Case #7. Bitcoin Miners Face an Uncertain Future

In the summer of 2021, the **Chinese government** instituted a succession of restrictive regulations and outright bans that severely reduced the size of the Chines cryptocurrency mining industry, at the time the largest in the world. (See Appendix A for an explanation of bitcoin mining and Mining Pools.) As a result, some one million mining computers were stranded in China, and miners were faced with a logistical dilemma. Do they ship machines to new locations? If so, where? And to whom? The United States, specifically Texas, Kazakhstan, Canada, and Iran, energy rich states, were possible options.

The large drop in active machines also reduced the energy consumption of the mining network, from a range of 25-50%, depending on the relative age and power efficiency of the machines taken out of use. If these mostly belong to the latest most power-efficient generation of Bitcoin mining machines, then the respective energy consumption could represent a lot less than 50% of the total network's energy demand, closer to the 25% level.

For example, it only takes around 727,000 of **Bitmain**'s (the world's largest manufacturer of Bitcoin mining devices which was also headquartered in China) Antminer S19 Pro devices to generate 80 "exahashes" ("***hashes***" are what miners generate. An exahash is a quintillion hashes See Appendix A for an explanation of hashes), per second. These machines would consume around 25 terawatt-hours (trillion watts) of electrical energy annually, which is only a fifth of the network's total estimated power requirement before China banned Bitcoin mining.

While this may not be the same "hashrate" as the network had prior to the Chinese mining ban, the energy consumption of the network could be a lot closer to making a complete recovery. A Bitcoin miner can have different performance settings and can be "overclocked" to further boost performance. As a result, the overall impact of the Chinese Bitcoin mining ban on the network's energy consumption might not be severely reduced.

Crypto Infrastructure

Cryptocurrency brokers provide speculative contracts on the price of digital currencies. As a crypto trader yo have a crypto wallet with broker where you will own the right to buy or sell the contracts as prices shift, not the digital currency. In addition to these Crypto asset custodians (brokers), there is a substantial crypto media made up of brokers like Coinbase, Crypto.com, and Coindesk that advocate for the crypto industry.

Bitcoin's Carbon Footprint

The **carbon footprint** of bitcoin mining is measured by Cambridge University's ***Bitcoin Energy Consumption Index*** If China's bitcoin mining moved to another country where it used petroleum-based energy, its carbon footprint would be greater, since a significant percentage of Chinese mining used hydropower. See **https://digiconomist.net/how-chinas-bitcoin-mining-ban-affects-energy-consumption-estimates/ July 2, 2021**

Energy consumption has become one focus of cryptocurrency critics. One such critic, Digiconomist founder Alex de Vries, said he's "never seen anything that is as inefficient as bitcoin."

Cryptocurrency defenders claim the Bitcoin ecosystem consumes less than 10% of the energy required for the traditional banking system. De Vries argues that if energy-conscious regulators "took all possible actions against Bitcoin, it's unlikely you'd get all governments to go along with that" mining regulation. "Ideally, change comes from within," de Vries said, adding he hopes Bitcoin Core developers will alter the software to require less computational energy.

According to ***Bitcoin Energy Consumption Index***, bitcoin miners are expected to consume roughly 130 Terawatt-hours of energy (TWh), which is roughly 0.6% of global electricity consumption in 2021. This puts the bitcoin economy on par with the carbon dioxide emissions of a small, developing nation like Sri Lanka or Jordan.

1 million bitcoin addresses are active, daily, out of up to 106 million accounts active in the past decade, as tallied by the exchange **Crypto.com.**

All of the top five **bitcoin mining pools**, consortiums for miners to cooperate for better profit margins, rely heavily on hydropower. Renewable energy makes up 39% of miners' total energy consumption.

Before the Chinese government pulled back on bitcoin mining operations, Chinese bitcoin mining operations represent around 65% of the network's power, i.e., "hashrate." North American miners make up roughly 8% of the global hashrate, followed closely by miners in Russia, Kazakhstan, Malaysia and Iran.

Bitcoin mining will proliferate in those nations and organizations that offer the least restrictions on energy use and most profitable mining regulations. Until recently, the Chinese subsidized the mining industry with incentives to use under-utilized hydropower sources.

The best way to make cryptocurrency mining more eco-friendly is to support lawmakers that want to encourage mining in regions that already have underutilized energy sources.

PoS vs. PoW

Within the cryptocurrency industry there are many people who dislike how power-intensive bitcoin mining is and are experimenting with different mining methods. For example, the Ethereum community is switching to a "proof-of-stake" (PoS) mining model, powering the network with locked up coins instead of Bitcoin's intensive "proof-of-work" (PoW) model.

(See Appendix B for a detailed comparison of PoW and PoS.)

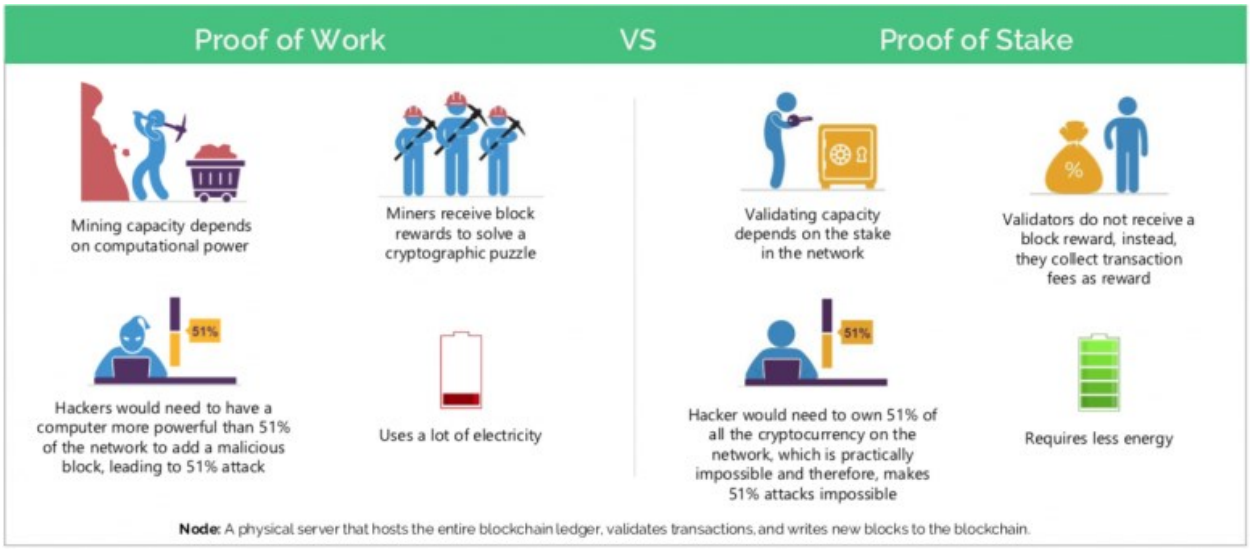
As the Ethereum community using PoS expands, the proliferation of Proof of Work (PoW) is slowing. As evidence, the stock of Ethereum (ETH) which is actively converting from PoW to PoS, is up +1,100%!

Incentivizing the right things

While PoW might have been the best tool available in the foundational 2008-2009 period, it is by comparison very expensive to generate.

PoW mining requires the purchase of specialized computers that depreciate rapidly in value as they are typically run continuously are regularly overtaken by faster mining devices, making them non-competitive.

With PoS mining you purchase digital assets then "stake" them in order to set up and operate nodes. PoS has very attractive gross margins and the underlying digital asset has the potential to appreciate in value as opposed to owning a specialized computer that has no appreciation potential whatsoever."



This last step – essentially putting staking capacity up on the cloud for others to buy at the retail level – might prove to be the bold move that will spell the beginning of the end of PoW.

The Spectre of Government Regulation

the University of Cambridge Bitcoin Electricity Consumption Index, according to which the global bitcoin network currently consumes about 80 terawatt-hours of electricity annually, roughly equal to the annual output of 23 coal-fired power plants, or close to what is consumed by the nation of Finland.

Bitcoin advocates argue that all industries use a lot energy, pointing out that bitcoin currently consumes a lot less electricity than the ATMs and data centers of traditional banks.

This is a function of time (and electricity) consuming crypto mining, but also the need to log every transaction on countless different computers, making crypto networks into a climate threat.

According to Digiconomist, Bitcoin and Ethereum together consume as much electric energy annually as Indonesia.

Like most industries, the crypto industry wants to minimum regulation and taxation. In fact, its initial goal was to carry on financial transactions outside the purview of governments.

In the U.S., the federal government, wants broad authority to oversee crypto precisely because of its desire to avoid taxation and regulation typical of the established financial sector. Further, there is a fear of financial products being created that prove unsupportable like the derivatives that helped create the 2008 financial crisis.

A proposal currently circulating in the **U.S. Congress** would give the **U.S. Treasury Department** authority to define "brokers" in the crypto markets and compel them to issue standard income tax forms and comply with the tax code. The crypto community is lobbying against the proposal. "I don't know how Treasury will use that authority," said Jerry Brito, executive director of Coin Center, a pro-crypto advocacy group. "I fear they'll use it in a way that has unintended consequences because they don't understand the technology."

To date, energy consumption has not been an issue in the EU. However, in July 2021, **European Commission** proposed tightening regulations on the transfer of crypto assets by requiring companies to collect details of senders and recipients, a somewhat different rationale and proposal from that circulating in the U.S. Congress.

- Such a law would extend to crypto the **Financial Action Task Force's** "travel rule" that already applies to wire transfers.
- The aim of the legislation would be to "ensure full traceability of crypto-asset transfers" and "allow for prevention and detection of their possible use for money laundering and terrorism financing," the Commission said.
- The travel rule requires service providers to exchange identifying information such as customer's name, address and account details.
- Extending these requirements to crypto transfers would prohibit the use of anonymous crypto wallets, just as anonymous bank accounts are already banned under EU anti-money laundering rules.

"These proposals have been designed to find the right balance between addressing these threats and complying with international standards while not creating excessive regulatory burden on the industry," the European Commission said. "On the contrary, these proposals will help the EU crypto-asset industry develop, as it will benefit from an updated, harmonised legal framework across the EU."

EU states and the European Parliament have the final say on the proposals, meaning it could take two years for them to become law.

So far, governmental concerns in the U.S. and EU have focused on the financial side of crypto, but many see a focus on energy consumption not far off, especially as Climate Change-related legislation seeks ways to minimize the use of electricity in some industries to make it available in

others, until such time as renewable energy sources can take over and make the 2050 Paris Accord zero emission targets a reality. Financial regulation of crypto could turn out to be a portal to energy regulation before such schemes as PoS takes over the industry.

ACTORS IN THE CASE

Government Actors

European Commission

European Parliament

Financial Action Task Force

U.S. Congress

Chinese Government

Crypto Industry Actors

Crypto Miners

Crypto Infrastructure: Crypto asset custodians (brokers) and crypto media like Coinbase, Crypto.com, and Coindesk

Ethereum

CASE QUESTIONS:

Design an Environmental Monitoring System for Bitcoin Miners that will help them answer the question of whether or not they should and exit the bitcoin coal mining business.

1. **(3) Identify (a) two issues, (b) two governmental organizations, (c) two technologies, and (f) two internet sites external to the crypto industry that Bitcoin miners should be monitoring to enable it to make a decision if they should exit bitcoin mining (and when) if you think the signal justifies an exit. Segregate your answers and be as specific as possible in each category as to (1) what is to be monitored and (2) why (in terms along the threat-opportunity continuum):**
   a. **Economic, political and social issues that would bear on the decision**
   b. **Political/governmental organizations**
   c. **Technologies**
   d. **Internet sites**

   (no more than 20 words for each signal)

2. **(3) Choose the most significant environmental signal for Bitcoin Miners to monitor and characterize it along three dimensions:**

   -the "strength" or "magnitude" of the signal--the probability that the event it portends will in fact occur. Along this dimension, signals can be characterized as weak or strong, depending on their clarity and immediacy.

   -the "timing" of a signaled event--if it does occur, will it occur next month, next year, or five-ten years from now.

   -the potential "impact" of the signaled event on the organization--its significance for the firm in terms of the economic "threat" or "opportunity" it presents. (maximum 100 words)

3. (2) Should Bitcoin Miners exit bitcoin mining now? Explain your answer (maximum 80 words)

Here is a note from Module 7:

"Threats" are just that--signals which suggest possible actions and events in the organizational environment which could have a negative impact on the firm--potential new competitors or products, a social movement targeted on an aspect of firm operations, or legislation which could significantly increase the costs of doing business. "Opportunities" would be opportunities for new product introduction which could profit the firm, such as a demand for pollution control equipment in Malaysia with the passage of water quality legislation. Some signals can represent either threats or opportunities, e.g., legislation which could render obsolete and existing product line but point the way to a new substitute product for which your firm has a unique technology.

Appendix A

Bitcoin Mining

Bitcoin mining is the process by which new bitcoins are entered into circulation, but it is also a critical component of the maintenance and development of the blockchain ledger. It is performed using very sophisticated computers that solve extremely complex computational math problems.

Although early on in Bitcoin's history individuals may have been able to compete for blocks with a regular at-home computer, this is no longer the case. The reason for this is that the difficulty of mining Bitcoin changes over time.

In order to ensure the smooth functioning of the blockchain and its ability to process and verify transactions, the Bitcoin network aims to have one block produced every 10 minutes or so. However, if there are one million mining rigs competing to solve the hash problem, they'll likely reach a solution faster than a scenario in which 10 mining rigs are working on the same problem. For that reason, Bitcoin is designed to evaluate and adjust the difficulty of mining every 2,016 blocks, or roughly every two weeks.

When there is more computing power collectively working to mine for bitcoins, the difficulty level of mining increases in order to keep block production at a stable rate. Less computing power means the difficulty level decreases. To get a sense of just how much computing power is involved, when Bitcoin launched in 2009 the initial difficulty level was one. As of Nov. 2019, it is more than 13 trillion.

Mining Pools

Mining pools are groups of cooperating miners who agree to share block rewards in proportion to their contributed mining hash power. While mining pools are desirable to the average miner as they smooth out rewards and make them more predictable, they unfortunately concentrate power to the mining pool's owner.

Most mining pools are in China. Many only have Chinese websites and support. Mining centralization in China is one of Bitcoin’s biggest issues at the moment.

There are about 20 major mining pools. Broken down by the percent of hash power controlled by a pool, and the location of that pool’s company, Chinese pools control ~65% of the network hash rate. 3% are in the U.S. and 3% in the Czech Republic.

Hash

A **Hash** or also called **hash function** is any **algorithm** that maps data of arbitrary length to data of a fixed length.

To be considered effective a hash function has to have following properties:

- Computational efficiency - it shouldn't take a long time to compute a hash from a given input.
- Collision resistance - it should be hard to find to distinct inputs that would result in the same hash after the application of the hash function.
- Ability to hide information - it should be hard to derive anything useful about the input from the hash whether it be the whole input data or as simple info about it as whether it is an odd or an even number.
- Random-looking hash - the hash should look like it was a result of several random events, like flipping a coin. There shouldn't be an apparent particular transformation protocol.

Bitcoin Hash function

Bitcoin uses the SHA-256 hash **algorithm** to generate verifiably "random" numbers in a way that requires a predictable amount of CPU effort. Generating a **SHA-256** hash with a value less than the current target solves a block and wins you some coins.

Blockchain

- Blockchain is a specific type of database.
- It differs from a typical database in the way it stores information; blockchains store data in blocks that are then chained together.
- As new data comes in it is entered into a fresh block. Once the block is filled with data it is chained onto the previous block, which makes the data chained together in chronological order.
- Different types of information can be stored on a blockchain but the most common use so far has been as a ledger for transactions.
- In Bitcoin’s case, blockchain is used in a decentralized way so that no single person or group has control—rather, all users collectively retain control.
- Decentralized blockchains are immutable, which means that the data entered is irreversible. For Bitcoin, this means that transactions are permanently recorded and viewable to anyone.

Cryptocurrency Brokers

Cryptocurrency brokers provide speculative contracts on the price of digital currencies. You own the right to buy or sell the contracts as prices shift, not the digital currency.

Crypto Wallet

A cryptocurrency wallet is **an app that allows cryptocurrency users to store and retrieve their digital assets**. ... When a user acquires cryptocurrency, such as bitcoins, she can store it in a cryptocurrency wallet and from there use it to make transactions.

Appendix B. "proof of work" or "proof of stake"?

https://www.coinbase.com/tr/learn/crypto-basics/what-is-proof-of-work-or-proof-of-stake/..lk,/

"Proof of work" and "proof of stake" are the two major consensus mechanisms cryptocurrencies use to verify new transactions, add them to the blockchain, and create new tokens.

Proof of work, first pioneered by Bitcoin, uses "mining" to achieve those goals. Proof of stake — which is employed by Cardano, the ETH2 blockchain, and others — uses "staking" to achieve the same things.

Cryptocurrency networks need to make sure that nobody spends the same money twice without a central authority like Visa or PayPal in the middle. To accomplish this, networks use something called a "consensus mechanism," which is a system that allows all the computers in a crypto network to agree about which transactions are legitimate.

To understand proof of stake, it's helpful to first understand proof of work, so we've paired them in this explainer.

What is proof of work?

Proof of work is the original crypto consensus mechanism, first used by Bitcoin. Proof of work and "mining" are closely related ideas. The reason it's called "proof of work" is because the network requires a huge amount of processing power. Proof-of-work "blockchains" are secured and verified by virtual miners around the world racing to be the first to solve a math puzzle. The winner gets to update the blockchain with the latest verified transactions and is rewarded by the network with a predetermined amount of crypto.

Proof of work has some powerful advantages, especially for a relatively simple but hugely valuable cryptocurrency like Bitcoin. It's a proven, robust way of maintaining a secure decentralized blockchain. As the value of a cryptocurrency grows, more miners are incentivized to join the network, increasing its power and security. Because of the amount of processing power involved, it becomes impractical for any individual or group to meddle with a valuable cryptocurrency's blockchain.

On the flip side, it's an energy-intensive process that can have trouble scaling to accommodate the vast number of transactions smart-contract compatible blockchains like Ethereum can generate. And so alternatives have been developed, the most popular of which is called proof of stake.

What is proof of stake?

Ethereum's developers understood from the beginning that proof of work would present limitations in scalability that would eventually need to be overcome — and, indeed, as Ethereum-powered decentralized finance (or DeFi) protocols have surged in popularity, the blockchain has struggled to keep up, causing fees to spike.

While the Bitcoin blockchain mostly just has to process incoming and outgoing bitcoin transactions, much like a vast checkbook, Ethereum's blockchain also has to process a vast array of DeFi transactions, stablecoin smart contracts, NFT minting and sales, and whatever innovations developers come up with in the future.

Their solution has been to build an entirely new ETH2 blockchain — which began rolling out in December 2020 and should be finished in 2022. The upgraded version of Ethereum will employ a faster and less resource intensive consensus mechanism called "proof of stake." Cryptocurrencies including Cardano, Tezos, and Atmos all use proof-of-stake consensus mechanisms — with the goal being to maximize speed and efficiency while lowering fees.

In a proof of stake system, staking serves a similar function to proof of work's mining, in that it's the process by which a network participant gets selected to add the latest batch of transactions to the blockchain and earn some crypto in exchange.

The exact details vary by project, but in general proof of stake blockchains employ a network of "validators" who contribute — or "stake" — their own crypto in exchange for a chance of getting to validate new transaction, update the blockchain, and earn a reward.

- The network selects a winner based on the amount of crypto each validator has in the pool and the length of time they've had it there — literally rewarding the most invested participants.
- Once the winner has validated the latest block of transactions, other validators can attest that the block is accurate. When a threshold number of attestations have been made, the network updates the blockchain.
- All participating validators receive a reward in the native cryptocurrency, which is generally distributed by the network in proportion to each validator's stake.

Becoming a validator is a major responsibility and requires a fairly high level of technical knowledge. The minimum amount of crypto that validators are required to stake is often relatively high (for ETH2, for example, it's 32 ETH) and validators can lose some of their stake via a process called slashing if their node goes offline or if they validate a "bad" block of transactions.

But even if that sounds like too much responsibility, you can still participate in staking by joining a staking pool run by someone else — and earn rewards for crypto that would otherwise be sitting around. This process is often referred to as delegating, and tools offered by exchanges by Coinbase can make it simple and seamless.

What are some differences between proof of work and proof of stake?

Energy consumption is one major difference between the two consensus mechanisms. Because proof-of-stake blockchains don't require miners to spend electricity on duplicative processes (competing to solve the same puzzle), proof of stake allows networks to operate with substantially lower resource consumption.

Both consensus mechanisms have economic consequences that penalize network disruptions and thwart malicious actors. In proof of work, the penalty for miners submitting invalid information, or blocks, is the sunk cost of computing power, energy, and time. In proof of stake, the validators' staked crypto funds serve as an economic incentive to act in the network's best interests. In the case that a validator accepts a bad block, a portion of their staked funds will be "slashed" as a penalty. The amount that a validator can be slashed depends on the network.