the sum of commission and stake based rewards.

COMMISSION

Polymesh allows node operators to define a commission, capped at a maximum of 10%. This commission is subtracted from the node rewards and allocated to the node operator before staking rewards are distributed to nominators. A higher commission will result in a higher reward for the node operator but may deter nominators from staking their POLYX on that node operator.

STAKE BASED REWARDS

After commission is subtracted, the remaining node rewards are divided proportionally based on the number of tokens nominated. The stake based rewards are equal to

Stake based reward = (node operator stake ÷ total stake) x node rewards

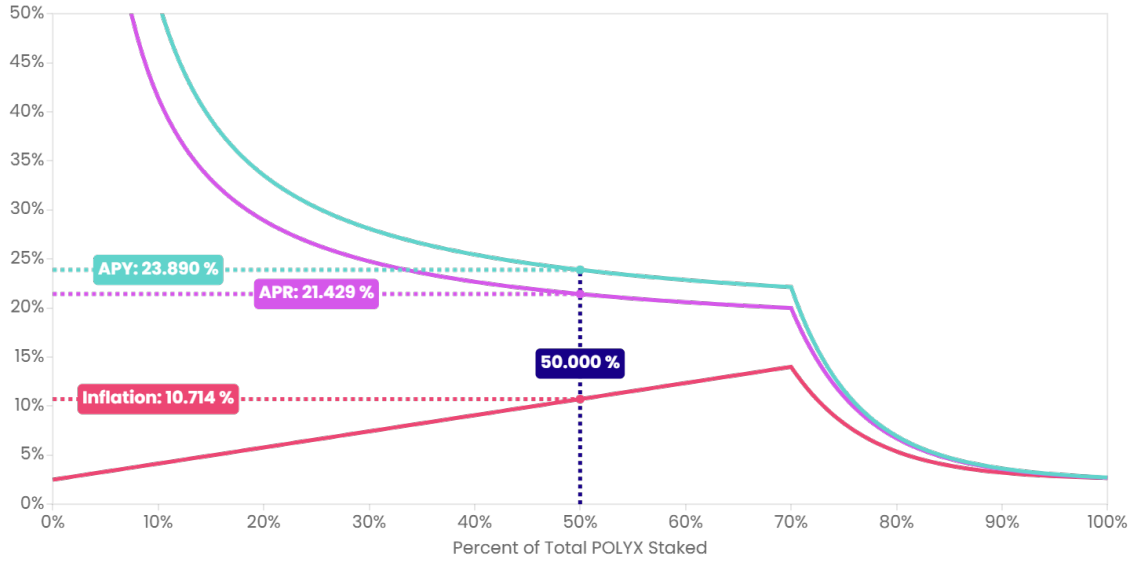
The higher the node operator's stake[3] as a portion of the total staked with that node, the higher the node operator's rewards will be.

STAKING REWARD COMPOUNDING

A node operator may elect to have their staking rewards distributed to their own account as unbonded, to another account as unbonded, or to their own account as bonded.

Electing to automatically bond, and hence stake, rewards results in compounding of rewards and can significantly increase the node operator's rewards over time.[4]

Figure 1: Polymesh Staking Reward/Inflation Curve



3. The minimum staking bond requirement for a node operator is 50,000 POLYX. The minimum bond threshold is set by the Polymesh Governing Council and may be subject to change.

4. Unbonding tokens to allow withdrawing has an associated 28 day waiting period. Tokens will not earn staking rewards while unbonding. Node operators must maintain a bonded balance above the minimum bond threshold or will not be eligible for election to the active node operator set.

Election of Node Operators

Polymesh is a Nominated Proof-of-Stake (NPoS) blockchain. Nominators back node operators with their own stake as a show of faith in good behaviour of the node operator. Each era, node operators are elected to the active node operator set based on the number of tokens nominated to them. If a node operator is not elected for an era, they will receive neither fees nor rewards.

Currently, Polymesh has a limit of 50 operator nodes[5]. When there are less than 50 operator nodes, all operator nodes will automatically be elected to the active operator node set, provided they are online and operational during the daily election phase. This is to incentivize more node operators to join and increase the chain's level of decentralization.

Once the number of operator nodes exceeds the limit, only the operator nodes with the highest number of nominated tokens will be elected to the active set. At that point, it becomes in the node operator's interest to encourage nominations of their node(s) to ensure they are elected, either by demonstrating a strong track record of node uptime and performance or by offering competitive commissions.

ELECTION PROCESS

As nominators on Polymesh may nominate up to 16 node operators, Polymesh uses a sequential Phragmén method for the election. The sequential Phragmén method is a multi-winner election method that ensures that the most supported node operators are elected.

POST-ELECTION OPTIMIZATION

The results for nominating node operators are further optimized for several purposes:

1. To minimize the number of node operators any nominator is actively staking
2. To ensure as much as possible an even distribution of stake among node operators

Minimizing the number of node operators actively staking a node means nominator tokens are typically assigned to a single node rather than split across multiple nodes. This reduces the amount of chain resources when rewards are being distributed.

Distributing the staked tokens as evenly as possible across operator nodes ensures approximately equal reward rates for stakers, irrespective of which node their tokens get allocated to.

5. The maximum operator node count is set by the Polymesh Governing Council and may be subject to change.

Fines (slashing)

Fines on Polymesh are only enabled for node operators. In the future, the Polymesh Governing Council may also enable fines for nominators.

As earlier described, positive node operator behaviour is rewarded through staking rewards. Polymesh also has a mechanism to punish bad or undesirable behaviour which may result in a node operator being removed from the eligible node operator set and potentially being fined some or all of their bonded tokens.

Polymesh implements fines for two infraction types:

1. Unresponsiveness
2. Equivocation or double-signing

All infractions result in the operator node being removed from the active operator node set. Once removed they will not be considered for subsequent elections of node operators, and hence will not receive rewards for subsequent eras, until they re-declare their desire to be a node operator.

All infractions with non-zero fines also result in the node operator losing their nominations. The node operator will once again need to gather support from nominators to ensure they are elected in future eras.

Although rewards are paid to operator nodes approximately equally, fines are relative to a node operator's stake. ***Therefore, if you have enough POLYX to run multiple operator nodes, it is in your best interest to do so.*** Multiple operator nodes should be run on separate infrastructure to minimize the risk of simultaneous failure.

UNRESPONSIVENESS

Each staking era is broken into six distinct four hour periods known as sessions. If during a session a node operator does not produce any block and their node fails to send an "I'm online" heartbeat message, they are marked as unresponsive and removed from the active operator node set.

A fine may occur depending on the number of node operators that were unresponsive during that session. Once a node operator is removed from the active operator node set, they will not receive additional fines for remaining offline.

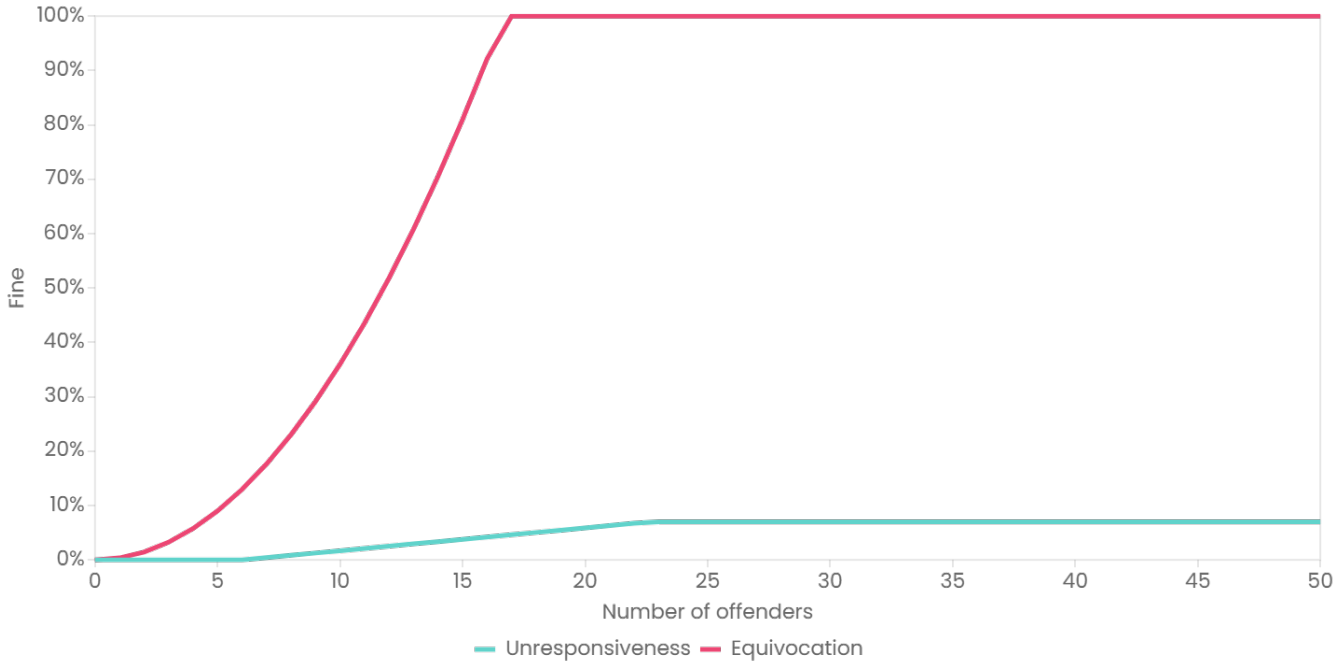
Fines for unresponsiveness start when more than 10% plus 1 node operator of the active operator node count are offline and increase up to a maximum fine of 7% of the bonded tokens when approximately 43.4% plus 1 node operator are offline. **Figure 2** shows an example of fines for unresponsiveness for a node operator count of 50.

EQUIVOCATION/DOUBLE SIGNING

Equivocation occurs when a node operator authors two or more blocks in the same time slot, or adjusts or rejects votes on a block. In general, this should not occur unless the node operator has misconfigured their nodes (e.g. used the same signing keys on multiple nodes) or is intentionally attacking the network.

Equivocation fines are more severe than unresponsiveness. A single instance of equivocation will result in a fine, with fines increasing exponentially up to a maximum of 100% when a third or more node operators commit an equivocation offence. **Figure 2** shows an example of fines for equivocation for a node operator count of 50.

Figure 2: Unresponsiveness and Equivocation Fines (for 50 node operators)



Staking rewards example

This section includes a realistic example of staking rewards a node operator might receive while running an operator node on Polymesh under the below assumed conditions.

Assumptions:

1. Total supply = 400,000,000 POLYX
2. Total staked = 200,000,000 POLYX
3. Number of node operators = 40
4. All node operators produced an equal number of blocks and received an equal number of era points. This simplifies the example and provides an indication of longer term reward trends. In practice, era points for a node can vary by up to ±15% from average for a single era.

Staking ratio = total staked ÷ total supply = 0.5 or 50%

From the reward/inflation curve (**Figure 1**), 50% staked results in an annual inflation rate of approximately 10.71%, which equates to 117,416.8 newly minted POLYX tokens per 24-hour era. This corresponds to an average reward rate of 21.42% APR for stakers.

APR = inflation ÷ staking ratio

Distributing these rewards evenly across the 40 nodes, each node operator receives **2,935.42 POLYX**, which is then distributed as commission and staking based rewards to node operators and their nominators.

Table 1: Sample reward calculations

Node operator	Own stake	Commission	Node total staked	Commiss. rewards	Stake based reward	Total reward	APR
A	50,000	5%	5,000,000	146.77	27.89	174.66	127%
B	50,000	10%	5,000,000	293.54	26.42	319.96	234%
C	50,000	10%	8,000,000	293.54	16.51	310.05	226%
D	50,000	10%	2,500,000	293.54	52.84	346.38	253%
E	150,000	10%	5,000,000	293.54	79.26	372.80	91%
F	250,000	10%	5,000,000	293.54	132.09	425.64	62%

The above example gives an appreciation as to how the node operator commission and amount of tokens staked by both node operators and their nominators can impact node operator rewards.

In general, higher commission and a higher number of tokens staked by a node operator will result in higher node operator rewards. Inversely, a lower number of tokens staked by nominators on an operator node will typically result in higher node operator rewards but may put the node operator at risk of not being elected.

Comparing node operator B and E, we see that node operator E is staking three times as many tokens but only receives 16.5% higher rewards. Yet if the operator had run three nodes instead of nominating the full 150,000 POLYX tokens to a single operator node, they would have received three times the rewards of node operator B, albeit with the additional cost of managing three nodes instead of one.