ndau Guide: Understanding Validator Node Operations and Rewards

NOTE: Additional validator node documentation can be found here in the ndau Knowledge Base.

The Role of Validator Nodes in the ndau Ecosystem

ndau is a Proof-of-Stake (PoS) blockchain, and therefore relies on a small number of trusted validator nodes to vote on and commit blocks to its blockchain.These validator nodes guarantee their voting integrity by staking ndau to their node operation activity. Validator-staked ndau is held as collateral during the course of a validator node's operation, and is at risk of being slashed if the node operator attempts any malicious behavior. Note that staking ndau to a validator node is completely different from staking ndau in your wallet app.

As an incentive to operate a validator node, node operators are eligible to receive node rewards. Node rewards are generated through transaction fees and through a 10% network operations fee charged to all ndau created through EAI. Node rewards are distributed regularly and must be explicitly claimed by the recipient. **As of October 2021 approximately 200 ndau are collected and distributed per day for node rewards.**

Voting power and node rewards both depend upon a node quality formula. The higher a node's quality is, the more voting power it has on the ndau blockchain and the more likely it is to receive node rewards.

Registering a Validator Node

To operate an ndau validator node a node operator must stake at least 1,000 ndau (plus ~10 ndau to pay for node transaction fees) to their validator node and then register the validator node on the ndau blockchain using the node's new address for node registration. A node's voting power and rewards increase if more ndau are co-staked, up to a maximum of 50,000 ndau. Additional stake (aka costake) can be added at any time from the original address for node registration or from any other ndau account (including locked accounts). Once a node is unregistered, all or part of its stake can be unstaked.

Staked ndau are at risk of being slashed (aka burned) due to malicious behavior. Slashing must be approved by the Blockchain Policy Council and only occurs in cases of serious and deliberate behavior that has the potential to damage the integrity of the ndau blockchain. All or part of a node's stake may be slashed, and the node is immediately unregistered.

To ensure that malicious behavior is discovered and to ensure node operator commitment, ndau are held for 90 days after they are unstaked. They may be re-staked at any time but will be subject to a new 90-day hold when unstaked. The staking hold operates like an independent locking system - staked ndau may not be transferred until their unlock hold has expired. Unlike locked ndau, staked ndau may not be used to pay the account's transaction fees.

Calculating the Node Quality Score

The **quality score** for each node is recalculated and updated every time a block is committed to the ndau blockchain. A node's quality score for voting and node rewards is determined by three factors: **staking score**, **delegation score**, **and voting history**.

1) **Staking Score:** The total amount of validator staked ndau is constantly changing, so each is scaled to a total of 100,000 in calculating node quality. Any particular node's staking score is calculated as its fraction of the total score, multiplied by 100,000:

   *Staking Score = (Staked ndau / All staked ndau) * 100,000*

   For example, if a node has staked 1,000 ndau and a total of 16,000 ndau have been staked by all nodes, its score is (1,000 / 16,000) * 100,000 = 6,250.

2) **Delegation Score**: A node's delegation score is calculated in the same manner as its staking score, as a fraction of a total 100,000 score.

   *Delegation Score = (ndau delegated to the node / All delegated ndau) * 100,000*

   To earn EAI, ndau accounts must be delegated to a validator node, and node operators can attract delegated accounts by frequently and reliably crediting EAI to them via a CreditEAI transaction.

   A node's quality score is the sum of these two scaled numbers (staking score + delegation score). At any point, therefore, the total quality score of all nodes is 200,000.

3) **Voting History:** Finally, since validator nodes ensure the integrity of the ndau blockchain, they are penalized for not voting on a block or for voting against consensus on a block (Byzantine voting). Voting history is examined over the last 20 blocks, and a node is penalized 5% of its score for failing to vote on a block and 25% of its score for voting against consensus. If, therefore, a node fails to vote for 20 consecutive blocks its voting power will become 0 and it will not be eligible for node rewards.

Validator Voting and Rewards

The nodes with the **25 highest quality scores** are assigned **voting power** for the next block equal to their quality score. The **quality score** is also used to calculate the **probability** that a node will receive the next **node rewards distribution**.

In summary, if you are running a validator node and if at any point in time your quality score drops below the quality scores of the top 25 other validator nodes on the network, then **your node will not receive any voting power** and as such **your node will not have the opportunity to earn node rewards**.

PLEASE NOTE!

Nodes that do not vote for 20 blocks are automatically removed from the validator set.

If a validator node is dropped because it isn't voting, it can become a validator again by submitting

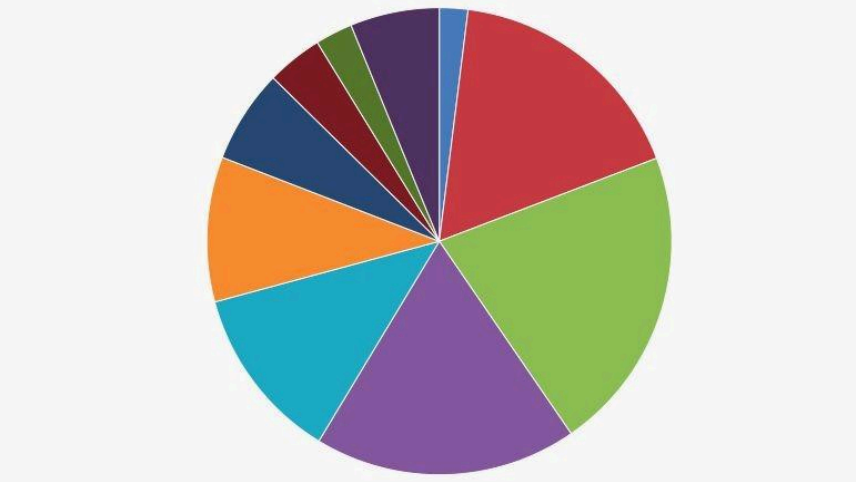
another RegisterNode transaction just like in the beginning. It will immediately become a validator and will remain one unless it drops offline for 20 blocks again.

Node Rewards Distribution

Node rewards are distributed by the selection of a **random number** every 24 hours (12:00am UTC). That random number is used to submit a NominateNodeReward transaction that chooses a winning node based on each node's quality score as a fraction of the total. If the sum of all quality scores is 18,450 then a node with a score of 2,400 will have a 13% chance of winning the next reward. The total accumulated reward since the last distribution goes to a single node, but over time each node's total reward will approximate its proportional share of the total.

To ensure reliable and attentive operation, **node rewards are not automatically credited to the node's account**. The winning node, based on the random number, is calculated and that node must explicitly claim it by submitting a ClaimNodeReward transaction within two hours of Oneiro's NominateNodeReward transaction being submitted to the blockchain. **If the winning node fails to claim its reward, that reward is burned and not distributed to any node.**

Think of it like a dartboard that looks like a pie chart. Every 24 hours at 12:00am UTC, a dart is thrown randomly at the dartboard. Each node has a section of the pie chart that is proportionally as big as its percentage of the total voting power of all the nodes, so increasing your voting power increases the probability of the dart landing on your section of the dartboard. Wherever the dart lands determines the winner of the node rewards, and the dartboard can change at any time based on changes in the total number of validator nodes and their changes in voting power.



Think of it like a dartboard that looks like a pie chart.

You should never co-stake to an existing validator node unless you are either running the node yourself or you've had a direct conversation with the node operator and fully understand their policy on node reward distribution.

By default, a validator node keeps all the node rewards earned (rewards are deposited in the node registration address). It's up to the validator node operator to determine if and how exactly they want to distribute node rewards among co-stakers. Currently, all Oneiro-run validators are configured to keep all their earned node rewards and therefore should not be co-staked to by any account not owned by Oneiro.

Current Node Rewards Values

Values last updated 10.29.2021

- Daily EAI Earned for all accounts: **~2,000 ndau**
- Daily Node Rewards (10% of the daily EAI earned by everyone): **~200 ndau**
- Distribution Rate: **Every 24 hours at 12:00am UTC**

Identifying other Validator Nodes and their Voting Power

How can I identify all the other validator nodes and their voting power to better understand my chances of winning the daily node rewards?

1) Use the */node/registerednodes* endpoint to identify your own node via your own ndau address for node registration and look for your *"tm_address"* field to identify your node's Tendermint Address.

2) Use the */node/consensus* endpoint to see the voting power of all validator nodes for the current block and to find your node's entry via your node's Tendermint Address.

See example below: using curl and jq we can display the tendermint addresses and voting power for all validators who voted in the last block.

The following example snapshot of the network was run on 01/31/2022 at 5:10PM Eastern:

```
$ curl -s https://mainnet-0.ndau.tech:3030/node/consensus | jq
'.round_state.last_validators.validators[].address,.round_state.last_validators.validators[].voting_powe
r'


"009864BEFCB7BEECAC4B3A21C890EA268E884577"
"07F883A471DAA5EC7E25D039F6A7A79EF31F3768"
"15F3D7E1A0267029475E0C205A0FD0F01D594C6A"
"5B3E2F2D9DC67642AFF5CFD7F25CF6D40F7374BF"
"5F42969E485F4630ABF098140C6BC652C7630803"
"660E214164BE887EDD81CDA308423FFC11D06253"
"677834E329639302000C55CEF70D32DB13E786AC"
"764F097CAF28E70FC98E32524916CA6166FA4712"
"810EADE5E9191253CD82DB51B9B639067084EC4E"
"83C94D9D82CC455A36EE4E3DF0D6642149276EF9"
"84F5AA45F947FA6D1D7ADD174234D2E2C11D659D"
"9652036F4F3860ADDB489080254EF45CBA3773E2"
"9BD3A4024FB3B4C26BADB3B73A48538728377A0A"
"C0DB600505D672306E3EBCC9286F9B454415CCD3"
"D9F8FDDE29672E1BD1FAFF454CD345657BD0704B"
"E4956510A438ECB1C725F339D59E7D74BE438CCA"
"E61AE1D051F7FD9BB16E0F2D2A94A2544F33079A"
"EE9DF46A562FD512265E5F69654FA517119E16D1"
"FB3DBA11CA41CE6F2C0C1C607EED88EA61792568"
```

```
"FB915177B180363B24194CF946C0C5FAB859B0AE"
"FFC7CEB37EA7FD54C5E5A19E5661606388DC8875"

"11050"
"1"
"6483"
"10773"
"218"
"408"
"1"
"3753"
"1"
"8232"
"10960"
"408"
"408"
"490"
"436"
"9053"
"436"
"10755"
"436"
"213"
"408"
```


With these data you now know the **total voting power in the network** as well as **each node's voting power**, with each node identified by its own unique tendermint address.

And you now know **your own node's percentage chance of winning** node rewards during a node rewards distribution.

Put these data into a spreadsheet and you can generate a pie chart for your own up-to-date dartboard visualization.

If you want to identify the 5 mainnet nodes run by Oneiro, you can find their tendermint addresses here.

For more info on API endpoints and example queries, please see the ndau API documentation page.

Identifying Staking and UnStaking Transactions

How can I identify all the other validator nodes and how much ndau they currently have staked to their nodes?

Nodes can *Stake* and *UnStake* whenever they wish, so this requires pulling live data from the ndau blockchain via the ndau API.

1) Familiarize yourself with and install the python tools described in the "Exploring the ndau Blockchain" guide. These scripts make it easy to query the ndau API and automatically dump data into a .csv file so you can do your own data analysis in a spreadsheet.

2) Run the following command:

```
$./forAllTransactions.py --network=main --txtypes Stake UnStake --output
allstakeandunstaketransactions.csv --fields blockheight timestamp txhash txtype txdata.qty
txdata.target
```

The returned **allstakeandunstaketransactions.csv** file will contain every *Stake* and *UnStake* transaction currently on the blockchain. From those data you can identify unique nodes via their **node registration address** (the txdata.target field in the .csv data) and identify how much ndau they currently have staked (all of a node's *Stake* transactions minus all of their *UnStake* transactions).