

Effective Balance

The validators effective balance is an attribute of the validator, stored on the beacon state.

Effective balance cannot exceed MAX_EFFECTIVE_BALANCE.

Validator balance can continue to accrue beyond a validators maximum effective balance.

Effective balance is security of the chain.

How is Effective balance used?

A validators effective balance influences

- Validator activation
- Validator Exit (forced below 16 eth)
- Rewards and penalties
- Probability to perform block production
- Probability to be in a sync committee
- Voting weight for chain security (fork choice).



Validators.

BLS Validator (PhaseO)

effective_balance: 32 eth MAX

withdrawal_address: 0x00...[BLS]

EL Validator (PhaseO)

effective_balance: 32 eth MAX

withdrawal_address: 0x01...[EL]

Compounding Validator (Electra)

effective_balance: 2048 eth MAX

withdrawal_address: 0x02...[EL]

Compounding validator.

A compounding validator can have an effective balance up to 2048 eth.

- Becomes more likely to propose or participate in sync committees than 32 eth validators
- Voting weight increases naturally with validator effective balance
- Compounding validator balances are not part of the automated withdrawals sweep below 2048 eth.
- MIN_ACTIVATION_BALANCE introduced at 32 eth.

Active validators can consolidate without exiting.

Validators with EL withdrawal credentials can consolidate using a request from the execution layer.

Consolidation moves balance from a source to a target validator.

Validation at the execution layer is not exhaustive, and there are failure modes on the consensus layer.

Skips activation delay, still pays exit delay.

Consolidation of active validators is possible.

Why switch?

A number of possible reasons for switching to compounding

- You have more than 32 eth and less than 64 and want to stake the extra eth
- Maybe you want to opt out of automated withdrawals sweep
- Looking to reduce large numbers of validators, but maintain staked amount.

Partial withdrawals added.

Compounding validators are able to withdraw their validator funds down to 32 eth.

The partial withdrawal mechanism is via EIP-7002, and initiated from an execution request.

This is a voluntary mechanism outside of withdrawals sweeps.

Addresses a lack of custom ceiling for compounding validators.

Voluntary partial withdrawals are possible.



Activation and exit queues now balance based.

Activation and exit queue mechanics change.

Deneb activation / exits can be expressed as 8 validators per epoch.

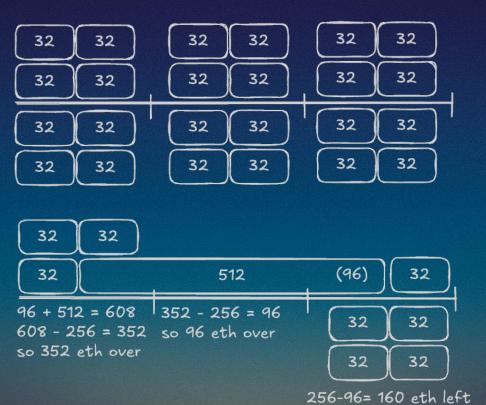
In electra, balance is more important, becomes 256 eth per epoch change.

Deposits stored in state.pending_deposits.

Exit epoch computed with balance change (earliest exit epoch updated each exit)

Pending partial withdrawals also queued on state, treated as an exit, and limited

Activation Queue.





Initial Slashing penalty.

Initial Slashing penalty if unchanged would be up to 64 eth for a compounding validator under Deneb rules (1/32 effective balance).

For Electra, the initial penalty has changed to 1/4096 of the effective balance, or 0.5 eth for a 2048 eth compounding validator.

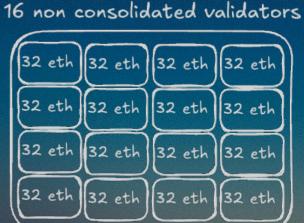
A 32 eth effective balance validator suffers an initial penalty of 0.0078125 eth.

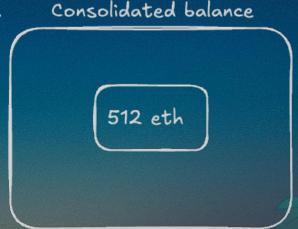
Initial slashing penalty reduces.

Consolidation risk.

For operators consolidating balances, consider how your risk exposure changes before consolidating your stake.

Some infra relies on slashing detection and shutdown of nodes when that occurs to protect other assets, but this would potentially mean your first slashing is a lot bigger than non consolidated validators.





Reassess your risk if you are consolidating.

