

Is Ethereum's (Hopefully) Imminent "Merge" a Major Step Towards Lowering Blockchain's Energy Footprint?

Ethereum, the second largest cryptocurrency platform, has just announced that testing has been completed and that the "Merge" to Proof of Stake – which is expected to dramatically reduce energy usage - will happen in mid-September 2022.



Regardless of what you may think about cryptocurrency – and ignoring the steep decline in valuation in 2022 and the failure of some major cryptocurrencies - crypto remains a major business with some analysts predicting rapid growth over the coming few years.

[According to CoinMarket Cap](#), the market cap of all crypto companies as of August 15, 2022, was approximately \$1.1 trillion, or about the same as the GDP of Mexico, the 15th highest GDP in the world.

But a little-known fact about crypto is that it uses a significant amount of energy – and, yes, we are talking about the energy used by computers to mine cryptocurrencies. While there are huge discrepancies in the reports on crypto's actual energy usage, the University of Cambridge (Centre of Alternative Finance) is probably considered the most reliable source. That being said, I have seen wildly different representations of Cambridge's numbers¹, so, I thought it would be helpful to print an image from the Cambridge Bitcoin Electricity Consumption Index (updated daily) taken on August 11, 2022:



¹ There has also been at least 1 report, from payment consultancy firm Valuechain, that claims that the University of Cambridge estimates are double Bitcoin's actual energy usage, but the basis for this and some other claims they make are dubious.

To put this in perspective, Bitcoin's usage of ~92 Terawatt Hours of electricity per year puts it on a par with Kazakhstan, which is ranked 34th in overall national energy consumption, just ahead of Pakistan, Finland, and the Philippines. Bitcoin represents around 40% of the cryptocurrency market and, while the energy footprint of all crypto companies aren't identical, a simple extrapolation suggests that the crypto market as a whole uses ~230 TWh of energy per year. That is about the same as Taiwan, which ranks as the world's 20th largest energy consumer.

Why Such Huge Energy Consumption?

Cryptocurrency is based on Blockchain, a way to maintain and update a database, typically across a network of computers. New data is added one 'block' at a time, and each block refers back to the previous block. Once data becomes part of the blockchain, it cannot be deleted or changed, which is the key argument for its use as currency.

To ensure each new block of data added to the chain is legitimate, a "consensus mechanism" is used that allows everyone on the network to check the legitimacy of every block. By far the most used method is called Proof of Work (PoW).

The people doing this work are called *miners*. Mining is a metaphor for introducing new tokens into the chain, based on the analogy that it requires work much like mining for gold or silver, although it is computational rather than physical effort. Of course, the tokens that miners find are virtual and exist only within the blockchain's digital ledger. The miner's goal is to be the first to get the answer to a complex problem (the "work"), which gives the miner the right to record transactions in the system's blockchain and broadcast the new block to the rest of the network. Successfully adding a new block to the chain generates some new cryptocurrency that miners keep as a reward. In addition, miners are paid processing fees for the transactions in the block they added.

In the early days of Bitcoin (the original crypto platform and still by far the largest) miners could use home computers to mint new coins. As the market grew over time, the puzzles the miners had to solve to earn new coins grew more and more complex, requiring increased computing power and, by extension, energy. Cryptocurrency mining is now a highly competitive business, with many large facilities that house thousands of high-end computers operating 24 X 7. And, the more computers trying to solve the puzzles, the harder the system becomes to tamper with, therefore increasing security - and the amount of energy used.

While energy usage of different crypto platforms may vary slightly, the carbon footprint of the different platforms can be dramatically different because the sources of energy vary considerably. Until fairly recently, the majority of cryptocurrency was mined in China, but China pulled the plug on decentralized digital currencies in 2021, in large part because of concerns about energy usage. The US is now the country with the greatest amount of crypto mining – followed by Kazakhstan. But Kazakhstan gets about half of its electricity from coal, so even if the energy used by crypto is the same in Kazakhstan as in the US (where coal is now responsible for less than 22% of electricity generation) its carbon footprint per crypto unit is more than double. And much higher than when Crypto was being mined in China, where hydropower was used to support crypto on a widescale basis.

Even within a single country such as the US the carbon impact of crypto is highly dependent on where it is mined, and the electricity sources being used. There are reports of crypto companies moving to renewable energy (and some miners have moved their computers to countries such as Iceland and Sweden which leverage geothermal and hydropower to lower their carbon footprint) but given the limited amount of renewable energy currently available greater use for crypto means less availability for powering other things. We are also seeing cases of older fossil-fuel based generating plants being brought out of retirement specifically for crypto mining. Case in point is the gas-powered Greenridge Generation plant in upstate NY. So as much as the energy usage of crypto is concerning, the environmental impact is even more so.

Lowering Crypto Energy Usage

For years there have been discussions about switching from the PoW approach to one known as Proof of Stake (PoS). With Proof of Stake, anyone who owns cryptocurrency can pledge their tokens as collateral towards the development of the blockchain and become what is known as “validators”. They are responsible for validating the legitimacy of transactions and deciding which ones will be processed first. In return, they are provided with a fixed percentage of the pledged assets when a new block is added to the chain. There’s no need for special equipment; the competition isn’t about quickly solving a problem, but rather about how much each party is willing to put up as collateral. This process is called the ‘staking’ of crypto assets. A block reward refers to the number of tokens you get for successfully mining a block of currency. Much less computational power is required – and therefore there is much less energy used by PoS than PoW.

For several years the 2nd largest cryptocurrency company, Ethereum with roughly a 20% market share (about half of Bitcoin’s), has been committed to moving from PoW to PoS (which they refer to as the Beacon Chain), a process they have been referring to as the “Merge”. The Ethereum Foundation estimates that this will *reduce the energy use of generating cryptocurrency by more than 99%*. The Merge has been delayed multiple times, but Ethereum reported on August 12th that they just completed the final testing (the Goerli Testnet) and the Merge will occur in mid-September with all Ethereum users ported over to the new process.

Where Does the Merge Lead?

Will other crypto companies follow Ethereum’s lead? Well, there are already a number that have adopted related technologies. Solana, which has grown into the ninth-largest cryptocurrency, has a variant in which transactions are given timestamps to speed up processing. Other approaches include: providing all users a chance to be randomly and secretly selected to propose and vote on batches of transactions that need confirming, with each party’s influence tied to how many tokens s/he owns; allowing users to elect delegates to validate transactions in six-hour shifts and receive new coins for their work; and enabling users to compete to provide bandwidth or digital storage space to the network in exchange for new coins.

But there are also detractors that claim that PoS is less secure than PoW. For example, a representative from digital asset investment manager CoinShares has suggested that the PoS code proof is so complex

that there's a greater risk of undetected software bugs and that the systems are more susceptible to censorship because once an entity/group acquires more than half the tokens there's no way for them to be unseated as the controlling entity. This argument is countered by PoS supporters who state that with PoW a small number of miners typically control most of the network, opening the door to manipulation, but, with PoS the only way for users to increase their influence is by increasing their stake, making it harder—and more costly—to game the system.

There is also at least one cryptocurrency platform, TRON, that is resistant to Ethereum's move to PoS and indicated that they plan to offer a "hard fork" that keeps some Ethereum transactions on PoW.

And despite a campaign started this past March by Greenpeace, Environmental Working Group and other climate organizations to get Bitcoin to switch to PoS, there has been significant resistance from Bitcoin. [As reported by Fortune Magazine](#), the Bitcoin community says this campaign is farfetched. They claim that PoW is a key part of Bitcoin's value proposition, vital for blockchain security, and a big part of why they are so devoted to Bitcoin. Additionally, they say, a move to PoS would destroy income for miners, since they'd become obsolete, and would render the large capital investment they made in computational power almost worthless.

In addition, they point out that being a decentralized network, not controlled by one group or entity, a move to PoS would have to be presented to the entire Bitcoin community and be voted on in order to be approved. It could take years for all the miners to reach consensus to move forward. And, if not all miners agree it could lead to Bitcoin being split into two blockchains – the same "hard fork" being promoted by TRON for Ethereum.

So, one can assume that there will not be an immediate transition to PoS by the entire crypto community. But, over time, if Ethereum continues to get good press – and a valuation bump – from the Merge, and as more people begin to understand the significant reduction in energy use – and the correlated reduction in costs – of the move to PoS, more and more crypto platforms are likely to make the move, and the campaign with respect to Bitcoin will become much more likely to succeed.

And, hopefully, crypto will become less and less of a barrier to the transition to a clean energy economy.