

Ninth CryptoSuper 500 List
Total Bitcoin dominance of POW Mining EstablishedStephen Perrenod
November 2022

Note: This research report is an analysis of the technologies and trends surrounding proof of work cryptocurrencies. It is not, and must not be considered as, financial, investment, or legal advice. Disclosure: As of this date, author has long positions in MicroStrategy, Argo Blockchain, Marathon, and ETF vehicles GBTC and BITO that hold Bitcoin and its futures contracts.

How Bitcoin Mining (Minting) operates

"Money has become information. Bitcoin is energy securely encapsulated as information. Electrons to eternal bits" - @moneyordebt

Cryptocurrency mining is named in a somewhat unfortunate manner. It should really be known as cryptocurrency minting. Mining is extraction of minerals from the Earth.

Bitcoin, and other proof of work cryptocurrencies, are minted above ground (although sometimes in Mom's basement, on her electricity bill) by specialized supercomputing resources located around the globe. Many of these 'ASIC mining rigs' are collected in large server farms close to favorable, low cost, and increasingly renewable, electrical power sources.

The minting process has electrical energy input into millions of these computer systems around the world. They effectively encapsulate that energy into digital currency, or digital property, as a secure and scarce asset. The value of the currency is a product of the security and scarcity, and usually exceeds the cost of the electrical energy input and capital equipment depreciation cost. If cryptocurrency prices fall considerably, marginal miners idle their least efficient equipment. And they may move equipment to more favorable environments for lower electricity cost and for regulatory reasons.

All of the millions of computers running the Bitcoin software and Nakamoto consensus protocol are engaged in a lottery, for each 10 minute block, that is, each computer races with all others to be the first to solve a cryptographic hashing problem and win the block reward. This is known as proof of work, and in particular reusable proof of work, RPOW, since the tokens created are highly reusable. It was Hal Finney's RPOW breakthrough that made Bitcoin possible.

The difficulty of this problem is regularly adjusted in order to keep actual block times near the nominal 10 minutes in the case of Bitcoin, since hash rates generally rise due to faster hardware and more participants. Sometimes, hash rates fall for reasons including mining (minting) bans, such as China's ban in June 2021, and when Bitcoin and other cryptocurrency prices drop significantly. Miners may shut down rigs with less favorable hash rates per kWh consumed.

OrionX Constellation™ reports cover 6 Es: big trends (Envision), industry milestones (Events), historical view of a technology segment (Evolution), main vendors in a market segment (Environment), customer decision criteria (Evaluation), and how vendors in a segment score (Excellence) based on the OrionX methodology, which considers market presence and trends, customer needs and readiness, and product capabilities and roadmap.

Different coins use different hashing algorithms; in Bitcoin's case it is an SHA-2 based hashing algorithm. ASICs are especially designed for particular protocols used by given sets of cryptocurrencies.

An individual ASIC mining rig is evaluated on its power utilization and the number of hashes it can generate each second. The most competitive minting or mining farms have the cheapest energy and the fastest and most energy-efficient computers. Often, renewable electricity sources are the lowest cost. Bitcoin minters (miners) tend to migrate to the efficient energy frontier.

In the remainder of this paper, we will use the usual terminology of referring to *mining* of cryptocurrency and Bitcoin, rather than *minting*.



*Electrical energy is processed by specialized computers, in a global cryptographic hash lottery, to mint Bitcoin.
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Publicly traded Bitcoin mining companies

Our CryptoSuper 500 reports have tracked mining pools since the beginning of this series four years ago. Pools and mining companies are distinct business categories. Pools are aggregations of mining from many unknown sources, and the hash rate within a pool could be from farms owned by the pool itself, it could be from other mining farms, it could be originating from a large number of small-scale individual miners. We do not know, and they do not disclose such information. Many pools were started first in China. Most are not public companies.

Pools exist because the chance of any single machine winning a block reward is less than one in a million. Thus, the majority of miners prefer to redirect their hash rate toward pools, who collect rewards and redistribute proportional shares, after retaining a fee of around 1 to 3 percent for the service. In this way, a miner can collect a relatively steady income, just because they have hash rate. There are many sharing algorithms in place, but essentially the share is in proportion to the hash rate contributed to the pool, as a percentage of the total pool hash rate. Think of pools as brokers or agents, such as the agents who you can take your winning lottery tickets to for collection.

Our tracking of pools provides a macro view of Bitcoin mining; it has been all that is available to us until public Bitcoin mining companies began to rapidly expand in the past year or so. So as of the last report, we also track the largest public mining companies. These companies may also redirect all or some of their hash rate to pools for operational efficiency.

The shift of mining to North America has corresponded with the rise of such publicly traded venture funded crypto mining companies. These are primarily headquartered in the Anglo-American countries of Australia, Canada, the UK and the the US. Below is a table listing a number of public crypto mining companies with market caps above \$150 million.

Many of these companies are losing money as they are investing in rapidly scaling up their hash rate to secure their position in a very competitive business. Many also hold much or most of their mined Bitcoin as reserves in their treasuries, anticipating higher future prices. If they fully implement their stated growth plans, they will have a collective 90+ Exahashes/sec (EH/s), which is over a third of the current global Bitcoin hash rate. As a rule of thumb, 1 EH/s produces about 3.5 Bitcoin per day currently.

Northern Data AG is a large cloud infrastructure provider that also engages in crypto mining. We expect to see more cloud and utility and energy companies enter the mining business as a useful adjunct to their core businesses. It is one way to monetize their excess capacity. Bitcoin miners frequently enter into load shedding agreements with electrical utilities in exchange for lower rates.

We reported on the hash rate capabilities and electrical consumption rates of some popular mining rigs in the [Eighth CryptoSuper 500 list](#). High end systems generate roughly 100 Terahashes/sec and consume about 3 kiloWatts of power. Liquid immersed systems are becoming more popular to juice performance. Thus, to put together a 1 Exahash/sec Bitcoin farm requires of order 10,000 ASIC-based mining rigs and 30 Megawatts of power. It would take around 2.5 million such machines to generate the current global level of hash rate.

With the “crypto winter” in prices throughout 2022 mining companies are under pressure and many have raised new debt or equity capital. Others have sold down Bitcoin treasury reserves. Core Scientific sold 7200 Bitcoin in June and their stock plunged 80% in a single day on October 27th, on bankruptcy rumors. They have the largest hash rate of a publicly traded mining company. Argo Blockchain had a capital raise fall through recently.

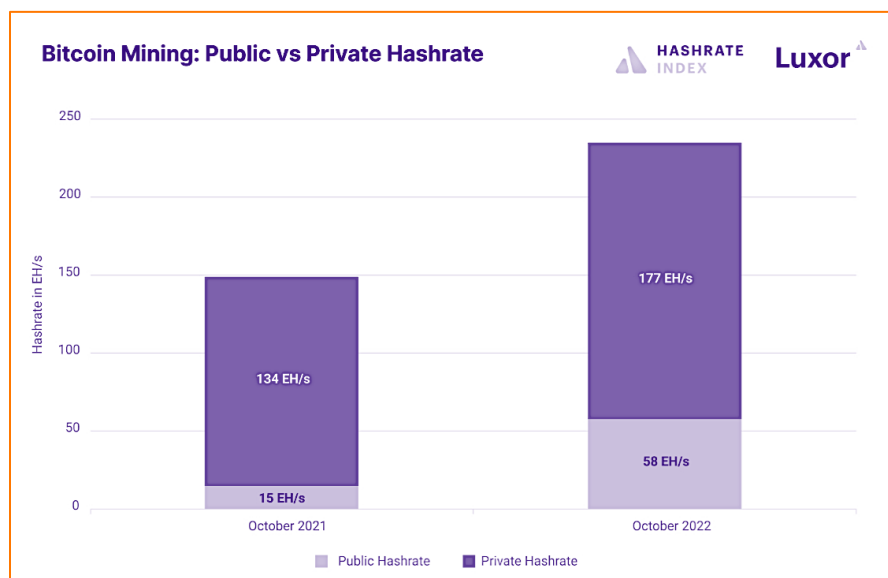


Figure 1. Growth of hash rate from publicly traded mining companies has been rapid over the past 12 months, nearly quadrupling. Their share of hash rate has climbed from 10% to 25% since October 2021. This is a direct consequence of the mining ban in China in June 2021 and the movement of the largest percentage of hash rate to North America.

Company	Market Cap \$Million	Earnings 2021, \$M	Stock Price \$	Hash Rate plans in Exahashes/sec	Bitcoin Held	Daily Bitcoin mined
Argo Blockchain	41	31	0.86	215 MWatts (up to 7?)	1,295	8
Bitfarms	185	22	0.90	4.2 now	5,243	16
Cipher Mining	235	-80	0.95	1.3 now, 6.9 early 2023	N/a	4
Clean Spark	141	-22	2.99	2.9	N/a	12
Core Scientific	60	47	0.16	13 now, 17 by year end	1,959	41
Hive Blockchain	244	80 (FY end March 2022)	2.95	4.5 now	3,091	9
Hut8 Mining	408	-73	2.1	3.07 now	8,388	10
Iris Energy Ltd.	158	-420 (FY 2022)	3	3.7 planning for 6	1,398	11
Marathon Digital	1275	-36	11.01	5.7 now, 23 by mid 2023	10,670	12
Northern Data AG	164	287	7.05	8.3 by year end	N/a	10
Riot Blockchain	990	-8	5.83	5.6 now, 13.5 by mid 2023	6,775	12
Stronghold	21	-11	0.93	1.5	N/a	5
Total	3922			Up to 93 by mid 2023	38,819	150

Table 1. Top 12 publicly traded Bitcoin mining companies as of late October, 2022. They may have as much as 25 to 30% of the total global hash rate by mid next year. They already mint about 1/6 of the total of 900 Bitcoin rewarded per day, and collectively hold over \$750 million in Bitcoin. Northern Data is a large cloud provider and Stronghold generates its own electricity.

Bitcoin Mining Council

The Bitcoin Mining Council provided their Q3 update and briefing in mid-October. Collectively their member miners represent very nearly half of the global Bitcoin hash rate.

In the presentation, Michael Saylor of MicroStrategy noted that Bitcoin is specialized supercomputing, bigger than Big Tech at what Bitcoin mining does: AWS, Google, and Azure collectively only have sufficient compute power for 1% of hash rate, because Bitcoin uses 2000 x more efficient ASIC-based SHA-2 hashing. Even their AI/HPC GPU-heavy resources are not well optimized for Bitcoin mining. If you took all the electrical energy consumed in the world with AWS-like standard cloud hardware, you still could not successfully attack Bitcoin.

Saylor calls Bitcoin the best technology to store “hundreds of trillions of dollars of value for hundreds of years”. In the past gold was the pristine reserve asset for individuals, banks and central banks. Since 1971 the world has been completely on a fiat standard, and gold has been sidelined.

Bitcoin is the 21st century alternative to gold as a pristine asset for individuals, companies, governments, and banks. Governments hold gold for historical reasons as a monetary reserve. We are in a debt-based fiat world for over a half century. And the world is awash in ever-increasing debt. Fiat is issued as debt; new fiat money enters the economy as checking account deposits when loans are made. Debt is always rising except in financial crises, and then central banks and governments step in with liquidity provision.

Bitcoin is superior to gold in both the dimensions of space and time. It is much, much easier, and cheaper, to move Bitcoin around, including across national borders. It can be moved across the globe within an hour, including 6 confirmations for high security, and a million dollars' worth can be moved for the cost of a few dollars in transaction fees. With the Lightning network, a second layer for Bitcoin, transactions can be even faster and cheaper than on the main chain.

Relative to gold, Bitcoin has held and increased value over the past decade plus. One could argue that gold has stood the test of time for thousands of years, but during the past dozen years of price discovery, Bitcoin has moved from nothing to \$400 billion in value, probably at the expense of gold's monetary premium.

According to the Bitcoin Mining Council presentation, Bitcoin has 99%+ of all cryptocurrency hash rate and thus security. It also has a hard monetary policy with ever-decreasing inflation of supply. They assert there is no second best crypto when it comes to institutional grade cryptocurrency investment.

The BMC has 51 members accounting for nearly half of all hash rate, and 2/3 of their electricity supply comes from renewables. According to their surveys of members and estimates for the industry as a whole, only 1/6 of 1% of global energy input and only 1/10 of 1% of CO2 emission is attributable to Bitcoin electricity supply.

Their reports updated the Ethereum situation post-Merge. ETH was using 23 TeraWh/year but limited hash rate has gone into the direct alternatives of ETC and ETHW, both proof of work versions of Ethereum.

Speculation is that these large GPU-based farms have in some cases been redirected as graphics rendering farms, or for AI computation. A large amount, perhaps as much as 75%, was turned off, so those GPU servers may be sold into the used system market.

The BMC briefing covered the potential for load balancing against peak loads generated from renewables in places like Quebec with hydropower and West Texas with wind energy. Bitcoin miners can contractually agree to halt mining when utilities have too much demand for electricity.

What is the projection for energy use for Bitcoin down the road? Subsequent Halvings will decrease the incentive to mine, but higher prices increase incentive. The Halvings are designed to cut the block reward and supply inflation in half every four years. Presently it is 6.25 Bitcoin per block, but in a year and a half the next Halving will cut it to 3.125 Bitcoin. The Halvings are shocks to flow of supply that push out the least efficient mining hardware and cause miners to seek other efficiencies in their power budget. They also tend to shock price upward, which is favorable for the miners that hang on during crypto winters.

Since the mining rig ASIC-based equipment is always becoming more efficient, miners have to run faster just to keep up with their competitors.

I note that the global rise in hash rate once grew extremely rapidly, faster than the tenth power of the age of the blockchain (that began in January 2009), but the relationship has flattened to the fourth power in the past three years. That is still much faster than Moore's Law. Fortunately for miners, the price of Bitcoin has been rising faster than the fifth power of time in the long term.

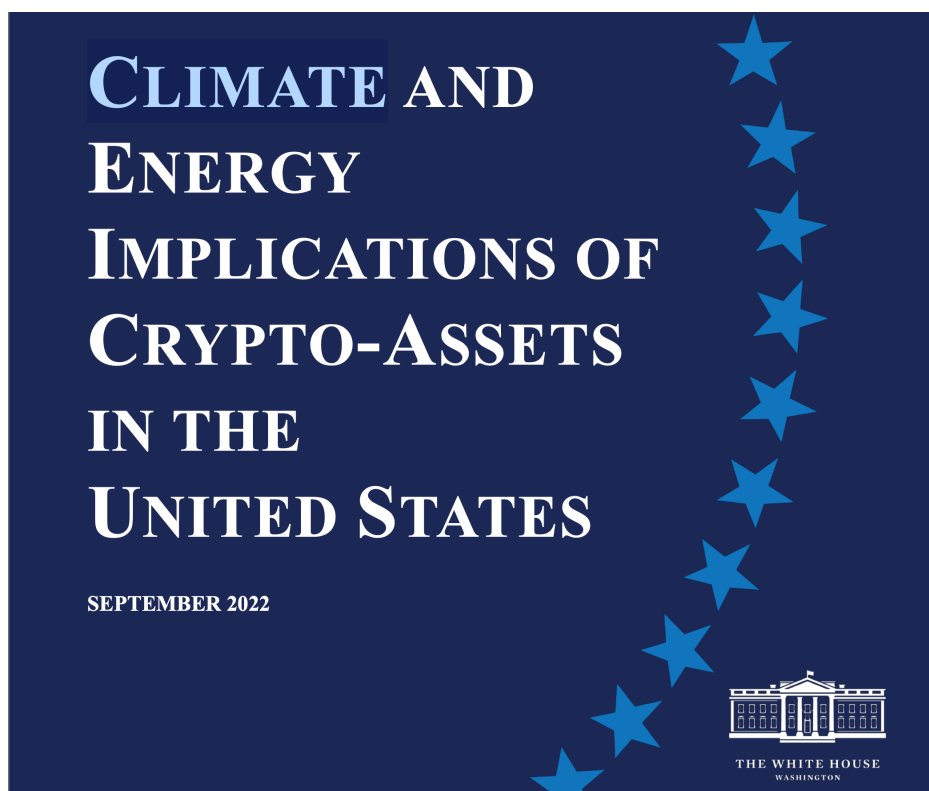


Figure 2. Cover of the White House report, *Climate and Energy Implications of Crypto-assets in the United States*, September 2022

White House report

In September the White House issued a report titled Climate and Energy Implications of Crypto-Assets. It takes a more sanguine view of the Bitcoin mining industry, expressing concern about emissions of the industry.

This is not surprising since Bitcoin mining in the US has grown by leaps and bounds since mid-2021 due to the China ban and good old American entrepreneurship.

The report states “The United States is estimated to host about a third of global crypto-asset operations, which currently consume about 0.9% to 1.7% of total U.S. electricity usage.” And the report says the industry is responsible 0.4% to 0.8% of US CO2 emissions.

These are higher numbers than the Bitcoin Mining Council primarily because the White House report is US-focused rather than on the global use of energy, and the US has such a high share of the Bitcoin mining industry at present.

“To help the United States meet its climate objectives of a 50% to 52% reduction in GHG emissions by 2030, a carbon pollution-free electricity system by 2035, and a net-zero emissions economy no later than 2050, crypto-asset policy during the transition to clean energy should be focused on several objectives: reduce GHG emissions, avoid operations that will increase the cost of electricity to consumers, avoid operations that reduce the reliability of electric grids, and avoid negative impacts to equity, communities, and the local environment.”

The report does note that Bitcoin mining can mitigate methane emissions, by using natural gas to operate at the well vicinity. Vented methane from natural gas wells is much more damaging than CO2 (80 times worse per ton in the first two decades after release). That is effectively a negative carbon strategy, since it replaces methane emission with much less dangerous CO2.

No ban on mining is even suggested by the report and the SEC, CFTC, IRS and other agencies will continue to regulate the financial aspects of cryptocurrency. Bitcoin is seen as a digital asset by the SEC and IRS and treated as a commodity by the CFTC, not as a securities offering.

The real dangers in the space have been from overleveraged, excessive risk-taking, and under-regulated crypto exchanges, and coins issued as proof of stake, ever since the Mt. Gox fraud in 2014. And now this year with two major blowups: this summer with an algorithmic stablecoin and just recently in the second week of November with the FTX exchange and its utility coin. Within shorter time frames these blowups can hurt the price of Bitcoin, Dogecoin and other POW mined coins, but they are intrinsically unleveraged assets. It has proven safer to self-custody your Bitcoin holdings.

Top 6 Mined coins

The top 6 reusable proof-of-work (RPOW) coins minted or mined are, in order of annual economic value current run rate: Bitcoin, Dogecoin, Ethereum Classic, Bitcoin Cash, Litecoin, and Monero. Ethereum Classic is the original Ethereum prior to the DAO fork and did not participate in the Ethereum 2.0 roadmap and Merge process into proof of stake; it remains as a POW coin, that can be minted using GPUs.

Note that the hash rates for these coins are mostly down in the Terahash domain, or even lower. A Terahash is only one-millionth of an Exahash, but comparisons are somewhat arbitrary since the consensus algorithms vary between coins. Comparisons with two coins using the same hashing algorithm are precise. Only Bitcoin and its 2017 fork Bitcoin Cash have Exahash levels of security on their blockchains, and Bitcoin is more than two full orders of magnitude more secure than Bitcoin Cash.

Coin	Symbol	Algorithm	Market Cap (B\$)	Price (USD)	Total hash rate	Daily value \$M	Annual production \$B (nominal)
 Bitcoin	BTC	SHA-256	333.8	17365	272 EH/s	15.82	5.78
 Dogecoin	DOGE	Scrypt	11.62	0.089	483 TH/s	1.21	0.44
 Ethereum Classic	ETC	Etchash	3.01	21.84	151 TH/s	0.322	0.117
 Bitcoin Cash	BCH	SHA-256	2.00	103.7	1.70 EH/s	0.094	0.034
 Litecoin	LTC	Scrypt	4.37	61.11	568 TH/s	0.110	0.040
 Monero	XMR	RandomX	2.32	127.5	2.70 GH/s	0.055	0.020

Table 2. The Top 6 coins by annual production value. We also list the algorithm, market cap and price and aggregate hash rate, as of November 11, 2022. Only Bitcoin and Bitcoin Cash are in the Exahash domain for hash rate enforced security. Only Bitcoin, Dogecoin, and Ethereum Classic produce over \$100 million per year. Only Bitcoin and Dogecoin pools make our cutoff of \$50 million minimum per pool. The annual production here is based on nominal block times, not actual average block times; that results in somewhat over \$6 billion for Bitcoin in practice.

Top Mining Pools list

As mentioned, it is important to note the distinction between mining farms or mining companies and mining pools. Think of mining pools as brokers or exchanges for hash rate. A mining company may point its hash rate toward an existing pool rather than create their own.

Pools allow anyone to share rewards amongst the pool members. It's like the lottery pool at work where everyone puts in their tickets and the winning ticket shares equally with the pool in proportion to the ticket count. Pools may have their own in-house mining farms, but there is little transparency on where their hash rate comes from, other than broad categorization of IP addresses by country.

We have a radical change in this list from the most recent June, 2022 Eighth CryptoSuper list, that had \$9 billion of Bitcoin value generated from the top 20 pools and \$8 billion of Ethereum value minted from that same set of pools.

In this list, Ethereum is gone, and Dogecoin is now the #2 coin, with a contribution of a few percent that of Bitcoin. Some \$6 billion of Bitcoin value is created on an annual run rate by the top 11 Bitcoin pools, and all Dogecoin generation amounts to less than half a billion dollars. For now, the CryptoSuper market has shrunk by nearly a factor of three in economic value since the last report in June. The crypto market has been in depressed

conditions in the current macroeconomic environment, aggravated by irresponsible behavior of some exchanges and non-POW coin issuers.

A given pool operator may have a Bitcoin pool, a Doge pool, or other cryptocurrency pools. For this list, 16 pools of \$50 million or more annual run rate are included, across 12 pool operators.

Pool	Country	Bitcoin (\$M)	Dogecoin (\$M)	Total \$M
Foundry USA	US	1,556	0	1,556
AntPool	Global	1,070	72	1,142
F2Pool	Global	979	50	1,029
Binance pool	US	713	0	713
ViaBTC	Germany	559	136	695
Poolin	US	408	0	408
Braiins Pool	Global	310	0	310
Luxor	US	224	0	224
Btcdotcom	Global	166	0	166
Unknown	Global	128	0	128
SBI crypto	Japan	84	0	84
Litecoinpool	Global	0	70	70
Top 12 operators		6,197	328	6,525
All Mining		6,238	440	6,678

Table 3. Top mining pools by value, using Bitcoin and Dogecoin prices as of 11/11/22. Transaction fees add 1.3% (last 30 days' average) on top of the block subsidy reward for Bitcoin of 6.25 BTC per block. We only include pools with at least \$50 million revenue for either Bitcoin or Dogecoin. We have seen substantial consolidation, as a result of Ethereum dropping out of the race, and the industry maturation process. Note that these 16 pools (12 operators) account for 98% of the value of Bitcoin and Dogecoin minted (mined). Only three are above \$1 billion production. The numbers for Bitcoin are a bit higher than in Table 2 because blocks have been running almost half a minute faster on average than the nominal 10 minutes, during the past 3 months.

Trends

Let us briefly compare the first CryptoSuper 500 list, with the fifth list, and with the ninth list. These are spaced two years apart, or four years between the first one and the latest list.

In the first list, in November of 2018, about 50 Exahashes/sec of Bitcoin security and competitive lottery power was generated by the Bitcoin global supercomputer industry. The top 5 Bitcoin pools were all in China. Bitcoin, Ethereum, Bitcoin Cash, Litecoin, and Monero coins were all represented in the list. The top 17 Bitcoin pools produced a little over \$4 billion annually of Bitcoin.

In the fifth list, in November of 2020, the power level was about 113 Exahashes/sec of Bitcoin competitive hashing and security enforcement. Bitcoin, Ethereum, Litecoin, Zcash, Bitcoin Cash, and BSV coin minting pools made the list. The top 18 Bitcoin pools produced over \$4.6 billion annually. Four of the top six pools were in China.

In this list, we have \$6.7 billion of economic value on an annualized basis, almost all of which is Bitcoin and from the top 11 Bitcoin pool operators. Bitcoin's aggregate hash rate is at new highs of 260 Exahashes/sec. Four of the top ten pools are in the US, one is in Germany, and one in Japan while two have emigrated from China in the past year to be "global".

We now also have about 1/6 of the Bitcoin minting, around \$1.1 billion, coming from publicly listed companies. This is not additional revenue but is part of the total pool value generated. These public miners may use pools in the table above, or have their own smaller pools, they do not disclose this information.

The global hash rate has increased by a factor of 5.2 in four years, for a compound annual growth rate (CAGR) of 51%. Bitcoin's value is up more modestly, with a CAGR around 15%, but the price remains highly volatile.

Summary

All but 1% of the Bitcoin block reward miners receive is for creating (minting!) new economic value. They produce a highly reusable, high security, quasi-eternal asset. Saylor and others call it digital property. It is suitable for transmission globally with low friction. Only 1% of the block reward is for transaction costs. ESG critics routinely make the error of evaluating Bitcoin based on the number and value of transactions, but most of the *raison d'être* and energy input for mining is to create new high value digital property.

And that property has been generally rising in value over time, thus it is an economically valid production process. The electricity used goes toward production of long-term value, not immediate consumption.

This is a specialized form of supercomputing that employs several million ASIC mining 'rigs' with many different owners yet working around the globe in a synchronized competitive race, repeated every block. They execute the same software and encode value and transactions onto a shared but decentralized and publicly auditable blockchain.

As of this report the economic value generated in Bitcoin has dropped to \$6.2 billion from \$9 billion since OrionX's prior report in June of this year. Ethereum mining was generating \$9 billion in value at that time, but that has collapsed to zero as of mid-September with the Merge and full conversion to proof of stake. Proof of stake is analogous to holding equity shares, and issuing new shares does not add value, it dilutes existing stake holders.

Dogecoin is the new #2, but is much smaller in generated annual economic value than Bitcoin due to much lower security and a more permissive money supply algorithm.

Proof of real work and true scarcity are proof of real long-term value for a given cryptocurrency. Bitcoin has for now and the immediate future achieved complete dominance in the proof of work cryptocurrency space.

Trends to watch going forward include faster and more energy-efficient mining hardware including some rigs that have liquid cooling, the continued dominance of the North American mining industry now with public companies as major players, and the trend of increasingly green electricity and even carbon neutrality goals for the industry. We expect some consolidation in the publicly traded crypto miners, unless prices rise quickly from here. And what will be the #2 mined PoW coin on our list a year from now, Dogecoin or Ethereum Classic or Bitcoin Cash or some other coin is an open question, given the dynamics and volatility of the reusable proof of work cryptocurrency industry.

Appendix: largest Bitcoin, Dogecoin pools

Top Bitcoin Mining Pools

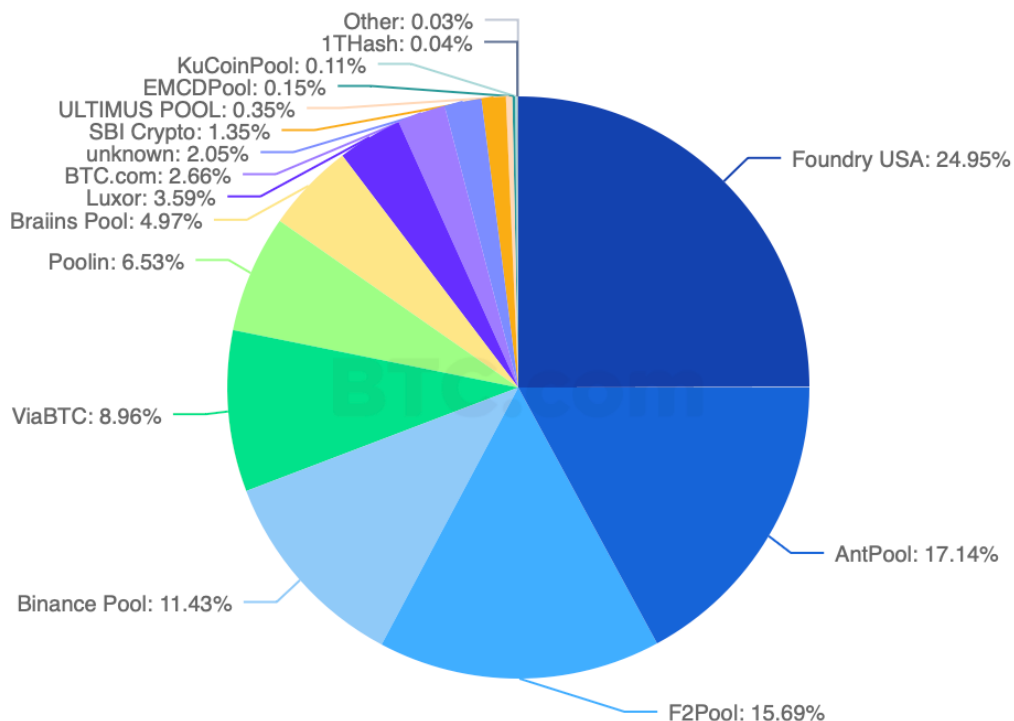


Figure 3. Distribution of block win rate for top Bitcoin mining pools in the three months prior to 10/25/22. Foundry USA has grown to a full 1/4 of all won blocks up from 19.5% in our last report. The top 3 pools are the same as the prior list and have over 50% of the hash rate and block win rate. The top 6 pools are responsible for about 85% of the blocks minted. Chart from explorer.btc.com. Think of pools as exchanges or brokers, individuals and commercial operations can readily point their hash rate toward a different pool with low switching costs.

Top Dogecoin Mining Pools

Last 999 blocks

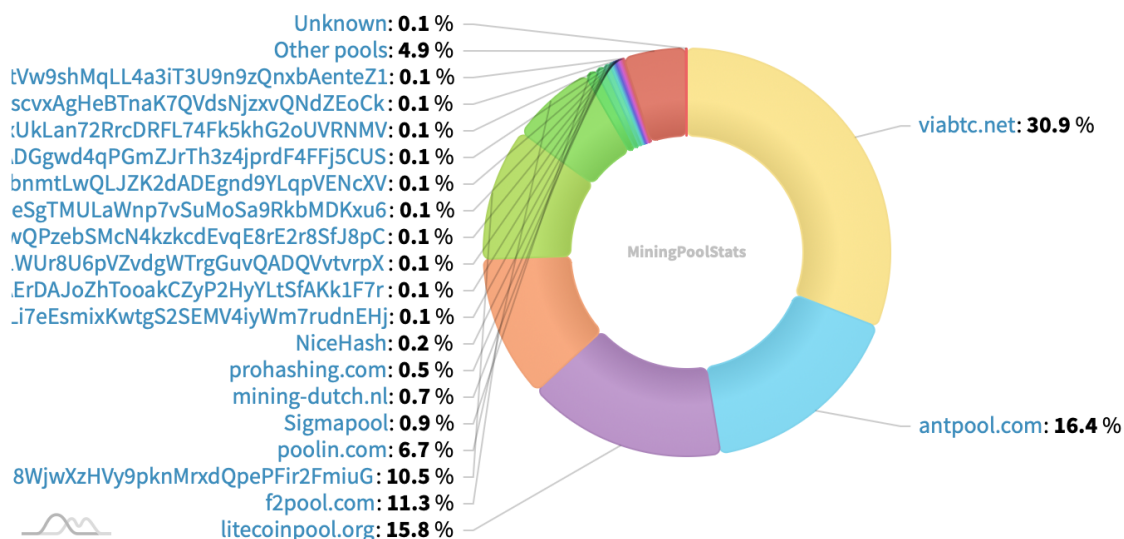


Figure 4. Distribution of block win rate for top Doge mining pools in the 999 blocks prior to 10/25/22. Three pools are responsible for well over half of the Doge coins minted, and 6 pools are responsible for 90%. Chart from <https://miningpoolstats.stream/dogecoin>

Glossary

Bitcoin – The original cryptocurrency, blockchain and consensus algorithm was outlined in October 2008 in the Satoshi white paper. The Bitcoin blockchain began in January 2009. Bitcoin uses proof of work and has a disinflationary monetary policy based on Halvings.

Blockchain – A chain of transaction blocks with each block linked to the one prior and the one after by a hashing technique. Each block incorporates a hashed representation of the prior block along with its own transaction records. A specific type of database with timestamped and linked record blocks.

Block reward – The reward for being the winning miner of a block. It consists of a subsidy and any transaction fees collected by miners.

Block years – A block year is one quarter of a four-year Halving era of 210,000 blocks; block years have 52,500 blocks. They are close to a calendar year in duration, within a week or two. Over 14 block years have elapsed since Bitcoin began.

BTC – Abbreviation for the bitcoin cryptocurrency.

Cryptocurrency – A currency stored in a digital ledger that implements cryptographic security to prevent theft or counterfeiting. Cryptocurrencies may be created with different mechanisms and the ledgers are often decentralized to varying degrees.

DeFi –Decentralized Finance. DeFi implements automated financial methods by use of cryptocurrencies and blockchains.

Dogecoin – A cryptocurrency created from Litecoin, itself a clone of Bitcoin, in 2013, as a joke. It has a mildly disinflationary monetary policy.

ETH – the native cryptocurrency of the Ethereum network.

Ethereum – The second largest cryptocurrency by market value was created in 2015 by Vitalik Buterin, Joe Lubin and others. It was designed to implement smart contracts such as those used in DeFi. It shifted fully to proof of stake in September 2022, eliminating proof of work mining.

Halvings – The algorithmically enforced decrease in the block reward subsidy for Bitcoin miners. Originally this was 50 BTC for the winning block. Halvings occur roughly four years apart after each 210,000 block interval. The last halving in May 2020 dropped the subsidy from 12.5 to 6.25 bitcoins per block, the next will be around May 2024.

Hash rate – The rate at which a computer system (mining rig) can generate hash guesses to solve the cryptographic puzzle. A Terahash/s is a trillion hashes per second, a Petahash/s is a quadrillion, and an Exahash/s is a quintillion (10^{18}) hashes per second.

Lightning – Lightning is a second layer solution for Bitcoin that allows for speedy payments including for very small amounts at very low cost. Lightning channels are opened between parties and this forms a network. Lightning payments are eventually resolved back onto the first level blockchain in batched transactions.

Merge, The – This refers to the merger of a new 'beacon chain' blockchain for Ethereum 2.0 with the original blockchain, that occurred on September 15, 2022. Ethereum 2.0 is based on proof of stake.

Miners – The computer systems that solve the cryptographic puzzle for a proof of work cryptocurrency. Miners are characterized by hash rate, the amount of solution power. Custom ASICs or GPUs are employed, typically. The first computer that solves the puzzle commits the block of transactions and receives the block reward. Miners are minters of cryptocurrency, through the combination of electricity, cryptographic hashing cycles, and a proof of work lottery reward system.

Money – A medium of exchange, store of value, and unit of account. Bitcoin represents monetary technology; it has not achieved full 'moneyness' but is on the path as utility grows. Ethereum removed proof of work and that makes it less 'money' and more of a payments and decentralized finance solution. Bitcoin is now legal tender as money in the countries of El Salvador and the Central African Republic.

Pools – Pools consist of mining farms plus smaller miners that choose to contribute their hash power in order to gain a proportionate share of the pool's mining rewards. Pools are run by companies for profit.

Proof of Stake – In proof of stake, rewards or dividends are paid, in proportional to their share, to existing holders of a coin or token, who have governance and block validator privileges. Holding such a token is conceptually similar to holding a share of a company. Long term value depends on scarcity and utility, but security is much lower than with proof of work.

Proof of Work – In proof of work, a cryptographic lottery must be won by miners competing with their hash power. The winning miner validates the transactions for a particular block and receives a block reward that includes a subsidy of new coins and transaction fees. Monetary policy is set by changing the block subsidy on a schedule, and a difficulty adjustment keeps block times around the nominal target. Proof of work and storage on a decentralized ledger with many copies solves the double spending (of the same coin) and counterfeiting problems.

Smart contract – An automated contract for exchange of value implementing agreed upon rules between the parties for transfers.

Time Chain – See blockchain. Blockchains are chains of time-stamped transactions, laid out as a permanent temporal record of those transactions.

Zipf's law – A relationship that says the rank order and value of some quantity (e.g. size of lakes) are inversely correlated to the first power. Cryptocurrency market cap value for the 21,000 plus coins and tokens falls off even faster than this.

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