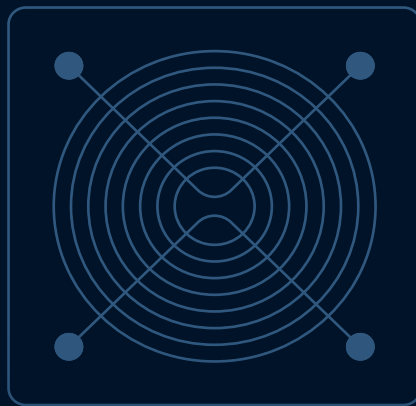
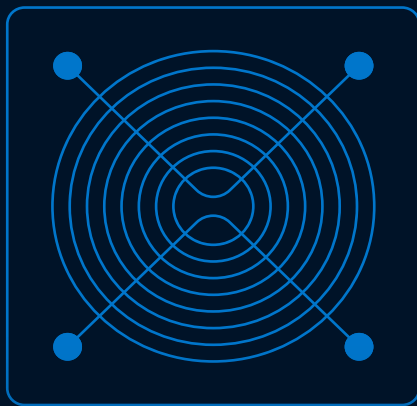
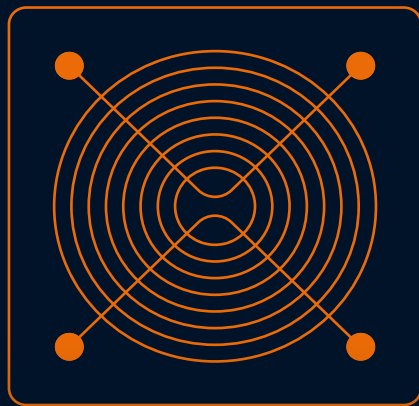


# The Current State of Bitcoin Mining

April 2024



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## 1.0 Introduction

Bitcoin is the fastest asset in history to go from \$0 to \$1 trillion. As Bitcoin has grown, so too has the only activity that brings Bitcoins into circulation, referred to as Bitcoin mining. Mining has become a very big industry itself, generating worldwide daily revenues of over \$10 million since 2018 and over \$40 million daily throughout Q1, 2024.

Mining is a crucial part of the operation of the Bitcoin Network. It is the only process by which Bitcoins come into existence. It has grown alongside the network – from a single computer operated by Bitcoin’s creator, Satoshi Nakamoto, in 2009 to millions of highly specialized, high-powered machines deployed all over the world today.

Mining doesn’t only issue the coins, it adds new batches of transactions to the ledger of Bitcoin, known as its blockchain, and it also secures those entries, making them irreversible.

It is thus the case that miners are paid in bitcoin by the Bitcoin network to maintain and secure the Bitcoin ledger.

This report provides an overview and explanation of key dynamics in the Bitcoin mining industry, along with some possible implications for the rest of 2024 and beyond. We explain the purpose, economics, and competitive forces of Bitcoin mining, focusing primarily on the entities that do the mining while touching upon the players they are directly involved with: ASIC manufacturers, energy producers, and mining pools.

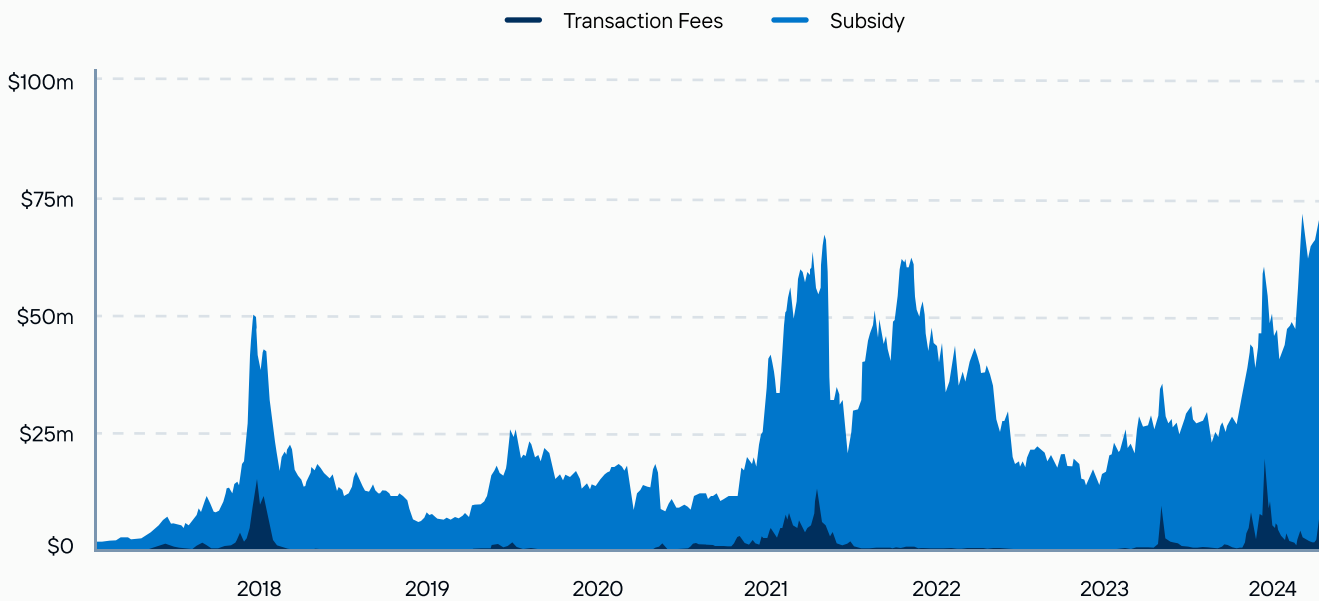
# 1.1 Bitcoin Mining Overview

Bitcoin mining is one of the least understood yet most important parts of the broader Bitcoin ecosystem. Miners play a critical role in processing transactions and securing the Bitcoin network by using electricity to power specialized machines that attempt to add valid blocks of transactions to Bitcoin’s immutable ledger.

The supply of Bitcoins, which will never exceed 21 million, is issued to miners for doing this work. This issuance reward, along with fees offered to miners by users seeking to have their transactions added to the ledger, is what compensates and motivates miners to incur the cost and effort to “mine” bitcoin.

As Bitcoin’s market capitalization has ballooned to more than \$1.4 trillion, the Bitcoin mining industry’s growth has followed suit. Daily revenues have recently shot up to over \$70 million and have been above \$10 million daily for nearly five years.

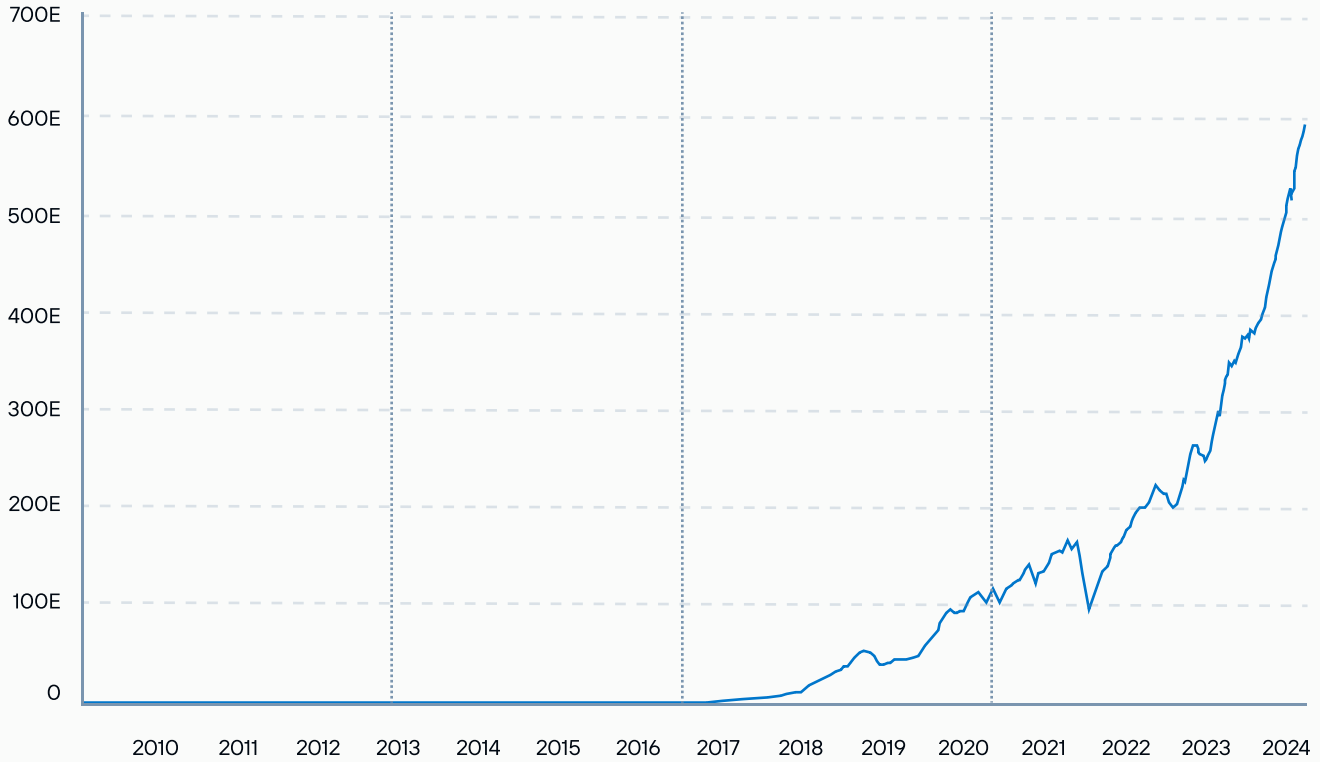
**Bitcoin Miner Revenue (Daily, 7DMA)**



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin  
 Data: The Block

Similar to Bitcoin’s price, its hashrate – the amount of computing power directed at mining Bitcoin – has exploded over the last 5 years. It is up +1,300% over that time.

### Bitcoin: Mean Hash Rate (30d Moving Average)



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin  
 Data: Glassnode

In 2009, mining was a relatively simple endeavor. Any individual could mine on their computer using the Bitcoin software. Fast forward to 2024, and mining has evolved into a multi-billion dollar industry consisting of individual at-home participants, private industrial-sized mining operations, and public mining companies valued at billions of dollars.

All of these entities run specialized computers called ASICs (application-specific integrated circuits), which are computers that can only do one thing – mine Bitcoin. All of these miners must power these machines with significant amounts of electricity to compete for earning the previously mentioned issuance and fee rewards that are issued roughly once every 10 minutes.

## 1.2 Understanding Bitcoin Mining

### 1.2.1 Bitcoin Mining Is a Unique Form of Competition

Bitcoin is a unique commodity in that a fixed amount of it is created regardless of how much work is done to produce it. No matter how many entities *mine* Bitcoin, or how much effort they put into the activity, *the quantity of Bitcoin produced will not change*. This contrasts with essentially every other industry that exists. If more people mine coal in more locations, more coal will be discovered. If more people farm wheat on more acreage, more wheat will be grown. But if more people mine Bitcoin in more facilities dedicated to Bitcoin mining, the amount of Bitcoin that exists will not increase!

This implies that the more Bitcoin one miner produces, the less another will. Imagine if starting a new coal mine meant that whatever amount of coal was mined from this new mine reduced the production of the rest of the world's mines by the exact same amount. Or, imagine if no matter how many acres of land were dedicated to wheat farming, the amount of wheat grown worldwide would remain the same. It seems impossible, and it is for those commodities, but this is how Bitcoin works.

So, Bitcoin is unlike other commodities whose supply increases and whose price generally decreases when more resources are dedicated to producing them. Devoting more resources to producing Bitcoin does not increase its supply and thus does not lower its price.

This is the world within which Bitcoin miners operate. They compete for a share of a fixed supply of Bitcoin. Whenever anyone operates more mining equipment anywhere in the world, the productivity of the rest of the world's equipment is reduced so that the total amount of Bitcoin produced over a given period of time remains unchanged.

As a result, while existing Bitcoin miners do not have to worry about a competitor flooding the market with newly added supply, they do have to face the harsh reality that a competitor's production of Bitcoin comes at the expense of Bitcoin they would have produced. These are the two dimensions – that increased competition cannot add to the global supply, but that competition instead reduces the output of existing producers – which differentiate Bitcoin mining from all other commodities in existence.

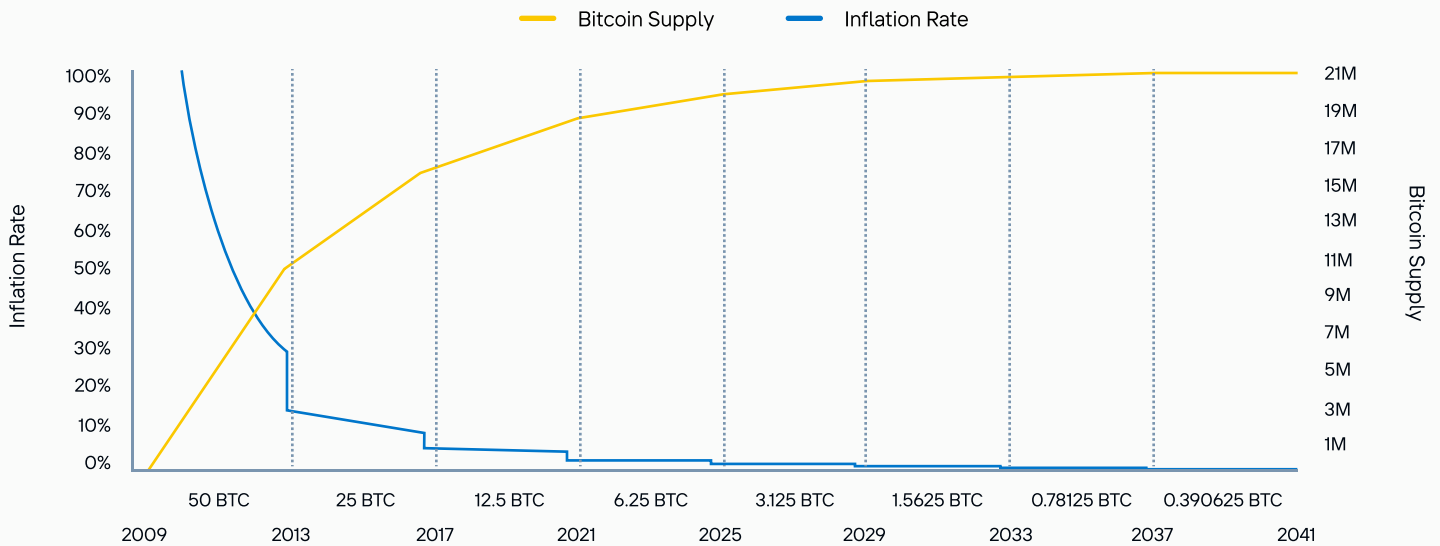
## 1.2.2 ...And Then There's the Halvings

As another thought experiment, imagine if, no matter how much land and other resources were dedicated to it, the amount of wheat grown all over the world got cut in half every four years.

This is the other unique feature of Bitcoin as a commodity. The amount of Bitcoin that is issued gets halved at regular intervals, commonly called "halvings." As the chart below shows, 10.5 million Bitcoin were created in the first Bitcoin epoch of 210,000 blocks. That amount, which gets halved with each subsequent epoch, converges to a grand total of 21 million Bitcoin ever existing in total.

Halving	Date	Block	Block Reward	Mined in Period	% Mined
BTC Launch	3 Jan 2009	0	50	10,500,000	50
Halving 1	28 Nov 2012	210,000	25	5,250,000	75
Halving 2	9 Jul 2016	420,000	12.5	2,625,000	87.5
Halving 3	11 May 2020	630,000	6.25	1,312,500	93.75
Halving 4	Expected 2024	840,000	3.125	656,250	96.875
Halving 5	Expected 2028	1,050,000	1.5625	328,125	99.4375
Halving 6	Expected 2032	1,260,000	0.78125	164,062.5	99.21875

**Bitcoin Issuance Schedule**



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin  
 Data: Nakamoto Institute

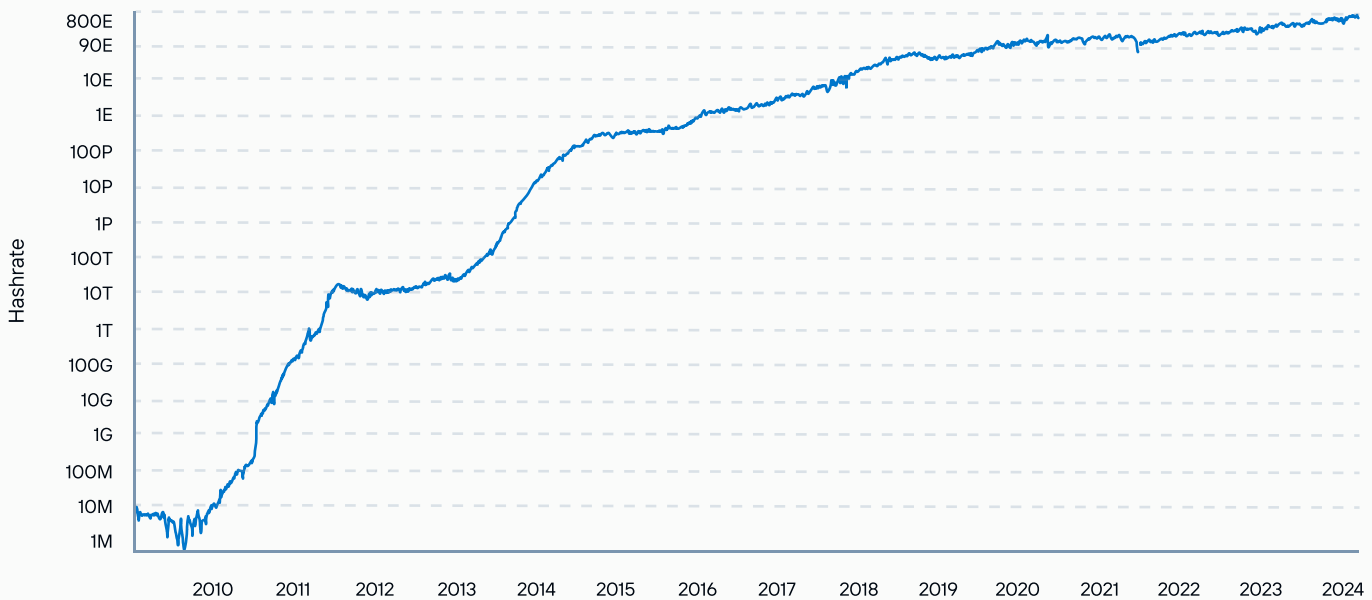
These pre-programmed halvings are just another factor that Bitcoin miners must contend with. Roughly every four years, they must navigate a 50% reduction in their primary revenue stream.

### 1.2.3 ... But Still They Mine

Despite the fact that more resources dedicated to mining do not increase the number of Bitcoin that get issued, and that earnings denominated in Bitcoin get cut in half periodically the resources applied to this activity have continued to grow – likely faster than any other computational endeavor in history.

The chart below shows this exponential growth, growing from 10 million hashes per second to its current approach towards one 1 sextillion hashes per second – a one hundred-trillion-fold increase!

Bitcoin Hashrate (log chart)



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin  
 Data: Bitinfo Charts



## 2.0 The Economics of Mining Bitcoin

Notwithstanding the uniqueness of Bitcoin mining discussed above, the economics of Bitcoin mining is actually relatively simple to understand.

### 2.1 Revenues: Three Sources of Income

Bitcoin miners have three primary sources of revenue. The first two are embedded in the Bitcoin protocol.

#### 2.1.1 Block Subsidy / Bitcoin Issuance

The first, and historically most significant source of revenue for Bitcoin miners, is the receipt of the newly issued Bitcoin that come to constitute all the Bitcoin in circulation. There will only ever be 21 million Bitcoin, and that entire amount will have come into circulation as rewards to Bitcoin miners.

The block issuance is a fixed amount, subject to the halving events explained above. With 6.25 Bitcoin issued per block at the time of writing, and a Bitcoin price of about \$70,000 per coin, miners (as a whole, worldwide industry) are earning about \$437,500 roughly once every ten minutes which works out to \$63 million in daily block rewards.

This subsidy halves at Bitcoin's 840,000th block to 3.125 Bitcoin issued per block. If Bitcoin's price remains at \$70,000, the reward, denominated in dollars, would drop to \$218,500 every ten minutes.

But, of course, the Bitcoin price does not stay the same for long. During this epoch of 6.25 Bitcoin per block, which began on May 20th, 2020, the price of Bitcoin has in fact been as low as \$9,200 and as high as \$73,000.

#### 2.1.2 Bitcoin Transaction Fees

Bitcoin blocks are limited in how much information can be stored in them. As a result, only a limited quantity of transactions can fit inside each of these blocks. And, as mentioned earlier, these blocks only come around, on average, once every ten minutes. When demand for space in these blocks exceeds the supply, users of the Bitcoin network pay miners to include their transactions, especially if they need their transactions confirmed sooner rather than later.

Because transactions are measured in the amount of data they consume, the fees are priced in bytes of data. As they are paid for using Bitcoin as currency, they get priced in “satoshis per byte.” (Satoshis are the smallest units of Bitcoin, representing 1/100,000,000 of a Bitcoin).

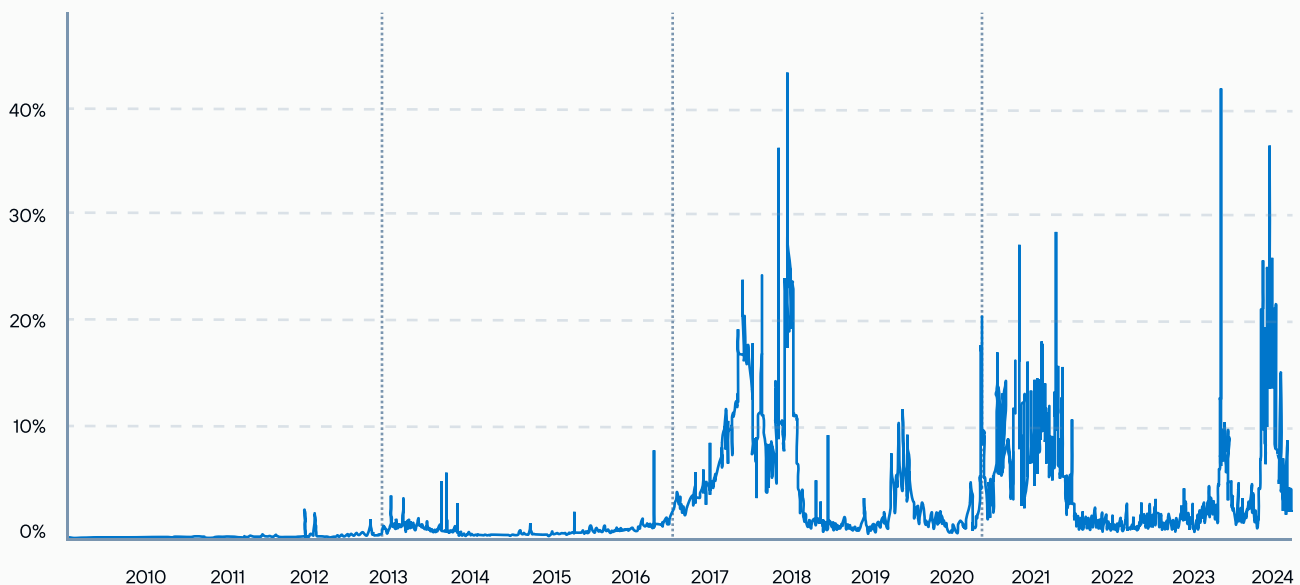
Miners generally assemble and mine the most valuable block they can that adheres to Bitcoin’s rules. Thus, a transaction paying 11 satoshis per byte will edge out a transaction paying only 10 satoshis per byte if a block is otherwise filled with transactions that are all 10 satoshis per byte or more.

As Bitcoin’s usage grows, the transaction fees will likely rise. Eventually, after many more halvings, Bitcoin’s subsidy reward will become negligible (and even zero after the year 2140), and fees will make up all of the protocol-based revenues of miners.

Today, however, fees are a smaller portion of miner revenues than block subsidies. Fees vary depending on the demand for block space. While there have been rare occasions where transaction fees briefly exceeded the subsidy rewards, for the most part, aggregate fees per block have ranged between 0.2 and 0.6 Bitcoin per block, significantly less than the subsidy reward.

The chart below highlights the percent of miner revenue derived from transaction fees.

**Percentage of Miner Revenue from Fees**



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin  
Data: Glassnode

This highlights how for most of Bitcoin's history, fees were often a negligible portion of miner revenues, as blocks were often not full, and transactions offering only the minimum fee settled quickly. However, one can observe how transaction fees tend to increase as usage grows, typically in bull markets. In addition, 2023 saw the emergence of some use cases in which Bitcoin transactions are being used to store data other than pure transactions in the blocks, which caused fees to rise to levels not seen since 2017. These fees for inclusion of transactions in the blockchain are expected to continue to rise as Bitcoin adoption continues to gain traction.

### 2.1.3 Other Sources of Revenue

More recently, miners have discovered that there are other possible sources of revenue than the two built into the protocol. For example, as consumers of large quantities of electricity some miners have found that they can strike agreements with energy producers to curtail their consumption when demanded and receive payment directly from the energy producers for providing such flexibility.

This source of revenue is nascent and hard to measure today, whereas the block subsidy and fees are a matter of public record since they are recorded on the blockchain, which is visible to everyone in the world.

*Summary: Revenues = Share of Hashrate x (Block Rewards plus Fees)*

Ultimately, because of Bitcoin's unique characteristics, a miner's revenues over some period of time is largely equal to their share of the computations competing to mine Bitcoin during that time frame multiplied by the sum of the block rewards and fees over that time.

### 2.1.4 Defining Hashprice: A benchmark for miner revenue

The revenues divided by the hashrate is often referred to as hashprice, and communicated as revenue per petahash over some period of time.

HashPrice in USD/PHps/Day From 2019 to Q1 2024



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin  
Data: Luxor

## 2.2 Miners' Expenses: Two Primary Cost Drivers

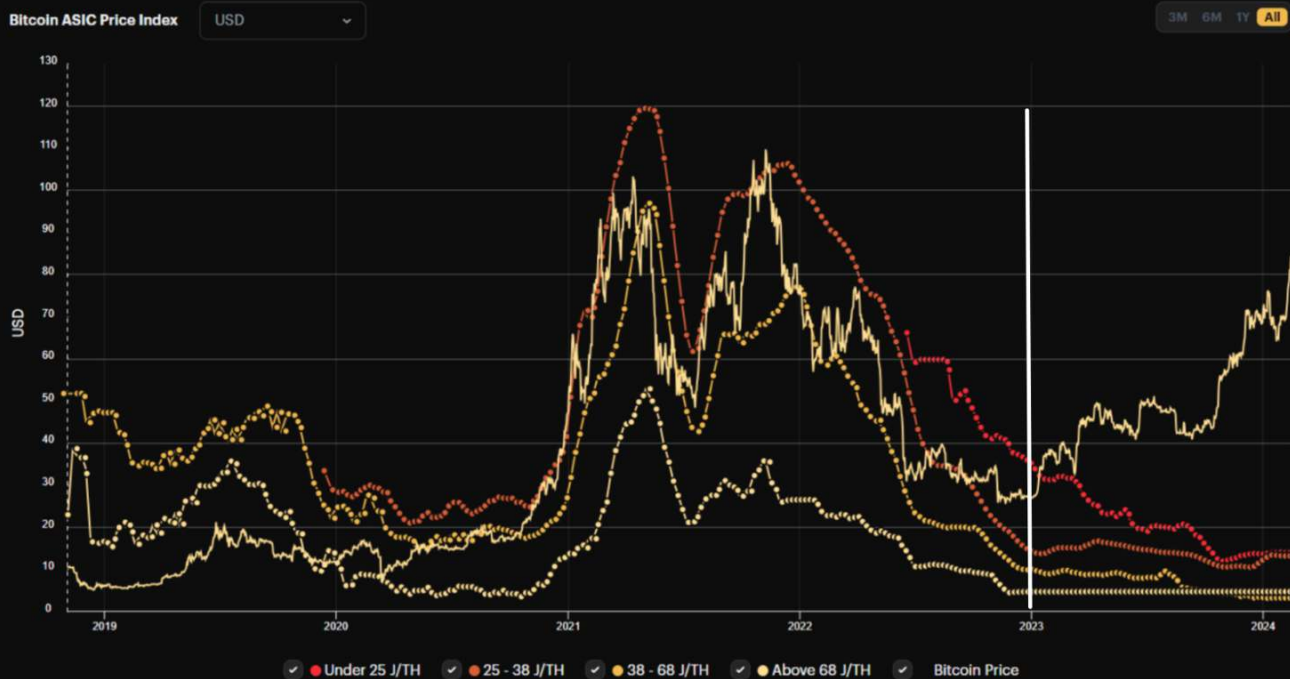
Miners have several expenses, but the two most prominent are their capital costs, most notably the mining equipment, and the operating costs of that equipment, most notably the energy it uses.

While miners have other costs, such as labor, interest, and facilities, these latter are dependent on the different miners' strategies and circumstances. All miners, however, must have mining equipment and they all must power it with electricity.

### 2.2.1 Equipment Costs

Historically, mining equipment increased in price as the price of Bitcoin rose, since miners were willing to pay more for hashrate when Bitcoins were worth more. The opposite was also true. When the price of Bitcoin fell the value of hashrate did too.

The chart below shows how ASIC prices have been related to the price of Bitcoin rising and falling with its price – at least until 2023 that is.



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin  
Data: Luxor

Overlaying the Bitcoin price on ASIC machine costs clearly shows that from 2019 until 2023 there was a very tight correlation between ASIC prices and the Bitcoin price measured in USD.

However, since 2023 (where the white bar on the chart appears), when the price of Bitcoin began recovering, we have not seen the price of ASICs rise with it. Instead ASIC prices have flattened or even fallen depending on efficiency.

This decoupling may have multiple explanations. It could be that demand was suppressed even as price went up because so much financial hardship, including many bankruptcies, occurred for miners during the bear market. It is also likely that miners were reducing what they are prepared to pay for added hashrate in anticipation of the halving of their block subsidies in April, 2024. Finally, competition between the mining equipment manufacturers has intensified, keeping prices down.

What does appear to have happened since, is that miners have acquired large quantities of modern equipment to replace their older machines. Owning gear that is more efficient than that of the competition gives a miner an advantage in this global industry as share of hashrate increases while energy consumption does not.

## 2.2.2 Energy Costs

Energy prices are very hard to predict and can even fluctuate dramatically within minutes because of energy demand for uses other than Bitcoin mining.

However the long term trend over the 2019-2024 period resembles that of the cost of mining equipment. Prices were highest in early 2022 at the same time that equipment costs were high just as the Bitcoin price itself had also peaked.

Although electricity costs vary greatly from region to region, one metric that has historically shown to be highly correlated to electricity prices due its significant role in electricity generation is the price of natural gas. The chart below shows how gas prices increased substantially from 2020 to 2022, coinciding with the increase in hashing equipment and the Bitcoin price from the chart above.

### Henry Hub Natural Gas Spot Price



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin

Data: EIA

## 2.2.3 Defining Hashcost

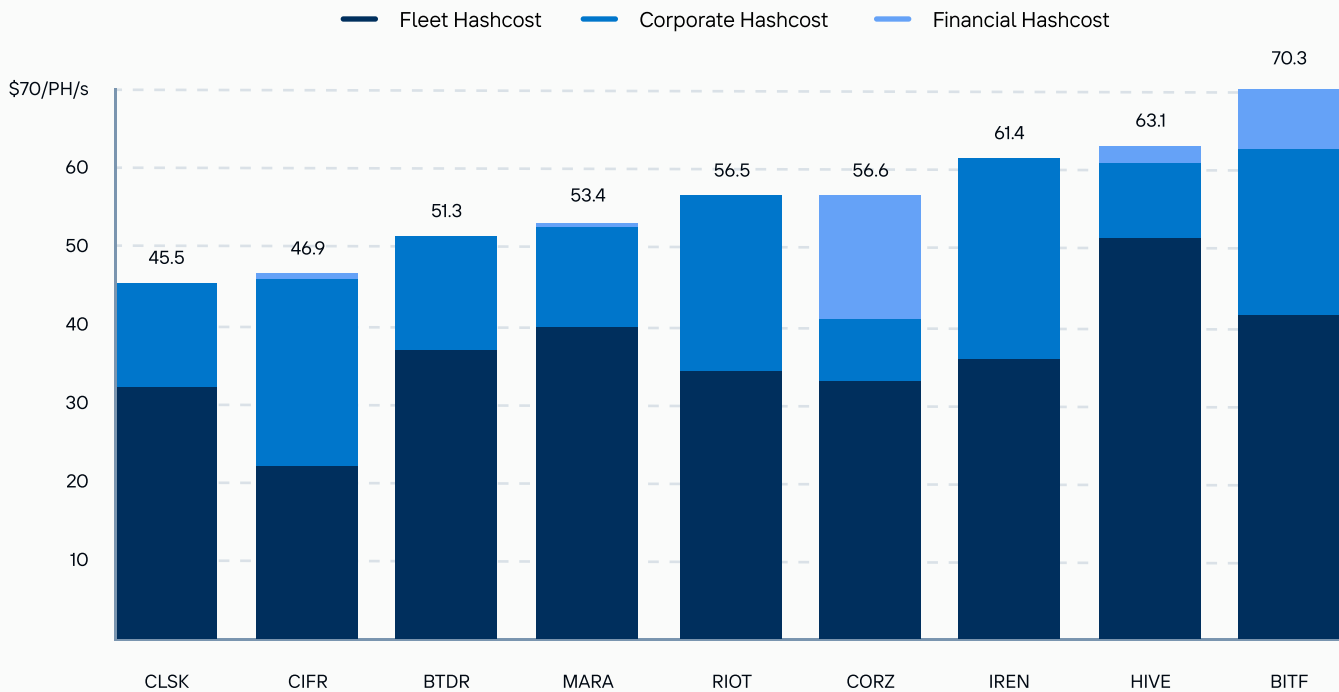
Similar to the calculation of hashprice, miners face a cost per terahash. Mining ASIC equipment is often evaluated on the cost per terahash basis. Additionally based on the efficiency of machines in their fleet and their cost of electricity. A miner's total Hashcost takes all of these into consideration providing a benchmark for what it costs in dollars per petahash over some period of time to operate the fleet.

### Calculation of Hashcost:

$$\text{Fleet Daily Hashcost (\$/EH/s)} = \text{Fleet Efficiency (J/PH)} * \text{Power Rate (\$/mWh)} * 24 \text{ (Hours)} = \text{Cost of Bitcoin Production (\$/BTC)} * \text{Daily Block Rewards (BTC)} / \text{Network Hashrate (EH/s)}$$

### Hashcost Breakdown of Bitcoin Mining Operations in Q4'23

Unit: U.S dollars per PH/s of realized hashrate



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin

Chart: TheMinerMag

Data: SEC Filings



## 2.3 Miners' Profits

As everywhere else, profits consist of revenues minus expenses. However, that is a vast oversimplification when analyzing the economics of Bitcoin mining.

Most of miners' revenues are generated in Bitcoin denominated terms, while most expenses are measured in terms of dollars (or other national currencies). Bitcoin's price in dollar terms fluctuates dramatically and unpredictably.

Miners' two most significant costs, equipment and energy, also happen to be two very different types of expenses. Equipment is a fixed capital cost that depreciates over time, and energy is a commodity that is consumed immediately as it is purchased. What both of these costs do have in common is that they too vary in cost dramatically.

## 2.4 Summary of Miner Economics

Bitcoin mining is an intensely competitive business.

The most unique aspects of the economics of Bitcoin mining come from Bitcoin's monetary policy, which is defined by the fixed issuance schedule and its halvings.

Miners must navigate through this unique and new economic model while also operating a business that requires high capital equipment investments and also large and fluctuating variable costs in the form of energy.

Mining is also a global industry with a perfectly fungible and transportable commodity as its product.

Miners have to continually improve to be the very best in the world at what they do, or risk failure.

### 3. Types of Bitcoin Miners

There are three primary types of miners:

#### 1. Individual “Home” Miners

These are retail miners who typically operate on a small scale, usually from their homes. They are often individuals, not companies, who engage in the activity out of personal interest, with the purpose of aiding decentralization, and/or for small supplemental income. They are called “home” miners because many literally run the operation out of their own homes. This type of mining is less competitive and has lower earnings potential compared to larger operations

#### 2. Private Industrial-Scale Miners

These miners operate large-scale mining operations. They invest heavily in specialized mining equipment and infrastructure, such as cooling and electricity systems, to maintain high levels of computing power. This setup allows them to mine more efficiently and profitably. They are typically private entities or individuals with substantial capital investment.

#### 3. Public Miners

This category consists of publicly traded companies that engage in Bitcoin mining. Given their disclosure requirements, there is much more information available about their operations.

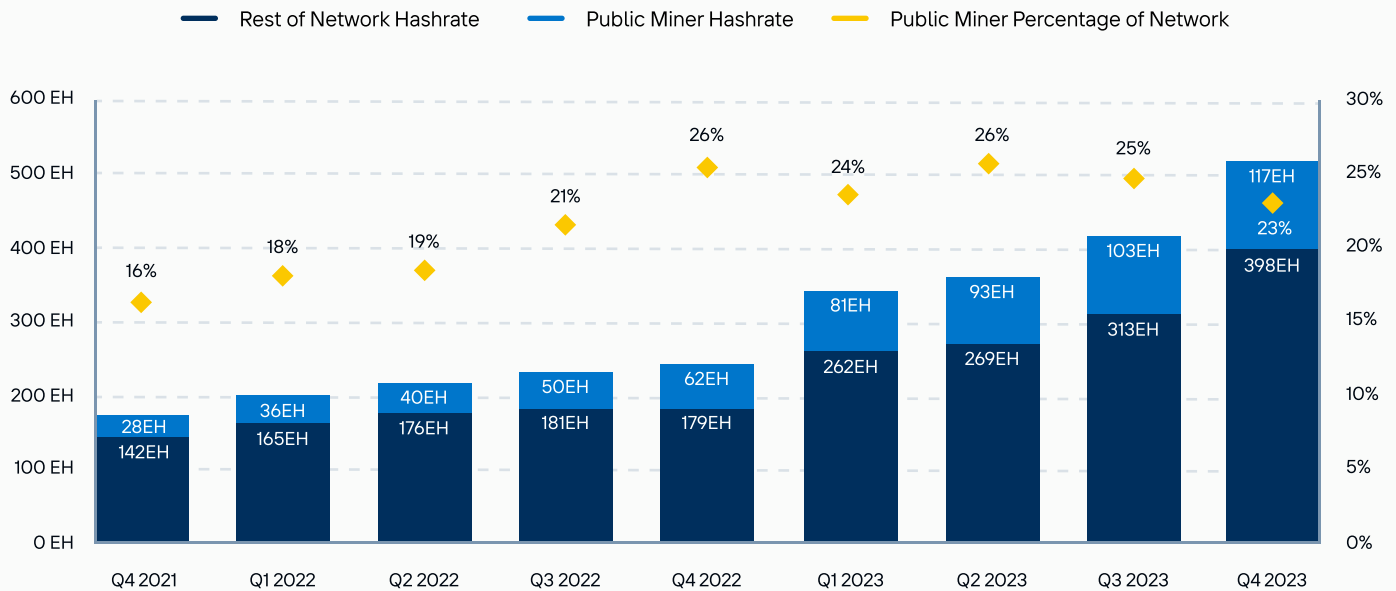
Public Miners operate on an industrial scale similar to private industrial-scale miners, but have the additional transparency and regulatory requirements that come with being a public company. These entities usually have access to vast amounts of capital, allowing them to invest in the most advanced mining technology and operate extensive mining operations.

Over the last several years, we have seen the rise of publicly traded Bitcoin mining companies and they have grown to become a larger percentage of Bitcoin’s total hashrate.

The chart below illustrates how public miners have steadily become larger players in terms of overall network hashrate, rising from 16% of it in Q4, 2021 to 23% just two years later.

### Hashcost Breakdown of Bitcoin Mining Operations in Q4'23

Unit: U.S dollars per PH/s of realized hashrate



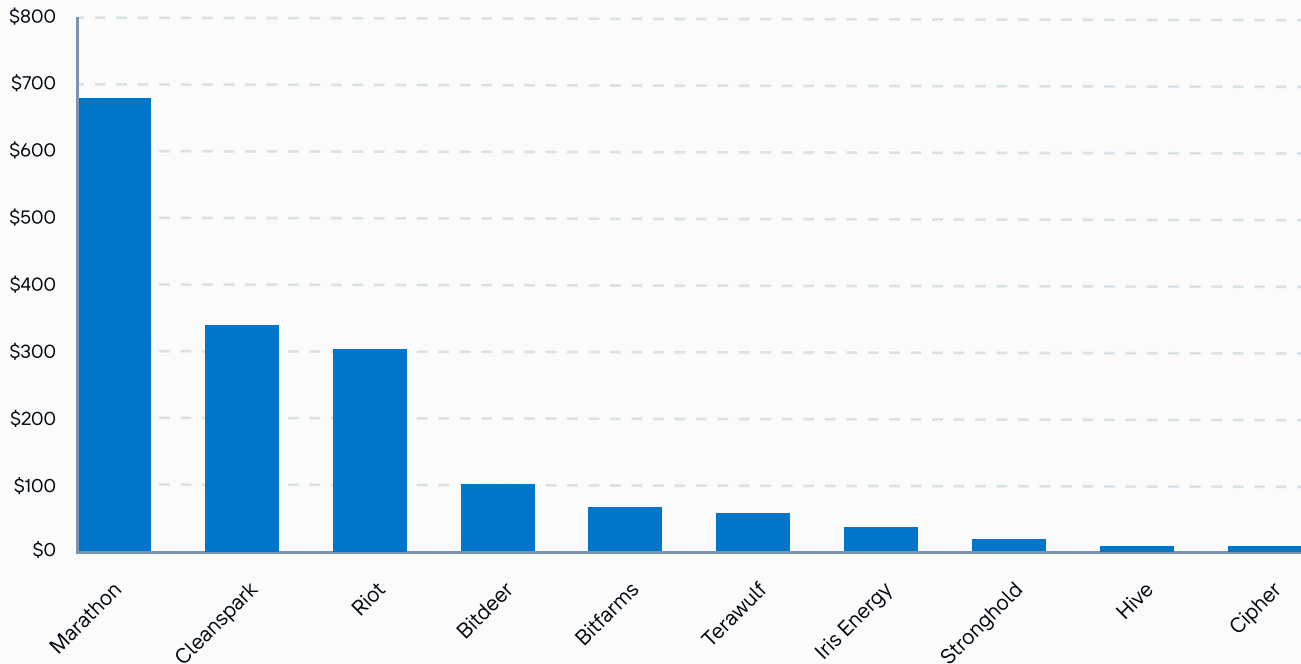
Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin

Data: Galaxy Research. Company press releases and filings. Public miner set includes Argo, Bitdeer, Bitfarms, Cipher, Core Scientific, Greenidge, HIVE, Hut, Marathon, Riot, Terawulf, Northern Data, CleanSpark, Stronghold, and Iris Energy.

Public miners appear to have some advantages over smaller or private mining operations. They often have access to more substantial resources, allowing them to purchase mining hardware in bulk at better rates, and secure larger energy deals, driving down the overall costs of their operations. In addition, being publicly traded provides these companies with access to capital markets. They can raise funds through the public issuance of stocks or bonds, enabling them to expand their operations, invest in more efficient mining rigs, or cover operational costs more easily than private miners.

Over the last year, we have seen public mining companies increasingly raise capital by selling equity to presumably bolster their capital reserves and order new machines to improve their fleet efficiency in preparation for the upcoming halving.

### Equity Raised by Publicly Traded Miners in 2023 (\$ millions)



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin  
 Data: SEC Filings

This advantage may become more evident post-halving as these public miners will have more efficient fleets to thrive after the halving, and will have cash on hand for potential M&A opportunities. This could result in public miners becoming a larger share of hashrate than they currently are today.

Regardless of the type of mining entity they are, all miners ultimately rely on using the same type of equipment – specialized mining machines called ASICs. These come from various suppliers and operate at different speeds and power efficiencies. The next section provides an overview of these ASIC manufacturers, ongoing trends, and what they potentially mean for Bitcoin miners moving forward.

## 4. Entities that Support and Supply Miners

There are three primary entities that miners typically engage with who fill the majority of needs they have. They are the ASIC equipment manufacturers, mining pools, and energy producers. A description of each of these along with recent developments and near-term expectations are included in the following pages.

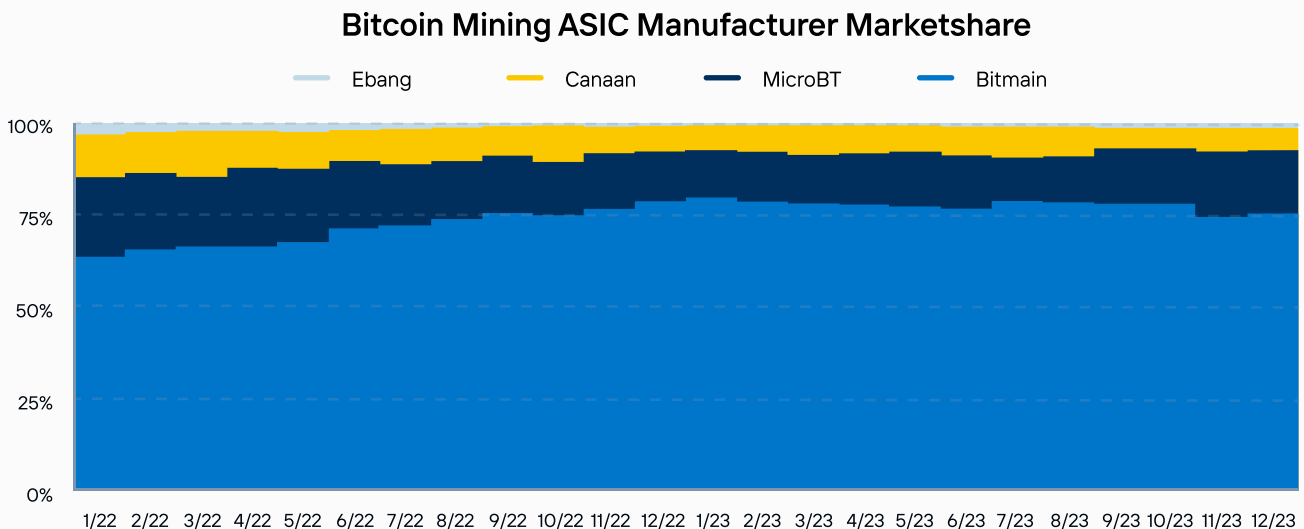
### 4.1 ASIC Manufacturers

Although miners are actually the ones powering the equipment that runs and secures the Bitcoin network, it is the ASIC manufacturers that provide them with the machines to make it happen. ASIC manufacturing remains highly concentrated today, with only two major players at present.

For many years, one company, Bitmain, was the undisputed leader of the ASIC marketplace. In 2017, it was estimated that Bitmain controlled nearly 75% of the market.

Fast forward to 2024, although Bitmain has continued to dominate the ASIC market, it could be better described as a duopoly. Bitmain and MicroBT now provide a vast majority of the mining rigs that power the Bitcoin network.

Using nonce analysis pioneered by Karim Helmy, we can estimate the amount of market share Bitmain and MicroBT currently control by analyzing the nonce pattern of each mining model contributing to Bitcoin's hashrate. The chart below illustrates that Bitmain and MicroBT models currently make up nearly 90% of the ASICs running today.

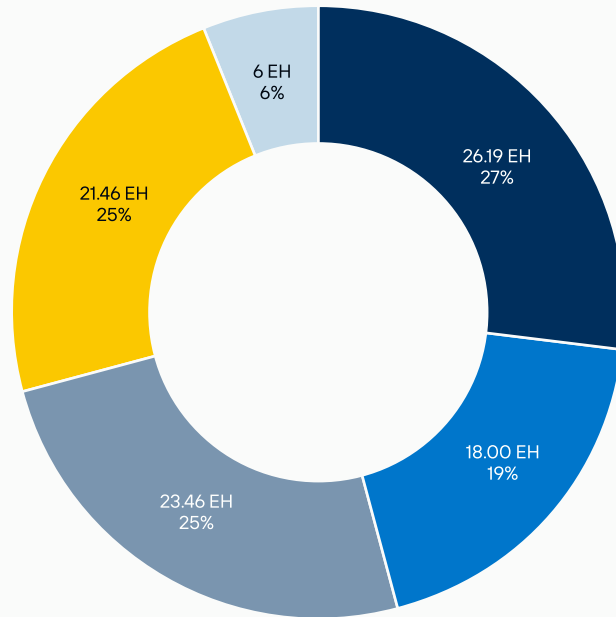


Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin  
 Data: Luxor, Coin Metrics

Further evidence of this duopoly in the ASIC market comes from a recent Galaxy Research survey which found that a whopping 94% of the machines ordered by public mining companies in 2023 were from either Bitmain (makers of S19, S21, and T21 series machines) or MicroBT (makers of M50 and M60 series machines). This data shows that, in terms of new machine orders, MicroBT is right on Bitmain’s heels, with MicroBT capturing 46%, and Bitmain capturing 48%.

### Types of Machines Ordered Throughout 2023 by Public Miners

● M50 Series	27%
● M60 Series	19%
● S21/T21 Series	25%
● S19	25%
● Others	6%



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin  
Data: Galaxy Research

Bitmain has historically produced the highest-performing and most efficient ASIC rigs. This was partly due to Bitmain's access to the ASIC chip manufacturing supply chain, enabling them to secure more fabrication time at leading chip foundries like TSMC. TSMC has the most sophisticated tools in semiconductor manufacturing, which Bitmain uses to obtain the highest-quality ASIC chips.

MicroBT has now also built a relationship with TSMC, using TSMC chips in its M60 and M60s series, which compete with the efficiency of Bitmain’s machines and have grown in popularity in the mining community.

In 2023, MicroBT and Bitmain released the first ASIC models to offer efficiency ratings below 20 J/TH. Below is a table that shows some of the most efficient ASIC machines on the market today.

Manufacturer	ASIC Model	Hashrate (TH/s)	Efficiency (J/TH)	Wattage (W)
Bitmain	Antminer S21	200	17.5	3500
MicroBT	Whatsminer M6OS	186	18.5	3441
Bitmain	AntMiner T21	190	19	3610
MicroBT	Whatsminer M6O	162	19.2	3104
Bitmain	Antminer S19j XP	151	21.5	3247
Canaan	Avalonminer A1466	150	21.5	3230
MicroBT	Whatsminer M50s++	150	22	3300
Canaan	Antminer S19k Pro	120	23	2760

Note: The lower the number, the better the efficiency

Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin

Data: Luxor

As the table shows above, the most efficient machines on the market are currently provided by Bitmain and MicroBT. While miners might benefit from more competition, the semiconductor industry has always been highly concentrated, and the specialization of this particular segment has made it hard for other companies to enter and remain successful in Bitcoin mining.

Still, in the Bitcoin ecosystem, any amount of centralization is concerning, and there may not be a more centralized part of Bitcoin than at the ASIC manufacturing level. Not only does the mining industry depend on effectively two companies for the infrastructure critical to the functioning and security of the Bitcoin network, but this also creates a dynamic where larger miners could have an advantage over smaller peers.

Acquiring the latest, most efficient mining rigs can be challenging due to supply constraints, especially during highly profitable mining periods. If a large Bitcoin miner has better accessibility to these companies' production because they are making large bulk orders, they will obtain new machines first and outcompete smaller, less connected operations. Recall, in Bitcoin mining, it's not just that miners want to obtain the most efficient machines – they want to obtain the most efficient machines that their competitors can't get. Because of these dynamics, this could create a situation where hash rate funnels to larger mining operations like publicly traded mining companies, potentially harming the network's decentralization in the process.

## The Future State of ASIC Manufacturing

The good news for miners is that even more ASIC competition appears to be on its way. Over the last couple of years, we have seen several major players announce the development of their own ASIC chips.

In March 2023, Canadian technology company ePIC Blockchain announced the ePIC BlockMine which integrates Intel's Blockscale ASIC chip.

ePIC Blockchain Introduces the ePIC BlockMiner™, North American Designed Bitcoin Mining Rigs Based on Intel® Blockscale™ Technology



NEWS PROVIDED BY  
ePIC Blockchain Technologies →  
07 Mar, 2023, 08:54 ET

Next, in November 2023, California-based Auradine, announced the launch of its new Teraflux Bitcoin mining rigs.

## Auradine Unveils Next-Generation Teraflux™ Bitcoin Miners Setting New Benchmarks for Efficient and Sustainable Mining

November 14, 2023 09:00 ET | Source: [Auradine](#)

These new rigs are scheduled to ship sometime in Q2 2024 and claim to deliver efficiencies that rival machines from Bitmain and MicroBT.



Another company getting into the ASIC mix is Bitcoin infrastructure company Blockstream.

## Technology

# Bitcoin Infrastructure Firm Blockstream to Unveil Its Long-Awaited Mining Rig in 3Q of 2024

The company expects to raise more capital to fund its mining business.

After acquiring mining infrastructure company Spondoolies in 2021, Blockstream also appears to be readying the release of its mining rig in the second half of 2024.

Further competition is expected to come from Bitdeer, which recently announced the launch of its own mining chip, the SEAL01.



### Bitdeer Announces New 4nm Bitcoin Mining Chip SEAL01

March 4, 2024

Offering power efficiency of 18.1 J/TH, "SEAL01" tested as exceptionally efficient; chips to be integrated into Bitdeer's upcoming "SEALMINER A1" mining machines

Bitdeer's new chips offer efficiency rates competitive with other market leaders and will be integrated into Bitdeer's own SEALMINER A1 mining machines.

Finally, and perhaps the most highly anticipated ASIC development is from Jack Dorsey's Block.

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## Jack Dorsey's Block Looks to Disrupt Bitcoin Mining

Block plans to create custom silicon for bitcoin mining hardware to bring decentralization to the industry

BY SHALINI NAGARAJAN / MAY 1, 2023 07:55 AM

Back in 2021, Dorsey announced that Square was considering building its own ASIC mining chips and rigs, stating that “Mining needs to be more distributed...The more decentralized this is, the more resilient the Bitcoin network becomes.”



Square is considering building a Bitcoin mining system based on custom silicon and open source for individuals and businesses worldwide. If we do this, we'd follow our hardware wallet model: build in the open in collaboration with the community. First some thoughts and questions.

3:29 PM · Oct 15, 2021

In April 2023, Block announced in a blog post that it had acquired “a large volume of Bitcoin mining ASICs from Intel.” These were 5nm chips that allowed Block to “focus their design team exclusively on cutting edge 3nm ASIC development.”

All in all, if all of these new ASICs hit the market soon, it appears that miners will soon have more suppliers to choose from than Bitmain and MicroBT, thus, we could expect ASIC equipment prices to remain low even if Bitcoin's price increases.

## 4.2 Mining Pools

One other major player Bitcoin miners work with is mining pools. Pools aggregate the hashrate of many individual miners, providing smoother and more predictable revenues than mining alone would.

One of the biggest challenges miners face in their core revenue stream – capturing a block reward – is its random and uncertain nature. For smaller miners, weeks or months can pass between them finding a block. For a mining operation with fixed costs such as server costs, labor, marketing, etc, this unpredictability makes running a business difficult.

Mining pools arose to help mitigate this problem. By participating in a mining pool, a miner can increase the probability of receiving a portion of a block reward, smoothing out their revenues. When a miner participating in a pool finds a block, the block reward is paid to the pool coordinator, and after taking a fee, the pool coordinator distributes the block reward to the miners in the pool based on the amount of hashrate they each contribute. The greater the hashrate contributed to the pool, the greater the percentage of the block reward a miner receives when any miner in the pool finds a block.

### **How Do Miners Choose a Pool?**

While pools offer a higher chance of earning rewards, more predictable income, and reduce certain risks, there are some drawbacks. Miners, of course, will receive smaller individual rewards compared to winning a block solo mining, but they also must rely on the pool's performance and stability. In addition, they must pay a fee to the pool coordinator, which varies between pools. Lastly, it is also very hard to audit a pool's composition and ensure that the payouts they are making to individual participants are a fair share of their contribution. There is a level of trust associated with participating in a mining pool. Ultimately, miners may mine with multiple pools simultaneously to try to determine which one pays out the highest rewards for a given amount of hashrate.

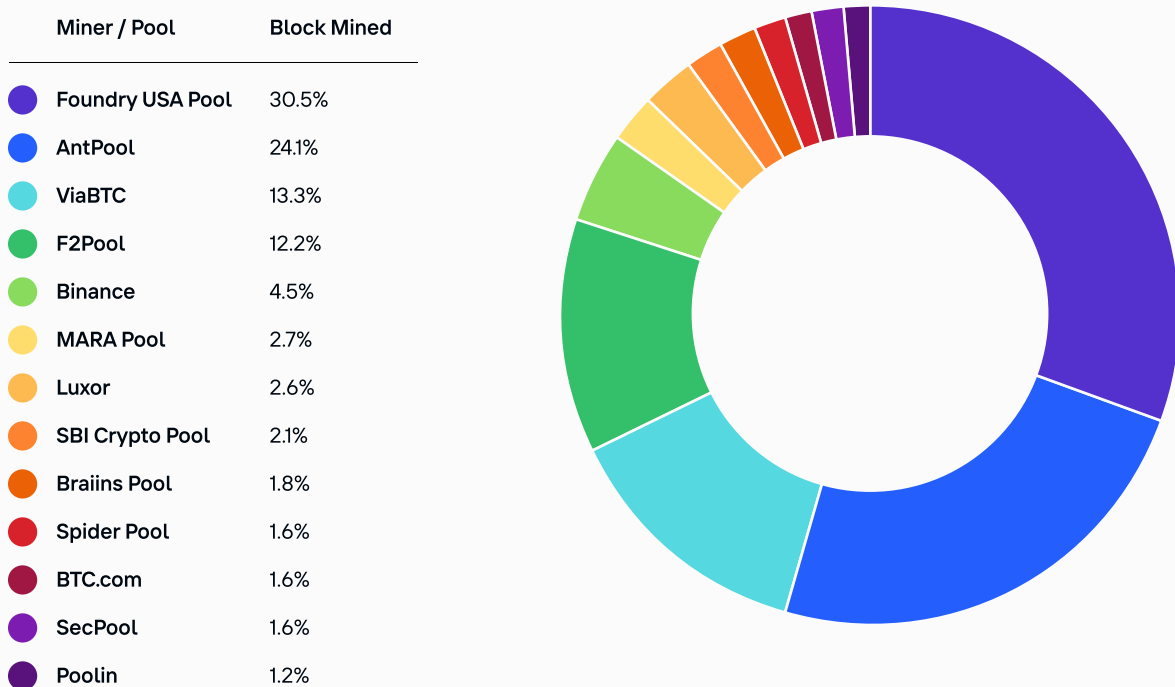
All mining pools are not created equal, however, and offer different tradeoffs. Low fees are attractive to miners, but performance, reliability, and transparency are also crucial trust builders. Some ways that pools can differentiate themselves from the competition are by providing simple retail dashboards and a great user experience, by offering fleet management and built-in demand response tools, and by providing hashrate marketplaces.

### Centralization Concerns Around Mining Pools

Bitcoin mining pools raise concerns about centralization, potentially compromising the network’s core tenets of decentralization and security. In general, we judge this problem to be a bit overblown. Financial incentives and game theory drive Bitcoin mining. There is very low friction when it comes to switching pools for miners. As a result, in the end, the real control and power rest with the miners producing hashrate. Every miner out there has the option to set multiple pool addresses. Should one pool become unresponsive or begin censoring transactions, miners can automatically connect and hash to a secondary pool set in the firmware settings.

Centralization concerns really center around censorship and control. Dominant mining pools can exert influence over which transactions get included in blocks. This could lead to censorship of transactions or favoritism toward certain users or entities, compromising the decentralization of the Bitcoin network.

Today, the mining pool landscape has evolved such that there are a few dominant mining pools in the space. The chart below shows that the two largest pools – Foundry USA and AntPool – represent over half of Bitcoin’s hashrate today.



Source: The Current State of Bitcoin Mining April 2024 by Swan Bitcoin  
Data: Braiiins

The problem is, despite the fact that miners can technically change pools within minutes, actual behavior in the past has shown that hashrate tends to stay with certain pools. This has occurred even when a pool has made controversial decisions around censoring transactions and despite a pool paying some of the highest fees at the time.

A perfect example of this occurred last year when one of the largest mining pools, F2Pool, was found to be censoring transactions to comply with OFAC sanctions.

### Technology

## Bitcoin's Anti-Censorship Ethos Surfaces After Mining Pool F2Pool Acknowledges 'Filter'

After a blockchain sleuth reported that the Bitcoin mining pool may have censored a transaction from an address blacklisted by U.S. authorities, critics responded, and so did the project's co-founder.

However, the industry is already focused on developing solutions that would reduce this centralization concern in the future. One answer to the growing centralization we recently have seen is new pools entering the fray. Namely, OCEAN and Demand pool, which intend to implement a core technology called StratumV2.

The key decentralization benefit of StratumV2 is that it allows miners to form their own blocks without having to depend on the pool to do so. It is impossible for a pool to censor transactions from a miner using StratumV2 this way. Although StratumV2 shows promise in addressing some of these centralization concerns, it remains to be seen how much hashrate will adopt it in the future.

Overall, pools play a crucial role in the Bitcoin mining ecosystem. They aggregate the computational power of individual miners, offering them more stable and predictable revenue streams compared to solo mining. However, the reliance on mining pools introduces concerns about centralization, potential censorship, and the need for trust in the pool's management and reward distribution. Despite these issues, the flexibility for miners to switch pools and the development of technologies like StratumV2 offer pathways toward mitigating centralization concerns.

2024 looks like it will be a year where a potential migration of hashrate starts to play out as miners' trust in pools wavers while their power to form their own blocks increases.

## 4.3 Energy Producers

Once an obscure player, the Bitcoin mining industry has evolved into a significant energy consumer and an unexpected ally for the energy industry. Bitcoin mining is proving to be a useful new technology that better stabilizes the electrical grid, utilizes stranded and wasted energy resources, and improves the economics of developing energy projects.

### **Enhancing Grid Stability**

For a stable industrial and residential environment, 24/7 power availability is a necessity. For this reason, the topmost mandate for power grid operators is grid stability. The name of the game in stabilizing the grid is to match grid demand with supply at all times.

Over the last decade, renewable energy sources like wind and solar have increasingly been incorporated into the grid, and although solar and wind energy are cheaper and cleaner than traditional energy sources, they have a significant limitation: they are unpredictable. Solar energy is abundant during the day but disappears at night or when it is cloudy. Wind energy is highly dependent on weather conditions that are inconsistent. This variability causes frequent mismatches between supply and demand and creates challenges for grid stability.

Bitcoin miners are now being recognized for their ability to adjust their electricity use quickly and efficiently, which is particularly useful with these intermittent energy sources. When demand is low, Bitcoin miners can help balance the grid by playing the role of “energy buyers of last resort.” When demand is high, and supply is scarce, Bitcoin miners can turn off immediately, giving much-needed power back to the grid. This flexibility helps stabilize power grids, especially when the supply is inconsistent, as is the case when more renewable energy sources are utilized.

Bitcoin miners are unique from other demand response programs because they can turn their equipment on or off with little notice, unlike other demand response programs, which are slower to respond to fluctuating grid demand and are more costly to switch on and off. Bitcoin miners are capable of adjusting their energy use based on the grid’s needs in real time, helping balance supply and demand efficiently.

This unique ability was echoed by former ERCOT Interim CEO Brad Jones in an [interview](#) when he said, “Most other data centers like Microsoft or Amazon, they all have customers to serve every hour of the day so they can’t just turn off, but these cryptocurrencies can...From our perspective, they are helpful if we happen to lose a generator—like a generator trips offline— they can real quickly respond to that frequency disruption and allow us to balance are grid more efficiently.”

This ability to balance the grid was also the driving force between the recent partnership between Marathon Digital and the UAE to build a large-scale mining operation in the nation’s capital.

## Finance

### **Marathon Teams Up With Abu Dhabi's Zero Two for Middle East's First Large-Scale Immersion-Cooled Bitcoin Mining**

The U.S.-based miner is partnering with Abu Dhabi-based Zero Two, a digital assets infrastructure development company focused on supporting the power grid of that Middle Eastern capital.

By Stephen Alpher  May 9, 2023 at 3:14 p.m. CDT Updated May 11, 2023 at 7:20 a.m. CDT

In the future, we expect Bitcoin miners to continue to become further integrated into electrical infrastructure around the world in order to enhance the stability of power grids, which will ultimately help drive the cost of the electricity down for local consumers.

## Reducing Flared Gas

Despite the energy sector's conservative nature and slow adoption of new technologies, Bitcoin mining has found a niche, especially in markets with stranded or wasted energy resources.

One noteworthy energy source to keep an eye on is flared methane, a harmful byproduct of oil extraction. Typically, when transporting this gas is not feasible, it is released into the atmosphere, significantly contributing to greenhouse gas emissions. The World Bank estimates that the world flared enough gas in 2022 to generate approximately 1,800 TWh of energy, almost two-thirds of the European Union’s net domestic electricity generation. Furthermore, it estimates that gas flared results in over 350 million tons of CO2 emissions annually.

Bitcoin mining offers a novel solution to this problem by converting this waste into electricity for mining operations, thus reducing the environmental impact. This method not only addresses environmental concerns by reducing potent greenhouse gas emissions but also provides a profitable use for otherwise wasted natural resources.

The World Bank is beginning to recognize this in its recent reports on the subject. In a [2022 report](#), the World Bank highlighted how Bitcoin mining company Crusoe Energy Systems was utilizing flared gas to mine Bitcoin. It stated how Crusoe's solution offered significant benefits for oil producers by ensuring they meet flaring regulations while generating additional income for their operations. It went on to explain how Crusoe's technology was used to utilize excess gas that would otherwise be flared due to insufficient pipeline capacity, thus avoiding uneconomical alternatives and contributing to on-site power generation.

The report concluded that

*“ Crusoe’s Digital Flare Mitigation [Bitcoin mining] solution results in both direct and indirect greenhouse gas emissions reductions,” and added that “Crusoe’s solution aims to provide a positive financial and environmental outcome for all stakeholders: operators, environmental groups, regulators, and royalty owners.*

This case study exemplifies how Bitcoin mining can adapt and contribute to environmental sustainability. By utilizing surplus natural gas from oil fields, miners can generate electricity for their operations, turning a waste product into a valuable resource [Bitcoin], all while helping achieve the US’s methane reduction targets.

### **Enhancing the Profitability of New Energy Projects**

Bitcoin mining introduces an economic rationale for developing energy projects that might otherwise be unviable. By offering a constant demand, Bitcoin miners enable energy projects to have a customer for all the energy they produce, allowing them to improve their profitability as they wait for a gradual increase of conventional, local demand.



For instance, developing wind and solar farms in remote areas face challenges because there is often insufficient infrastructure to distribute the generated power effectively. Highly mobile Bitcoin miners can consume excess energy directly at the source by co-locating at the energy sites. This arrangement not only helps to stabilize the grid by ensuring that excess power is utilized rather than wasted but also helps to prevent these projects from incurring economic losses. Therefore, Bitcoin mining can serve as a flexible and advantageous energy off-taker for energy projects that struggle with overproduction and underutilization. By utilizing excess energy from renewable sources, Bitcoin mining can increase the profitability and sustainability of such energy projects.

Historically, Bitcoin mining has been a buyer of stranded and unused energy, finding the cheapest sources it could in the remotest of locations. However, it is now becoming seen as a strategic technology in planning future energy generation projects. As such, we can expect to see partnerships between energy suppliers and Bitcoin miners in long-term projects in the coming years.

## 5. Conclusion

Mining is a complex and unique business that has formed and expanded along with Bitcoin's growth. From a mere hobby it has grown to become a multibillion dollar industry with many public companies involved. It is attracting attention, energy, and capital all over the world.

As mining continues to grow, its increased involvement in the global energy sector may serve to strategically tie Bitcoin mining to the colossal energy industry itself. Mining could thus become yet another pillar supporting the growth and importance of Bitcoin itself, weaving it further into the fabric of our modern, energy-dependent civilization.

At the same time, the unique economics of mining and the high rate of technological progress add to the difficulty in predicting the long term outlook of individual companies. Successful long-term strategies are still being discovered and developed.

In our next report, we will focus on these different strategies being taken by various miners, and what the advantages and disadvantages are present in each.