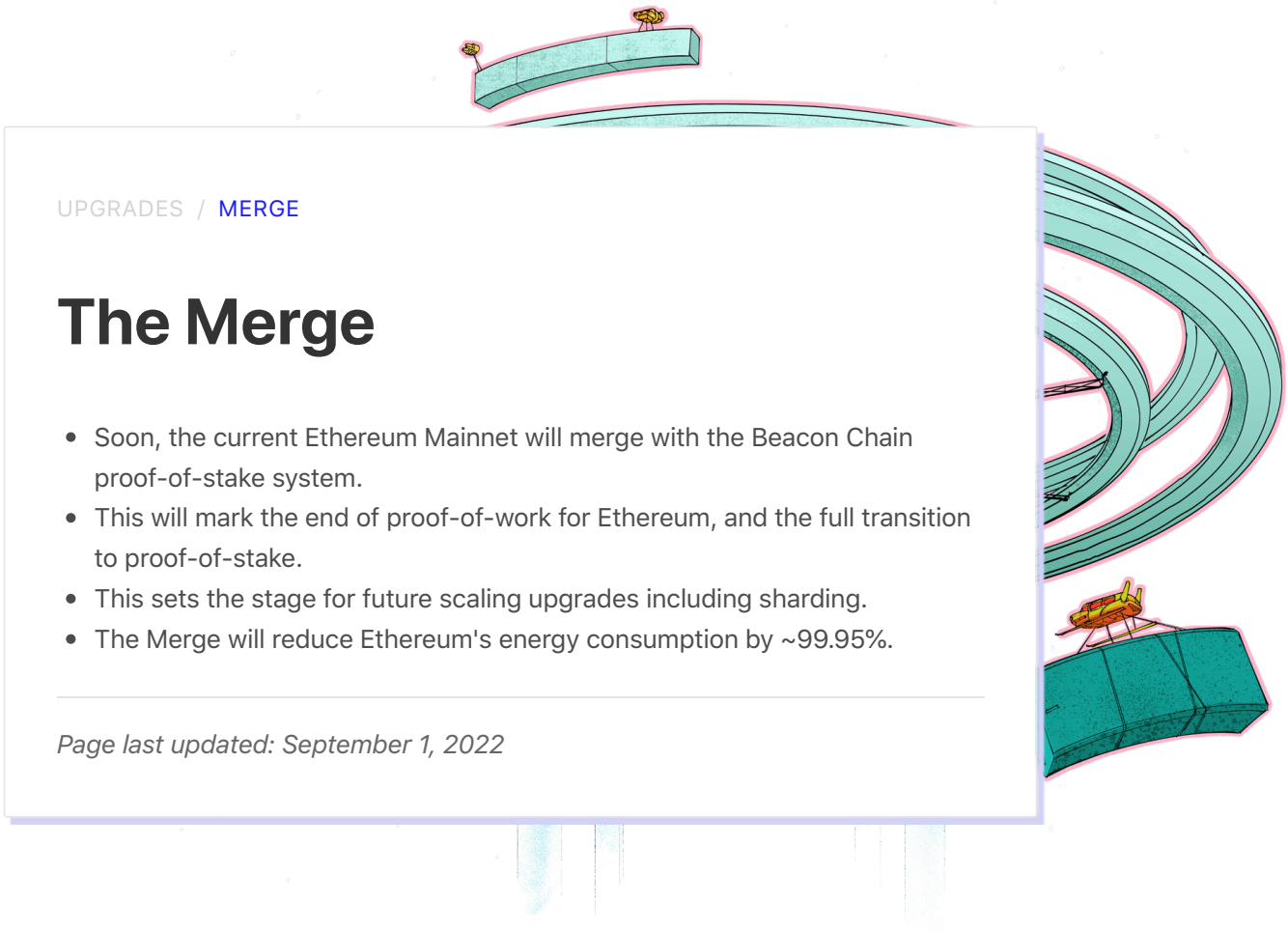


UPGRADES / MERGE

The Merge

- Soon, the current Ethereum Mainnet will merge with the Beacon Chain proof-of-stake system.
- This will mark the end of proof-of-work for Ethereum, and the full transition to proof-of-stake.
- This sets the stage for future scaling upgrades including sharding.
- The Merge will reduce Ethereum's energy consumption by ~99.95%.

Page last updated: September 1, 2022

Guide to Ethereum upgrades

The Merge

WHEN'S IT SHIPPING?

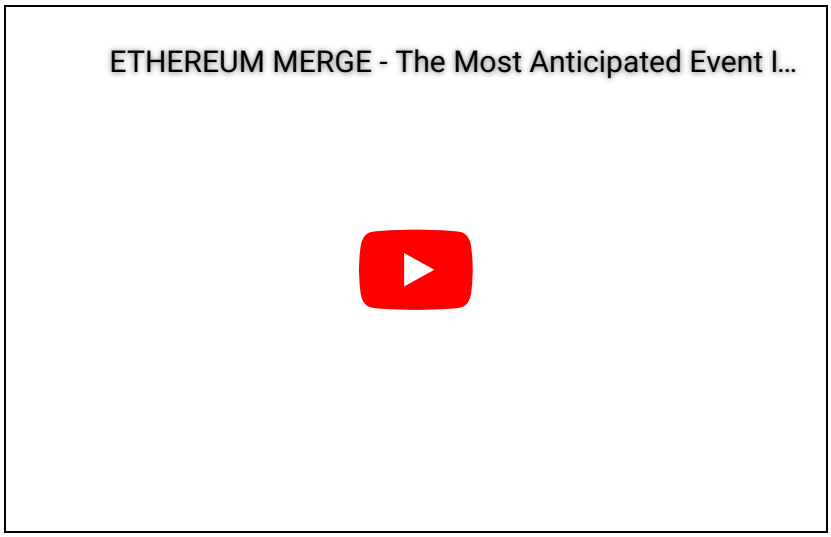
~Q3/Q4 2022

The Merge is the most significant upgrade in the history of Ethereum. Extensive testing and bug bounties were undertaken to ensure a safe transition to proof-of-stake.

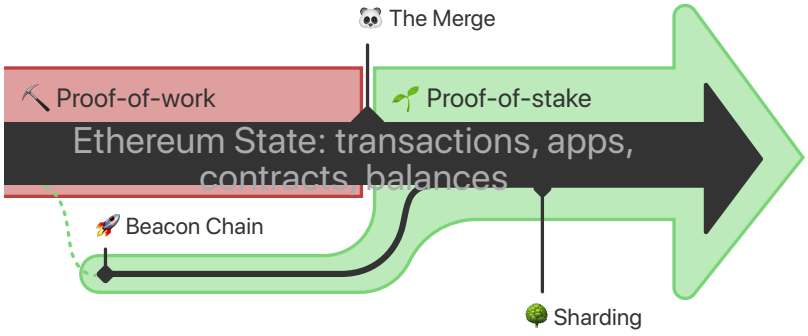
This process is in its final stages, with plans to undergo The

Merge on a few public testnets before finally moving forward with Mainnet. If you're excited about The Merge, follow the EF Blog ↗ or the client communication channels for the latest official word on *When Merge?*

What is The Merge?



The Merge represents the joining of the existing execution layer of Ethereum (the Mainnet we use today) with its new proof-of-stake consensus layer, the Beacon Chain. It eliminates the need for energy-intensive mining and instead secures the network using staked ETH. A truly exciting step in realizing the Ethereum vision – more scalability, security, and sustainability.



It's important to remember that initially, the Beacon Chain shipped separately from Mainnet . Ethereum Mainnet - with all it's

accounts, balances, smart contracts, and blockchain state - continues to be secured by proof-of-work, even while the Beacon Chain runs in parallel using proof-of-stake. The approaching Merge is when these two systems finally come together, and proof-of-work is replaced permanently by proof-of-stake.

Let's consider an analogy. Imagine Ethereum is a spaceship that isn't quite ready for an interstellar voyage. With the Beacon Chain, the community has built a new engine and a hardened hull. After significant testing, it's almost time to hot-swap the new engine for the old mid-flight. This will merge the new, more efficient engine into the existing ship, ready to put in some serious lightyears and take on the universe.

Merging with Mainnet

Since genesis, proof-of-work has secured Mainnet. This is the Ethereum blockchain we're all used to—it contains every transaction, smart contract, and balance since it began in July 2015.

Throughout Ethereum's history, developers have been hard at work preparing for an eventual transition away from proof-of-work to proof-of-stake. On December 1, 2020, the Beacon Chain was created, which has since existed as a separate blockchain to Mainnet, running in parallel.

The Beacon Chain has not been processing Mainnet transactions. Instead, it has been reaching consensus on its own state by agreeing on active validators and their account balances. After extensive testing, the Beacon Chain's time to reach consensus on more is rapidly approaching. After The Merge, the Beacon Chain will be the consensus engine for all network data, including execution layer transactions and account balances.

The Merge represents the official switch to using the Beacon Chain as the engine of block production. Mining will no longer be the means of producing valid blocks. Instead, the proof-of-stake validators assume this role and will be responsible for processing the validity of all transactions and proposing blocks.

No history is lost. As Mainnet gets merged with the Beacon Chain, it will also merge the entire transactional history of Ethereum. You don't need to do anything. Your funds are safe.

> This transition to proof-of-stake will come with some changes to the way ether is supplied. Learn more about ether issuance before and after The Merge.

What do I need to do to get ready?

The Merge is one of the most significant and anticipated upgrades in the history of Ethereum, and although in the long-term its impact will be felt by everyone, in the near-term some folks will need to take action to be fully prepared.

Users and holders

You do not need to do anything to protect your funds entering The Merge.

This bears repeating: As a user or holder of ETH or any other digital asset on Ethereum, as well as non-node-operating stakers, **you do not need to do anything with your funds or wallet before The Merge.**

Despite swapping out proof-of-work, the entire history of Ethereum since genesis remains intact and unaltered after the transition to proof-of-stake. Any funds held in your wallet before The Merge will still be accessible after The Merge. **No action is required to upgrade on your part.**

As we approach The Merge of Ethereum Mainnet, **you should be on high alert for scams trying to take advantage of users during this transition.** Do not send your ETH anywhere in an attempt to

"upgrade to ETH2." There is no "ETH2" token, and there is nothing more you need to do for your funds to remain safe.

More on Ethereum security

Node operators and dapp developers

Staking node operators and providers

If you are a staker running your own node setup or a node infrastructure provider, there are a few things you need to be aware of to be prepared for The Merge.

More

Non-validating node operators and infrastructure providers

If you're operating a non-validating Ethereum node, the most significant change that comes with The Merge is the requirement to run clients for BOTH the execution layer AND the consensus layer.

More

Dapp and smart contract developers

The Merge has been designed to have minimal impact on smart contract and dapp developers, but there are a few small things devs may want to be aware of heading into The Merge.

More

What date is The Merge?

The Merge is expected to land within Q3/Q4 2022. The client developers are currently working to a soft deadline of 19th

September 2022, but this could change depending upon the success of the final testnet merge (Goerli) in mid-August, continued client refinements and the hashrate of the existing miners continuing in a predictable manner. Everyone is working hard to deliver The Merge as soon as possible.

After The Merge

This will signal the end of proof-of-work for Ethereum and start the era of a more sustainable, eco-friendly Ethereum. Learn more about Ethereum energy consumption.

This will also set the stage for further scalability upgrades not possible under proof-of-work, bringing Ethereum one step closer to achieving the full scale, security and sustainability outlined in its Ethereum vision.

Misconceptions about The Merge

Misconception: "Running a node requires staking 32 ETH."

More

False. Anyone is free to sync their own self-verified copy of Ethereum (i.e. run a node). No ETH is required. Not before The Merge, not after The Merge, not ever.

Misconception: "The Merge will reduce gas fees."

False. The Merge is a change of consensus mechanism, not an expansion of network capacity, and will not result in lower gas fees.

More

Misconception: "Transactions will be noticeably faster after The Merge."

False. Though some slight changes exist, transaction speed will mostly remain the same on layer 1.

More

Misconception: "You can withdraw staked ETH once The Merge occurs."

False. Staking withdrawals are not yet enabled with The Merge. The following Shanghai upgrade will enable staking withdrawals.

More

Misconception: "Validators will not receive any liquid ETH rewards til the Shanghai upgrade when withdrawals are enabled."

False. Fee tips/MEV will be credited to a Mainnet account controlled by the validator, available immediately.

More

Misconception: "When withdrawals are enabled, stakers will all exit at once."

More

False. Validator exits are rate limited for security reasons.

Misconception: "Staking APR is expected to triple after The Merge."

More

False. More up-to-date estimations predict closer to a 50% increase in APR post-merge, not a 200% increase.

Misconception: "The Merge will result in downtime of the chain."

More

False. The Merge upgrade is designed to transition to proof-of-stake with zero downtime.

What happened to 'Eth2'?

The term 'Eth2' has been deprecated as we approach The Merge.

After merging 'Eth1' and 'Eth2' into a single chain, there will no longer be two distinct Ethereum networks; there will only be Ethereum.

To limit confusion, the community has updated these terms:

- 'Eth1' is now the 'execution layer', which handles transactions and execution.
- 'Eth2' is now the 'consensus layer', which handles proof-of-stake consensus.

These terminology updates only change naming conventions; this does not alter Ethereum's goals or roadmap.

Learn more about the 'Eth2' renaming↗

Relationship between upgrades

The Ethereum upgrades are all somewhat interrelated. So let's recap how The Merge relates to the other upgrades.

The Merge and the Beacon Chain

The Merge represents the formal adoption of the Beacon Chain as the new consensus layer to the current Mainnet execution layer. Once The Merge happens, validators will be assigned to secure Ethereum Mainnet, and mining on proof-of-work will no longer be a valid means of block production.

Blocks will instead be proposed by validating nodes that have ether staked for the right to participate in consensus. These upgrades set the stage for future scalability upgrades, including sharding.

The Beacon Chain

The Merge and the Shanghai upgrade

In order to simplify and maximize focus on a successful transition to proof-of-stake, The Merge upgrade will not include certain anticipated features such as the ability to withdraw staked ETH. The Shanghai upgrade is planned to follow The Merge, which will enable the ability for stakers to withdraw.

Stay up-to-date with the Shanghai upgrade planning issue on GitHub↗ , or the EF Research and Development Blog↗ . For those curious, learn more about What Happens After The Merge↗ , presented by Vitalik at the April 2021 ETHGlobal event.

The Merge and sharding

Originally, the plan was to work on sharding before The Merge to address scalability. However, with the boom of layer 2 scaling solutions, the priority has shifted to swapping proof-of-work to proof-of-stake via The Merge.

Plans for sharding are rapidly evolving, but given the rise and success of layer 2 technologies to scale transaction execution, sharding plans have shifted to finding the most optimal way to distribute the burden of storing compressed calldata from rollup contracts, allowing for exponential growth in network capacity. This would not be possible without first transitioning to proof-of-stake.

Sharding

Further reading

- Ethmerge — Ethmerge ↗
- The Merge is Coming — Alchemy ↗
- The State of The Merge: An Update on Ethereum's Merge to Proof of Stake in 2022 — Consensys ↗
- Announcing the Ropsten Merge Testnet — Ethereum Foundation ↗
- Execution layer specs — Ethereum Foundation ↗
- Consensus layer specs — Ethereum Foundation ↗

Engine API specs ↗
Ethereum Foundation

The Hitchhikers Guide To Ethereum ↗
Delphi Digital

Was this page helpful?

Yes No

Website last updated: September 1, 2022

Use Ethereum

- Find wallet
- Get ETH
- Decentralized applications (dapps)
- Layer 2
- Run a node
- Stablecoins
- Stake ETH

Learn

- What is Ethereum?
- What is ether (ETH)?
- Ethereum wallets
- Community guides and resources
- History of Ethereum
- Ethereum Whitepaper
- Ethereum upgrades
- Ethereum security and scam prevention
- Ethereum glossary

Developers

- Get started
- Documentation
- Tutorials
- Learn by coding
- Set up local environment

Ecosystem

- Community hub
- Ethereum Foundation
- Ethereum Foundation Blog ↗
- Ecosystem Support Program ↗
- Ethereum bug bounty program
- Ecosystem Grant Programs
- Ethereum brand assets
- Devcon ↗

Enterprise

- Mainnet Ethereum
- Private Ethereum
- Enterprise

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- Cookie policy
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Ethereum governance

Blockchain bridges

Zero-knowledge proofs

Ethereum energy consumption

What is Web3?

Ethereum Improvement Proposals