SYGNUM

Does crypto have an energy problem?

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A report from Sygnum Bank on Bitcoin's energy challenges and the emergence of green blockchains

Contents

Bitcoin's high energy consumption is an often used criticism against the world's first cryptocurrency, often described by the media in a way that suggests that cryptocurrencies in general have an "energy problem".

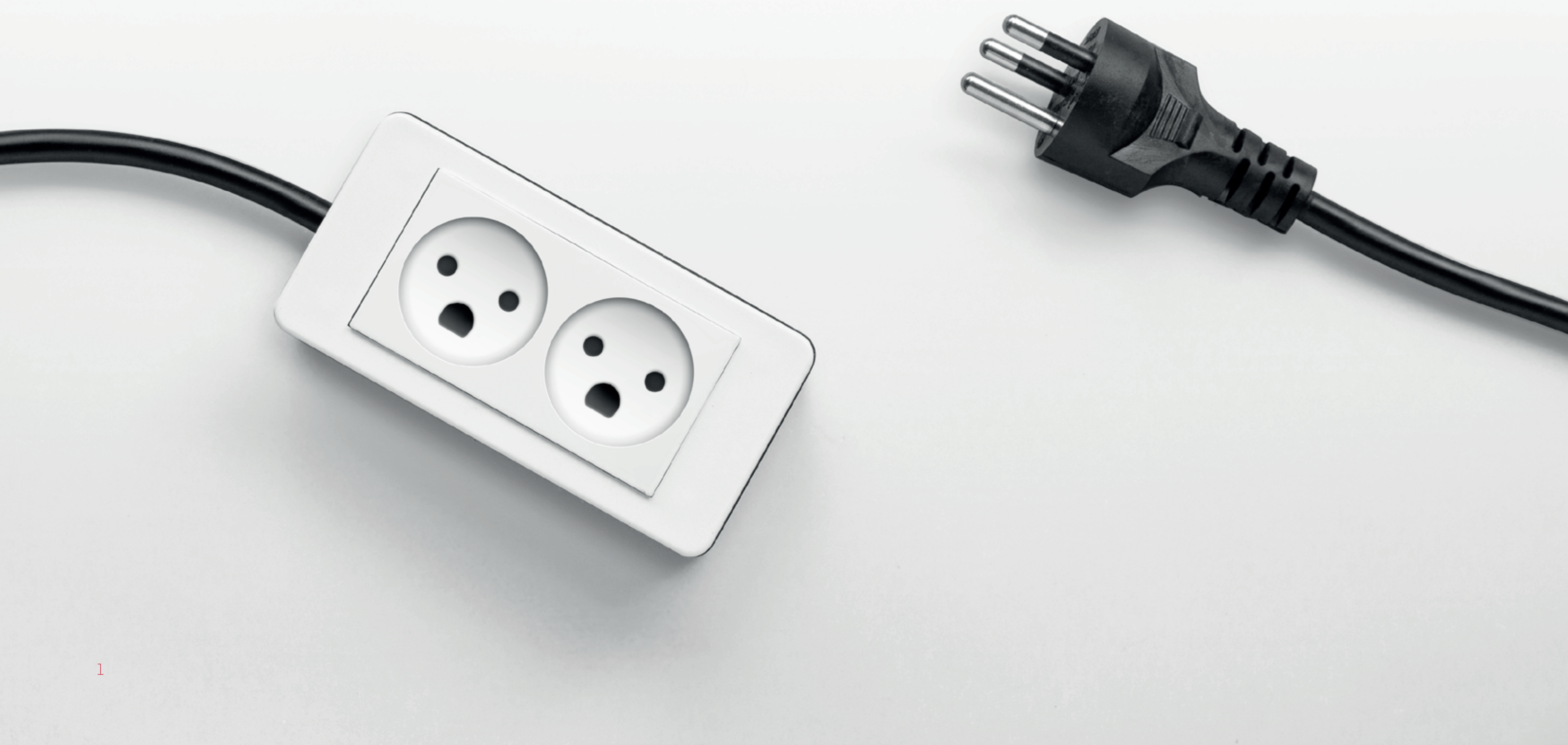
1. Executive summary

While Bitcoin is energy inefficient, solutions have been proposed since its earliest days to mitigate its energy consumption, including by its creator, "Satoshi Nakamoto". Early innovations in this area yielded results, but ultimately it was the invention of an alternative consensus mechanism, Proof-of-Stake, that definitively solved the problem.

Technological solutions to Bitcoin's high energy consumption have been available for some time now, and the fact that the market has neither pivoted away from Bitcoin to a Proof-of-Stake cryptocurrency, nor put any pressure on Bitcoin to upgrade its platform to be more energy efficient, is a sign that market participants to date have not been particularly concerned about the energy inefficiency of Bitcoin.

Meanwhile, the majority of cryptocurrencies today use very little energy, and the second largest cryptocurrency, Ethereum, is changing its protocol to the energy efficient Proof-of-Stake mechanism.

In this report, we answer the question "Does crypto have an energy problem?". We review the reasons for Bitcoin's high energy consumption, look at energy sourcing flexibility, and analyse the innovative solutions the industry has found to address this problem.



2. Why does Bitcoin consume a lot of energy?

Bitcoin's high energy consumption is a consequence of the consensus mechanism used to validate its decentralised ledger.

The consensus mechanism, called Proof-of-Work, chooses transaction validators based on the computing power they commit. The greater their computing power, the higher their chances of earning the transaction fees and mining rewards. Bitcoin's growing popularity has led to validators ("miners") dedicating ever greater computing resources to the network, in turn escalating energy use.

Following is a review of why Bitcoin chose the Proof-of-Work consensus mechanism.

2.1 The utility of Bitcoin

Bitcoin was launched in 2009, making it the first successfully implemented decentralised cryptocurrency and blockchain. With its ideological roots in the Austrian school of economics, Bitcoin proposed to solve the problems that led to the 2008 financial crisis by creating a "better money" than fiat currencies controlled by central banks.

The Bitcoin whitepaper described a corruption-proof, transparent monetary system without the centralised entities that concentrated power. In this spirit, the first Bitcoin block actually encoded the words "Second Bailout for Banks", a recent newspaper headline from The Times referring to the financial crisis.

The important utility Bitcoin was designed to provide was a transparent, tamper-proof supply mechanism. In Bitcoin's case, a hard supply cap was coded in the system. Some of the cryptocurrencies that followed used different supply models, but generally always remained algorithmic and transparent.

2.2 Distributed consensus: the breakthrough innovation behind Bitcoin

Digital forms of money existed prior to the emergence of Bitcoin in centralised systems, with a single ledger containing the information on which accounts held what number of units.

In the 1990s, a lot of innovation occurred in the area of cryptography and decentralised ledgers. Projects have attempted to apply these advances to create new forms of money that are anonymous and secure (DigiCash), or decentralised and thus not controlled by a single central entity (Hashcash). Whitepapers were written attempting to tie these advances together and create a decentralised digital money that is private and secure. These whitepapers (Bit Gold, B-Money) were not realised as projects, but all contributed to the knowledge base that was eventually brought together in the Bitcoin whitepaper and led to the first successful implementation of a decentralised cryptocurrency.

To be successful, the system needed unambiguous agreement on who the holders of the units in the ledger were, a method of ensuring that bad actors could not corrupt the data, and the ability to withstand malicious attacks. The Proof-of-Work transaction validation mechanism was the breakthrough solution that achieved consensus without a central entity and did not sacrifice security and data integrity ("distributed consensus").

The eventual high energy use was anticipated, not least because Bitcoin's predecessor Hashcash had already run into that problem. However, a large number of validators committing significant computing resources was seen as an effective barrier to attacks on the system.

The narrative by Bitcoin's creator(s) was that the value such a decentralised system provides is well worth the energy use – just as the utility gold provides is seen to be worth the energy used when mining gold.

2.3 Introduction to Proof-of-Work

In the Proof-of-Work system, transaction validators (called "miners") use their servers to run nodes that store a copy of the Bitcoin ledger. These miners validate and update the network with new transaction information at regular intervals – approximately every ten minutes in Bitcoin's case – by agreeing on the correctness of the transactions and then creating the next data block of the blockchain.

To incentivise miners to participate in validating transactions in the Bitcoin network, and to compensate them for their investment in hardware and electricity costs, miners receive the transaction fees paid by users and a block reward of newly minted Bitcoins (the latter available only until the maximum supply is eventually reached in approximately 2140).

The mechanism that selects miners who create the next block (and thus receive the fees and block rewards) creates a de facto random selection, where a string of numbers need to be correctly guessed and then put through the cryptographic hashing algorithm to create the target hash. Each string is created randomly, so it can take millions of guesses before the target hash requirement is met and new Bitcoins are minted to the successful miner. This trial-and-error exercise favours those with greater computing power who can calculate more strings at a faster rate.

The system is designed with a difficulty adjustment mechanism depending on the number of miners present in the network, which occurs approximately every two weeks. If there are less miners present, the complexity of the hash is lowered which allows miners to solve it with less computing power, while if the number of miners in the network increases, the difficulty level of the function increases resulting in higher computational demand, as has been the case in recent years. The purpose of this difficulty adjustment is to ensure that the average block creation time is always around ten minutes. Recently, China's mining ban resulted in a sharp drop of the mining difficulty, which increased shortly thereafter as US and European miners filled the void and increased their operations.

FIGURE 1

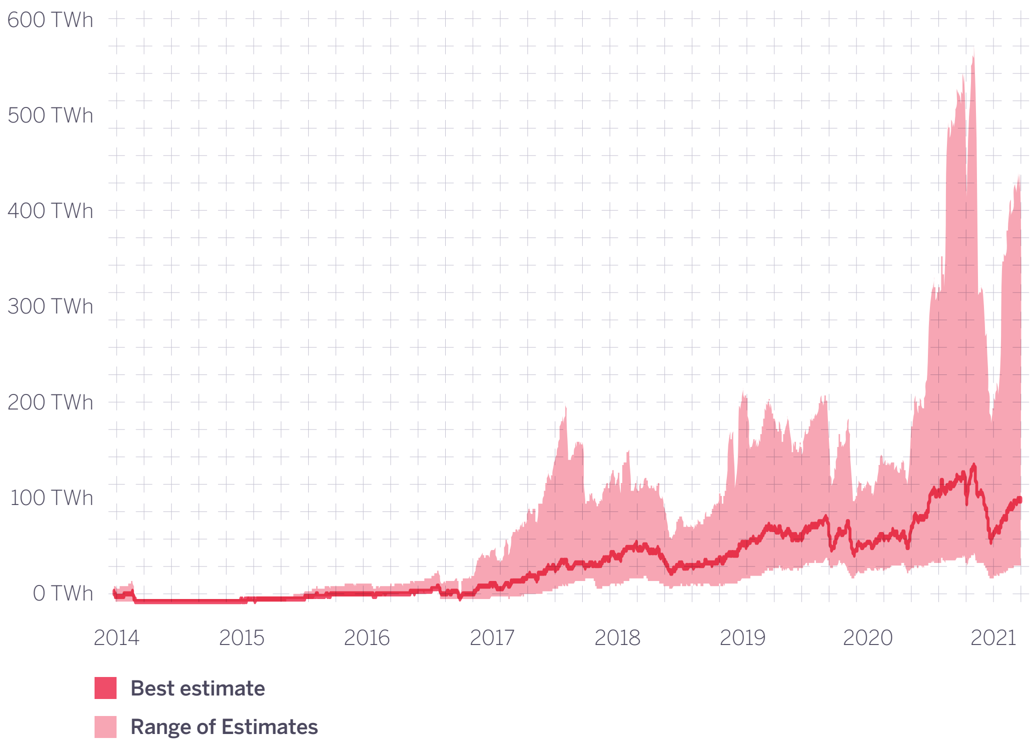
Bitcoin network difficulty

Source: www.blockchain.com/charts/difficulty

Currency in USD Trillions

FIGURE 2

Bitcoin's estimated electricity consumption



Source: cbeci.org/index

Energy measured in Terrawatts per hour (TWh)

2.4 Increasing energy consumption due to adoption

In the early days of Bitcoin, one could participate in the mining process and be competitive with the computing power of a regular consumer computing device. Initially, it was the easiest way to acquire Bitcoin, as marketplaces for trading cryptocurrencies did not yet exist.

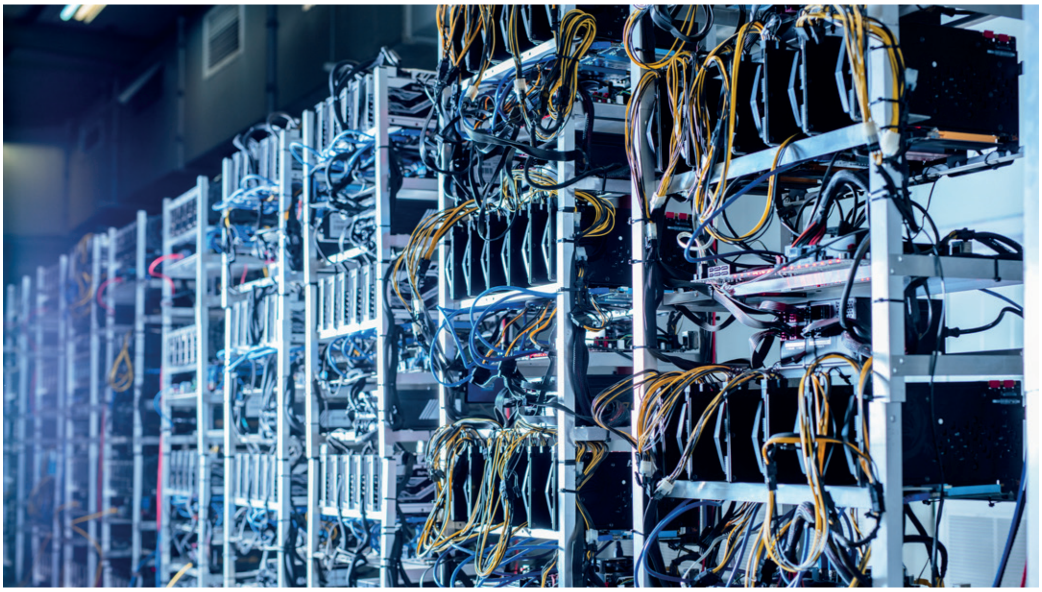
As Bitcoin's popularity and usage exponentially increased over the last decade, the number of miners increased too. To get ahead of the competition, some miners created large mining pools where the computational power of multiple miners were bundled together have a higher probability to be the first to generate the right hash. As the price of Bitcoin increased sharply, mining became very lucrative which attracted the interest of commercial entities.

In 2013, this race also led to the development of specialised mining equipment called Application Specific Integrated Circuits (ASIC's). This was followed by newer versions of ASIC's with increasingly advanced hardware.

As a result of more and more computing power joining the race to create the next block, Bitcoin's energy consumption steadily increased over the last decade to approximately 0.07 percent of global energy usage (https://cbeci.org/index). This is similar to the annual energy usage of a country such as Belgium or Finland. After peaking in May 2021, electricity consumption dropped when China banned Bitcoin mining, although it has been increasing again as miners' relocated their operations.

2.5 Energy inefficiency

Bitcoin's high energy use has the positive consequence of making the network very secure as it makes the cost of attacking the network extraordinarily high. Trying to tamper with the data stored on the Bitcoin blockchain would require the attacker having more computing power than the rest of the network (a so-called 51 percent attack). This requires enormous amounts of energy, discouraging bad actors.



The market has continued to favour Bitcoin and allowed it to remain the largest cryptocurrency despite the launch of new, more innovative, technologically superior and better designed protocols. Bitcoin's scalability challenges, and increasing concerns about its energy inefficiency, suggest that the enduring security of the Bitcoin network has been a feature that the market has valued greatly.

However, as the adoption of Bitcoin (and cryptocurrencies in general) have accelerated, and Bitcoin's total energy use has matched that of whole countries, questions about the value of securing a network in such a way are now being raised.

Ultimately, the Proof-of-Work mechanism is wasteful and inefficient. The millions of trillions of calculations that take place every second serve no other purpose but to win the next block, and the results of these calculations (except for the one resulting in the successful guess for the correct hash) are immediately discarded. Most of the calculations executed to keep the system running are not actually performing any useful work.

Energy use represents an additional barrier to Bitcoin's scaling, alongside the various technological barriers that have yet to be overcome. If Bitcoin truly fulfils the vision mapped out in its whitepaper, it would become the single largest energy consumer in the world.

2.6 Comparisons

It is also interesting to put Bitcoin's energy usage in context. Bitcoin's use case as an alternative inflation resistant store of value makes a comparison to gold highly relevant.

Estimating the energy use of various processes is somewhat subjective, with numerous assumptions involved. However, even when using a wide range of assumptions, all estimates put the energy consumption of gold mining either slightly above or significantly above the energy used in Bitcoin mining. And in the case of gold, various downstream processes (e.g. energy expended in the production of machinery and components used) and transportation and storage are not considered in that estimate, while in the case of Bitcoin, the validation and mining process accounts for 100 percent of its energy use.

2.7 Flexibility of energy sourcing

It is also important to note that Bitcoin miners (and cryptocurrency miners in general) are extremely flexible and adaptable, including in terms of the geographic location of their mining operations. Unlike for example gold mining that can only occur where gold ore is located, crypto mining can be located anywhere with a stable internet connection.

If the market demands that Bitcoin relies on certain types of energy sources, Bitcoin miners can adapt to this very quickly. Initially, their primary objective was to be located where the cheapest electricity prices could be found. However, if the market shuns Bitcoin based on its energy source, and the Bitcoin price declined and ate into their profits, mining operations could quickly be relocated.

Indeed, as the push to use renewable energy sources has increased, a significant portion of Bitcoin mining (currently estimated to be approximately 50 percent) has pivoted to these sources.

In October 2021, El Salvador, the first country to make Bitcoin legal tender, commenced Bitcoin mining using geothermal energy generated by volcanoes.

It is also interesting to note that because Bitcoin miners are unrestricted in terms of their geographic location, they can use energy sources that would otherwise be wasted as they cannot be transported or efficiently stored. Hydro energy is a good example of this, as is the natural gas that is a by-product of the oil extraction process. Crypto mining can use these energy sources efficiently by locating the mining rigs in their proximity.

2.8 Implications of China's mining ban

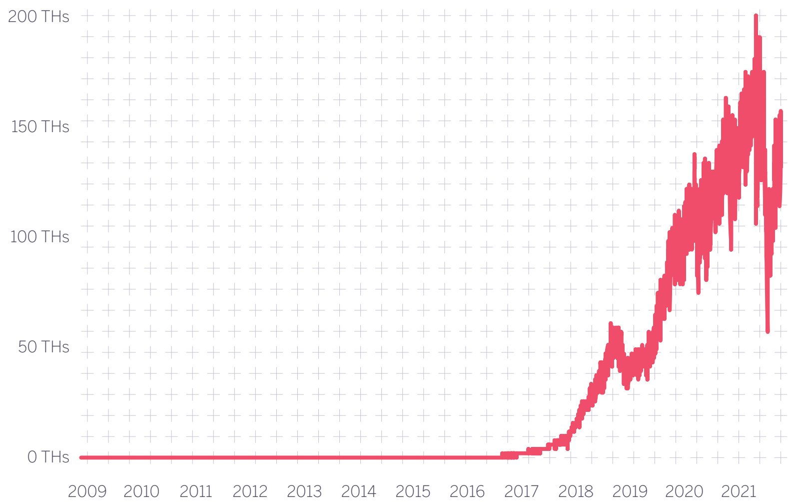
The Chinese government had been suggesting since early 2019 that they intended to ban cryptocurrency mining, with rumours starting a year before the official announcements. This translated into serious enforcement action in May this year that led to over 90 percent of Bitcoin mining capacity located in China being shut down. At the time of this clampdown, it was estimated that between half and two-thirds of Bitcoin's mining power was located in China. As a result, the amount of network power (hash rate) committed to Bitcoin declined significantly after the ban was enforced, along with Bitcoin's energy consumption. However, this decline was short lived as mining capacity quickly relocated outside China.

As Chinese miners started moving their hardware abroad, and mining operations elsewhere started picking up the slack, the energy sources used for Bitcoin mining have also shifted away from coal. It is worth noting that while only about a quarter of world energy comes from coal, it supplies over half of the energy used in China, which many miners tapped into.

A less positive consequence is that some of the seasonal hydro energy that Bitcoin miners have used in China will no longer be utilised. Remote mountainous areas in parts of China offer enormous quantities of renewable hydro energy during the wet season, with much of it going to waste each year. Bitcoin miners formerly relocated to these regions during the wet season to utilise this clean resource.

FIGURE 3

Computing power dedicated to Bitcoin mining



Source: digiconomist.net/bitcoin-energy-consumption
Energy measured in Terrahash per second (THs)

3. Solutions to Bitcoin's energy problem

Bitcoin's heavy energy use inspired innovators from the earliest days to find technological solutions that mitigate this problem.

Copies and forks of the Bitcoin protocol have created more efficient versions of the Proof-of-Work consensus mechanism. Some of these solutions were aimed primarily at improving scalability, but also have the consequence of reducing energy consumption.

As the industry works towards scalability to allow mass adoption, various "second layer" solutions have emerged that process transactions off the main blockchain. These solutions are also very effective at reducing energy requirements.

However, the breakthrough that reduced cryptocurrencies' energy consumption to a negligible level was to use consensus mechanisms that did not select transaction validators on the basis of the computing power they commit – as with Bitcoin. Below is a review of these solutions, and their impact on energy use.

3.1 Modifying Bitcoin

As early as 2011 Litecoin, a copy of the Bitcoin protocol aimed to create a "lighter" version using a simpler algorithm, was launched.

Technological solutions aimed at improving the scalability of blockchain protocols such as increasing transaction capacity ("block size") or running transactions in parallel also improve the energy efficiency.

Several copies and forks of Bitcoin are more energy efficient than Bitcoin, however, these solutions have pros and cons beyond the energy issue.

Meanwhile as the crypto industry innovates to optimise different aspects of the blockchain technology – privacy, security, decentralisation, scalability – some of the solutions to these problems actually made the energy issue worse. For example, some protocols are made to be resistant to application specific (ASIC) mining hardware in order to keep the protocol more decentralised by avoiding a high upfront hardware investment requirement for miners. While this helps prevent centralisation, the types of hardware used in ASIC resistant protocols are generally less energy efficient.

3.2 Lightening the load on the network

Second layer scaling solutions have been inspired primarily by the anticipation of mainstream adoption, rather than by the wish to reduce energy consumption. They do, however, have the effect of making blockchain protocols more energy efficient, often significantly so.

These solutions centre on doing a lot of the transaction processing away from the main network, and with this they reduce the pressure on the protocol. This helps prevent bottlenecks in the network, and also improves energy efficiency.

The Lightning Network payment channel, for example, can reduce transaction times and fees on Bitcoin – with much reduced energy requirements.

3.3 Other mechanisms for selecting validators

As it is the consensus mechanism of Proof-of-Work algorithms that leads to their high energy use, if the transaction validators are selected on the basis of criteria other than committing computing power, energy efficiency increases dramatically.

There have been a few models suggested, but some of them only work in private networks and are not appropriate for public blockchains, or they introduce an element of centralisation that is undesirable for parts of the crypto community (such as the "Proof-of-Authority" (PoA) method where a central entity approves the validators).

The Proof-of-Stake consensus mechanism has gained a lot of popularity and has succeeded in providing a viable alternative to Proof-of-Work. Under this mechanism, validators are chosen on the basis of their holdings in the network's native cryptocurrency. This system sometimes includes a loyalty component where longevity of the token holding is favoured.

It is also possible to select validators on the basis of some genuine economic value they provide to the network, however efforts in this direction have only yielded limited results, with this mechanism being used only by a small number of protocols.

As new projects vie for visibility, they often invent new names for their consensus protocols, usually on the basis of some secondary feature that is unique to them. However, the validator selection ultimately comes down to either the token stakes held, or the computing power committed, or to a central entity selecting and authorising the validators.

While the primary motivation to develop alternative consensus mechanisms was not to reduce the energy consumption, if the validators are not selected on the basis of the computing power they commit to the network, the protocol's energy consumption is therefore minimal.

3.4 Introduction to Proof-of-Stake

Proof-of-Stake, the alternative consensus mechanism that has succeeded in providing a viable alternative to Proof-of-Work, was created in 2012, just a few years after the creation of Bitcoin. Its first implementation was Peercoin, a protocol launched in 2013.

In a Proof-of-Stake blockchain, transaction validators are selected on the basis of their token holdings. Just like in a Proof-of-Work system, the validators are randomly chosen to process the next block – and thus earn the transaction fees and block rewards. But instead of the miner generating a random number by performing vast numbers of guesses and running them through the cryptographic hash function, the protocol itself performs the random selection for each block. The probability of being selected depends on the number of tokens the validator holds.

Validators need to deposit ("stake") the protocol's native token as collateral in the network to be able to participate in the consensus creation and to earn block rewards ("staking rewards").

The stake also serves as a security measure as malicious validators will forfeit some or all of their staked tokens. Securing the network in this way removed the need for committing vast computing resources to the protocol, and reduced the energy consumption to a very small fraction of Bitcoin's energy consumption.

The details of how the Proof-of-Stake mechanism is implemented vary across protocols, and the industry is still innovating around the best solutions to optimise security, scalability, and decentralisation. In some cases, the staked tokens are locked and cannot be moved or traded; some protocols allow all token-holders to earn staking rewards by delegating their token holdings to validators; others vary in how staking rewards are determined.

But ultimately, the innovation of Proof-of-Stake achieves not only far greater efficiency (including with regard to energy use) but also better aligns the interests of the validators and token-holders. Instead of buying expensive, highly specialised computer hardware, validators invest in the protocol's tokens which supports the price and benefits the token economy.

The Proof-of-Stake mechanism also democratises the mining process as all token holders can stake their tokens and earn block rewards.

There is debate in the industry on whether Proof-of-Stake is more, or less, secure than Proof-of-Work, with passionate advocates on both sides. So far both algorithms have proven antifragile, with no attempted attacks resulting in failure, but instead triggering upgrades to make the networks more secure.

3.5 Implications of Proof-of-Stake for energy use

Although energy efficiency was not the main driver to innovate and devise alternative consensus mechanisms, it is most certainly one of its very important benefits. In general, Proof-of-Stake protocols are very energy efficient, with the aggregate amount of energy they consume being negligible.

The Ethereum Foundation expects to reduce its energy consumption by 99.95% as it upgrades its protocol to Proof-of-Stake. Tezos, a Proof-of-Stake protocol, estimates its energy usage per transaction at 1/25,000,000th of that of Bitcoin's when both chains operate at full capacity.

3.6 Upgradeability of blockchain protocols

Blockchain protocols are designed to be regularly updated with new features and fixes. This flexibility allows entire components to be switched out and upgraded – such as the consensus mechanism.

Ethereum, the second largest cryptocurrency, is currently undergoing such an update from Proof-of-Work to Proof-of-Stake. Zcash, a cryptocurrency launched in 2016 by copying the Bitcoin protocol, is also considering an upgrade to Proof-of-Stake.

Bitcoin itself could also upgrade to Proof-of-Stake. Although there are no plans or indications for such a move, Bitcoin's dramatically declining dominance may be a sign that the market may be putting pressure on Bitcoin to evolve.

FIGURE 4

Bitcoin's share of total crypto market capitalisation

Source: coinmarketcap.com/charts/

3.7 Ethereum 2.0 update

Ethereum is currently the second largest cryptocurrency by market capitalisation after Bitcoin. Launched in 2015, a core part of the founders' vision was to provide a foundation for the development of a wide range of applications by putting executable smart contracts on the blockchain. It has since become the dominant smart contract platform.

Although the current version of Ethereum employs the energy-intensive Proof-of-Work consensus mechanism, founder Vitalik Buterin had signalled his intention to move to Proof-of-Stake before the network even went live. Since December 2020, developers have been migrating to this more efficient consensus mechanism in a phased development approach. See the Ethereum 2.0 migration phases opposite.

The switch to Proof-of-Stake is intended to improve the scalability of Ethereum, enhance security and lower the barriers to participating in the transaction validation process (thus earning fees and rewards). Although there is a minimum number of tokens that validator nodes need to deposit, all token-holders can participate and earn staking rewards by using third-party pooling services.

Ethereum, being a more efficient technology, currently uses slightly over half of the energy used by Bitcoin. This is, however, still a significant amount. The Ethereum 2.0 upgrade is expected to reduce its energy consumption by 99.95 percent, comparable to that of a town, rather than a small country, according to an Ethereum Foundation blog.

Launched on 1 December 2020 — **Beacon chain**
A coordination mechanism for the new network that enables the creation and validation of new blocks, and the rewarding of validators.

Planned for 2022 — **Legacy Ethereum integrates with Ethereum 2.0**
The legacy Ethereum network becomes a shard of the new core Ethereum 2.0 blockchain and transitions to Proof-of-Stake.

Planned for 2022 — **Shard chains**
Shard chains enhance network scalability and capacity, and reduces the hardware requirements to run a node. Validators can confirm transactions, create new blocks, and communicate with the beacon chain.

4. Does the crypto market have an energy problem?

The creation of Bitcoin, the first decentralised cryptocurrency, inspired developers to innovate further and build their own versions of decentralised protocols. To date, there have been several hundred cryptocurrencies launched that represent alternative blockchains, and over ten thousand tokens that represent applications built on top of these blockchains.

Some of the new protocols were simply copies or forks of existing protocols with certain, sometimes relatively minor, modifications. Others represent significant innovations and entirely new ways of constructing a blockchain.

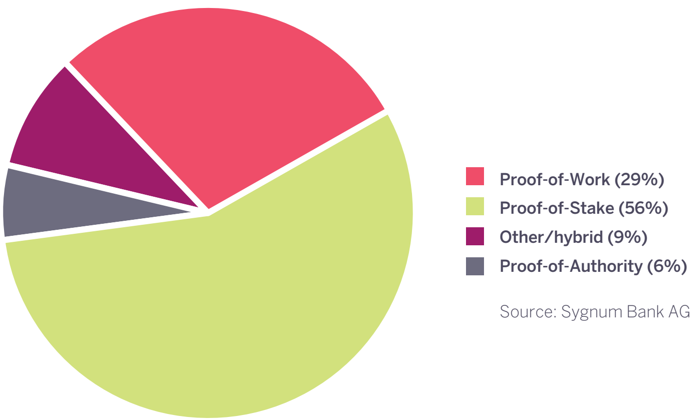
When we consider the energy usage and energy efficiency of the cryptocurrency market, we need to look at the market as a whole rather than Bitcoin only, as most blockchain protocols do not have the same energy consumption as Bitcoin.

4.1 Dominant consensus mechanisms

Proof-of-Work based cryptocurrencies represent less than 30 percent of the top hundred blockchains today. Approximately 60 percent of protocols solely or predominantly (Other/Hybrid) rely on the Proof-of-Stake consensus mechanism, making these highly-efficient protocols the consensus mechanism of choice for top blockchains today.

FIGURE 5

Consensus mechanism of Top 100 Blockchains



Source: Sygnum Bank AG

Due to Bitcoin's still dominant position, Proof-of-Work still accounts for approximately 75 percent of the crypto market in terms of market capitalisation. However, this has been steadily declining over time – both because of Bitcoin's declining dominance, and because the share of new projects using Proof-of-Work has also been declining.

After Ethereum's migration to Proof-of-Stake, Proof-of-Work protocols will represent just over half of total market capitalisation. And if Bitcoin's dominance continues to decline, Proof-of-Stake protocols could soon represent the majority of the market – not just in number but also in terms of market capitalisation.

4.2 Consensus mechanism of choice for new blockchains

Proof-of-Work was the consensus mechanism of choice for new blockchain protocols in the early period of industry development. However over the last five years, Proof-of-Stake has increasingly taken over as the preferred consensus algorithm – even after other consensus mechanisms were invented.

FIGURE 6

Top 100 blockchain protocol launches by consensus mechanism

Source: Sygnum Bank

The vast majority of projects launching now use Proof-of-Stake, with new Proof-of-Work blockchains becoming increasingly rare. Although the energy efficiency is only one of the reasons for this trend, and not the primary driver, the impact has been very positive on the overall energy efficiency of the cryptocurrency market.

In addition, more recent Proof-of-Work protocols (such as Arweave) often use modifications to the consensus mechanism that also act to significantly reduce the energy requirement.

4.3 The largest non Proof-of-Work blockchains

Ethereum will be the largest Proof-of-Stake blockchain after the upgrade. Other than Ethereum, some of the most prominent Proof-of-Stake protocols include Cardano, Binance Smart Chain, Solana, Polkadot, Terra, Avalanche, Dfinity, Polygon and Algorand. XRP and VeChain use the extremely energy efficient Proof-of-Authority (PoA) mechanism. Filecoin bases its consensus on the economic contribution to the protocol, in this case the amount of data storage space contributed.

It is also interesting to note that other than Ethereum (which will be switching to Proof-of-Stake), few new applications have been building on top of Proof-of-Work protocols. Proof-of-Work cryptocurrencies are more likely to be used as a medium of exchange and store of value. Due to the lesser scalability of Proof-of-Work, the trend of applications favouring Proof-of-Stake chains is likely to continue.

5. Conclusion and outlook

Do cryptocurrencies have an energy problem?

Bitcoin, the largest cryptocurrency by market cap, does use a lot of energy, but most cryptocurrencies do not. In fact, most cryptocurrencies are extremely energy efficient.

From a technological point of view the "energy problem" of Bitcoin was definitively solved by 2012/3 with the invention of alternative consensus mechanisms, in particular Proof-of-Stake.

The crypto market does not have an energy problem from a technical perspective.

Does Bitcoin use too much energy?

Bitcoin is energy inefficient. This is true irrespective of the energy sources used, especially as some of the claims in this regard are not necessarily accurate (for example that Bitcoin mining moving away from China would be a clear positive – crypto miners were using a lot of very clean hydro energy in China that was otherwise wasted).

Having said that, mining Bitcoin is more energy efficient than mining gold. And ultimately, the market may place a higher value on Bitcoin's utility relative to alternatives, including other cryptocurrencies, and continue to be prepared to pay the price in terms of energy inefficiency.

Is the market concerned about Bitcoin's high energy consumption?

Even though the issue arises regularly as new investors enter the market, usually during bull runs, ultimately the market reconciled itself to Bitcoin's energy consumption each time in the past without pressing for a change – either by way of an upgrade to the Bitcoin protocol, or a change in mining practices.

Now for the first time, we are seeing an impetus for change – with miners relocating, and a real possibility that the market may favour the soon-to-be energy efficient Ethereum protocol over Bitcoin.

People ultimately vote with their wallets. If Bitcoin continues to be favoured without calls for an upgrade to the consensus mechanism, that would signal a lack of genuine concern about the energy issue.

If Bitcoin's energy consumption is a sincere concern, alternatives are readily available. An energy efficient cryptocurrency could take Bitcoin's place as the dominant protocol, or the market can put pressure on Bitcoin to upgrade to an energy efficient consensus mechanism.

About Sygnum

Sygnum is the world's first digital asset bank, and a digital asset specialist with global reach. With Sygnum Bank AG's Swiss banking licence, as well as Sygnum Pte Ltd's capital markets services (CMS) licence in Singapore, Sygnum empowers institutional and private qualified investors, corporates, banks, and other financial institutions to invest in the digital asset economy with complete trust.

Sygnum operates an independently controlled, scalable, and future-proof regulated banking platform. Our interdisciplinary team of banking, investment, and Distributed Ledger Technology (DLT) experts is shaping the development of a trusted digital asset ecosystem. The company is founded on Swiss and Singapore heritage, and operates globally.

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