AMINA RESEARCH X AlixPartners

2025 Bitcoin Miners Landscape

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Executive Summary

The 2024 Bitcoin halving catalysed a structural transformation across the global crypto mining industry. While the halving itself was a predictable event, its economic ripple effects were profound and have significantly reshaped market dynamics, technology deployment, regulatory considerations, and miner strategy.

Key outcomes of the halving:

- **Industry consolidation accelerated,** as smaller miners exited the market due to tighter margins, while larger firms capitalized on M&A to scale operations and secure power access. The top pools—led by Foundry USA and MARA Pool—now account for over 38% of global Bitcoin hashpower.
- **Profitability pressure led to operational innovation.** Miners proactively invested in next-generation Application-Specific Integrated Circuits (ASICs), diversified into AI/HPC (High Power Compute) workloads, and adopted hedging tools to protect cash flows. This transition positioned many miners as infrastructure providers, not just Bitcoin producers.
- **Bitcoin's price doubled post-halving,** rising from ~$53,000 to over $109,000, reinforcing its scarcity narrative and providing temporary relief for mining revenues. However, volatility and fee dynamics introduced new challenges to sustainability.
- **Environmental progress continued,** with over 55% of mining now powered by renewable energy. While this supports miners' ESG narratives, it hasn't fully insulated the sector from regulatory tightening, particularly in Europe and parts of Asia.
- **Strategic risks have increased,** especially around cybersecurity, energy availability, and financial planning. In this increasingly complex environment, many miners are turning to specialized consultants and crypto-native banks to support decision-making, structure hedging and liquidity solutions, and accelerate their path to institutional professionalism.

Implications for stakeholders:

- **Miners must professionalise** further by integrating treasury management, financial risk controls, and energy strategy into core operations.
- **Investors** should assess mining firms not just on hashrate or revenue, but on vertical integration potential, energy sourcing, and ability to diversify income streams (e.g., into AI data centres).
- **Regulators and policymakers** are challenged to balance innovation and sustainability, as mining continues to migrate to more favourable jurisdictions.
- **Hyperscalers and tech firms** can leverage underutilised mining infrastructure for AI/HPC demand, creating potential for strategic partnerships and acquisitions.

This report provides a comprehensive review of the post-halving landscape, equipping decision-makers with the insight to navigate a more complex, competitive, and capital-intensive mining ecosystem.

Section 1: Introduction

The 2024 Bitcoin halving marked a fundamental economic shift within the cryptocurrency ecosystem, driving significant changes in miner behaviour, market efficiency, and capital allocation. As a pre-programmed event embedded in Bitcoin's consensus mechanism, halvings have historically acted as deterministic supply shocks, constraining new issuance and reinforcing Bitcoin's scarcity model. The latest halving reduced block rewards from 6.25 BTC to 3.125 BTC per block, cutting the daily issuance from 900 BTC to 450 BTC, with profound implications for network security, miner profitability, and the broader financial landscape.

The interplay between Bitcoin's monetary policy and market dynamics post-halving raised critical questions about price elasticity, transaction fee economics, and network decentralization. While historical data suggested that halvings catalyse long-term price appreciation due to a reduced rate of new supply entering the market, this outcome was not guaranteed. The extent to which miners offset reduced rewards through efficiency gains, fee markets, and alternative revenue models shaped the post-halving equilibrium. Moreover, the increasing role of geopolitical factors, energy constraints, and regulatory pressures added complexity to this evolving landscape.

This report examines the post-halving transformation of the Bitcoin mining industry by analysing shifts in market structure, technological adoption, and economic sustainability. Through empirical data and industry insights, we explore how miners adapted to the new paradigm and what these adaptations mean for the future of Bitcoin's security model and economic viability.

The 2024 halving followed a predictable pattern based on past halving events, reducing block rewards from 6.25 to 3.125 BTC. However, unlike previous events, Bitcoin's price surged from $53,000 to over $109,000. This provided temporary relief from margin compression but also created new challenges around operational planning and cash flow management for miners.

Halving events reduce miners' earnings by half - a predictable occurrence every 4 years. However, the network's hash rate, representing computational power dedicated to Bitcoin mining, continues to reach new records.

Bitcoin miners experienced peak revenue periods leading up to the 2024 halving. Monthly aggregate miners' revenue reached 2 billion USD in March 2024, a 10% increase from the 2021 peak of 1.8 billion. The current monthly revenue stands at 1.4 billion USD.

Bitcoin mining has numerous advantages too, with very few risks. The process creates revenue channels for miners while improving resource utilization efficiency.

Moreover, miners operate with strategic foresight, implementing measures like hedging strategies, securing operational loans, offering AI/HPC services for supplementary income, thus strengthening their capability to manage revenue fluctuations well in advance of anticipated events.

Section 2: Economic Implications of Halving

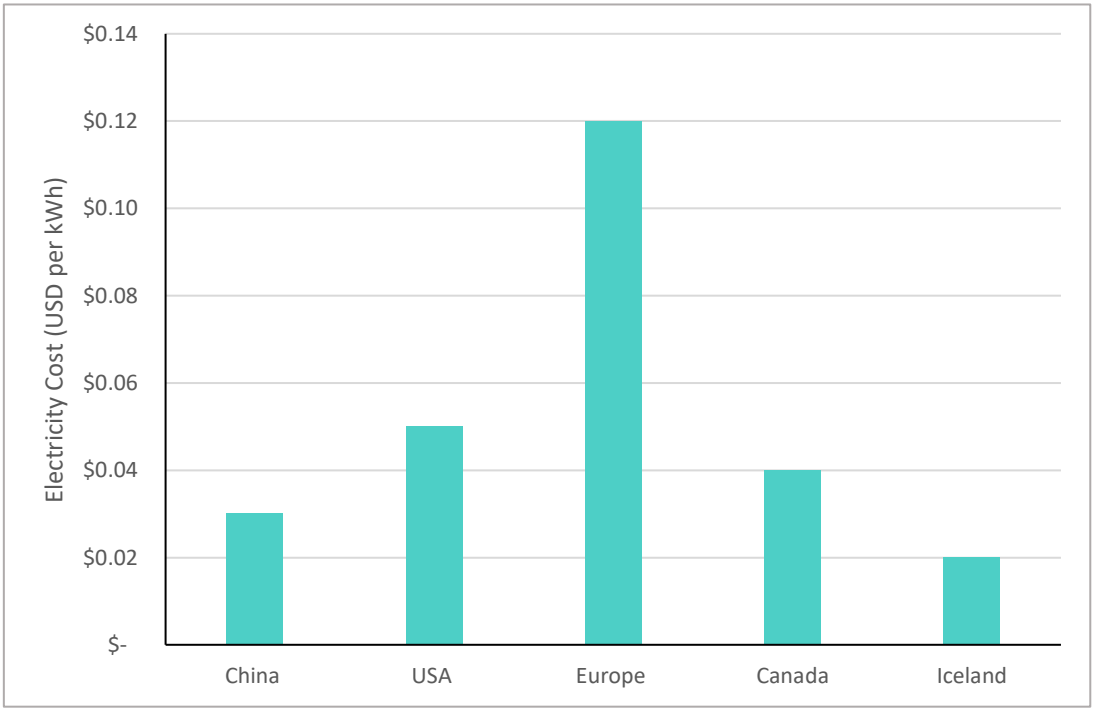
The profitability of a Bitcoin mining operation hinges on several critical factors that directly influence the profit and loss (P&L) statement. Understanding these drivers and implementing sophisticated financial analysis tools are essential for miners to navigate the post-2024 halving landscape effectively.

Section 2.1: Drivers of a mining business P&L

1. Energy Costs

Electricity expenses constitute a significant portion of mining operational costs, driving miners to seek regions with low electricity rates or invest in energy-efficient technologies.

Electricity Cost for Bitcoin Mining by Region



Source: AMINA BANK, CBECI (3 March 2025)

The graph above illustrates the electricity costs for Bitcoin mining in selected regions. Miners often strategically target areas with surplus energy or low electricity rates, such as Iceland or parts of China, to optimize their operational costs and enhance profitability.

2. Hardware Depreciation

Mining hardware, particularly ASICs, involves substantial upfront investment, often necessitating regular upgrades to remain competitive.

3. Bitcoin Price Volatility

With price fluctuations significantly affecting profitability, miners often strategise to hold or sell mined Bitcoins based on market conditions to optimise returns.

4. Block Rewards and Halving Events

As mentioned in Section 1, Bitcoin rewards reduction intensifies competition among miners and pressures profit margins, making efficiency improvements crucial.

5. Network Difficulty

The Bitcoin network adjusts its difficulty approximately every two weeks to ensure a consistent block addition rate, which requires constant upgrades in computational power.

6. Operational Expenses

Beyond energy and hardware, effective management of maintenance, cooling, facilities, and staffing costs remain essential for sustained profitability.

Break-even Analysis Tools

To determine break-even, miners can divide their daily electricity cost (power consumption in kW × 24 h × cost per kWh) by their hash rate.

For example, a mining rig consuming 3.25 kW at $0.06 /kWh over 24 hours against 90 terahash (TH)/s yields a minimum earning requirement of $0.052 per TH. Real-time tools such as CoinWarz, NiceHash and Hashrate Index factor in current network difficulty, Bitcoin's price and hardware specs to streamline this analysis.

Small-scale operators contend with higher per-unit costs and depend on low-cost electricity costs; medium miners benefit from moderate efficiency while large farms achieve superior economies of scale and can drive break-even even with higher electricity cost and more expensive hardware.

ROI Calculations for Efficiency Upgrades

ROI calculations for hardware efficiency upgrades utilize the formula:

$$ROI = ((Revenue - Costs) / Costs) \times 100\%.$$

Modern mining operations can achieve 5% monthly ROI with proper cost management. Miners evaluate total costs including equipment, electricity, and maintenance against estimated monthly Bitcoin income. Online calculators like WhatToMine and CryptoCompare facilitate rapid profitability assessments considering equipment parameters, electricity costs and network difficulty.

Risk Management Frameworks

Risk management frameworks address multiple operational challenges. Key risk categories include Bitcoin price volatility, hashrate competition and cash flow constraints. Mitigation strategies include operating cost reduction, hashprice futures hedging, hashrate capacity increases, and regular equipment upgrades to more efficient models. Successful frameworks generally implement monitoring systems tracking market trends and pre-warning indicators to adjust strategies proactively.

Section 2.2: State of Bitcoin Mining Competitiveness

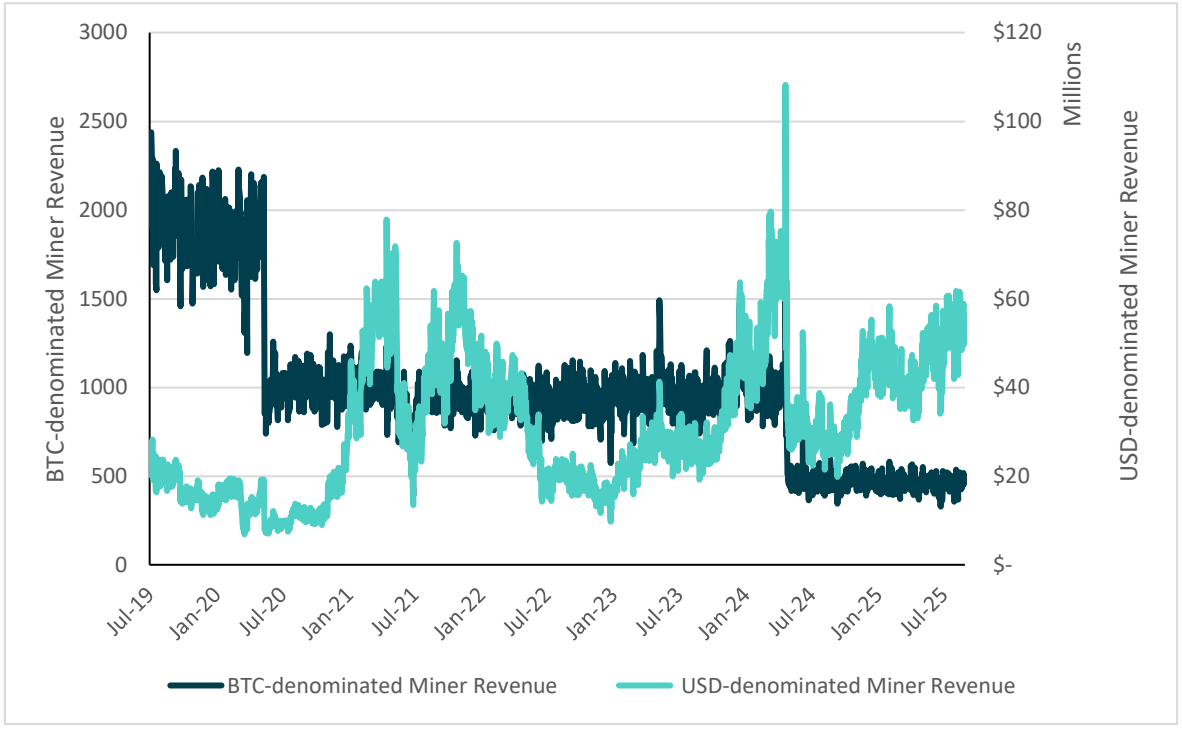
In the months preceding the 2024 Halving, Bitcoin saw an exponential rise in price. From the beginning of Q4 2023 to the end of Q1 2024, BTC rose by over 256%. In Q1 2024, miners

enjoyed some of the best economics over the past two years. Hash price (daily USD revenue per TH/s) averaged $0.094/TH for the quarter, propelled by the rise in bitcoin price.

Hashrate also continued its steady climb during the quarter to offset some of the increases in bitcoin price. **The Bitcoin mining network experienced meteoric growth, with a 104% increase in hashrate in 2024, following a 90% growth in 2023.** The robust margins in Q1 2024 were needed to build cash balances before Bitcoin's 4th halving in Q2 2024.

The 2024 Bitcoin halving event had a substantial impact on miner profitability, with a sharp drop in BTC-denominated revenue per terahash (TH/s) of mining power, though the recent surge in Bitcoin's price to over $105,000 as of 4 Sep 2025 has more than offset this impact.

Miners revenue



Source: AMINA Bank, Glassnode (4 September 2025)

The mining network has also undergone a remarkable efficiency transformation. Currently, the network boasts a weighted average efficiency of 34W/T, representing an 8% improvement in efficiency in 2024 alone and a 28% enhancement over the past three years. Based on these trends, projections indicate that by mid-2026, the efficiency level could reach as low as 10W/T as chip design continually improves and more efficient mining hardware is brought online.

Section 2.3: Post-Halving Reality

Following the 2024 halving event, the average cost of production per Bitcoin increased dramatically to $37,856, with direct cost of production rising to $27,900 and operating breakeven reaching $37,800. This represents a fundamental shift from pre-halving economics where weighted average costs stood at approximately $16,800 for cost of production and $25,000 for cash cost.

Public miners tracked in the analysis consume a weighted average of 4.5 cents per kWh of energy, with electricity costs representing about 68% pre-halving and 71% post-halving of the cash-cost structure on a weighted average basis.

Bitmain's Antminer series' dominance across all ASIC versions isn't accidental—it represents the convergence of years of specialized chip design, thermal management innovation, and manufacturing optimisation. What makes this particularly significant is that each generation of mining hardware becomes the new baseline, forcing the entire network toward higher efficiency standards. Unlike many industries where older, less efficient equipment continues operating for years, Bitcoin mining's economic model naturally phases out inefficient hardware.

Table: *Bitcoin and Crypto ASIC Miner Profitability (in decreasing order of efficiency and operating margin, assuming electricity cost of 0.045 USD/kWh)*

Model	Release Date	Hashrate (TH/s)	Watts (W)	Efficiency (W/TH)	Revenue ($/day)	Profit ($/day)	Operating Margin (%)
Antminer U3S21EXPH	Sep-24	860	11180	13	46.6	30.5	65.4
Antminer U3S19XPH	Sep-24	514	10599	20.6	27.9	12.6	45.2
SEALMINER A2 Pro Hyd	Mar-25	500	7450	14.9	27.1	16.4	60.4
Antminer S21 XP+ Hyd.	Jul-25	500	5500	11	27.1	19.2	70.7
Whatsminer M63S++	May-24	478	7409	15.5	25.9	15.2	58.8
Antminer S21 XP Hydro	Jun-24	473	5676	12	25.6	17.9	68.1

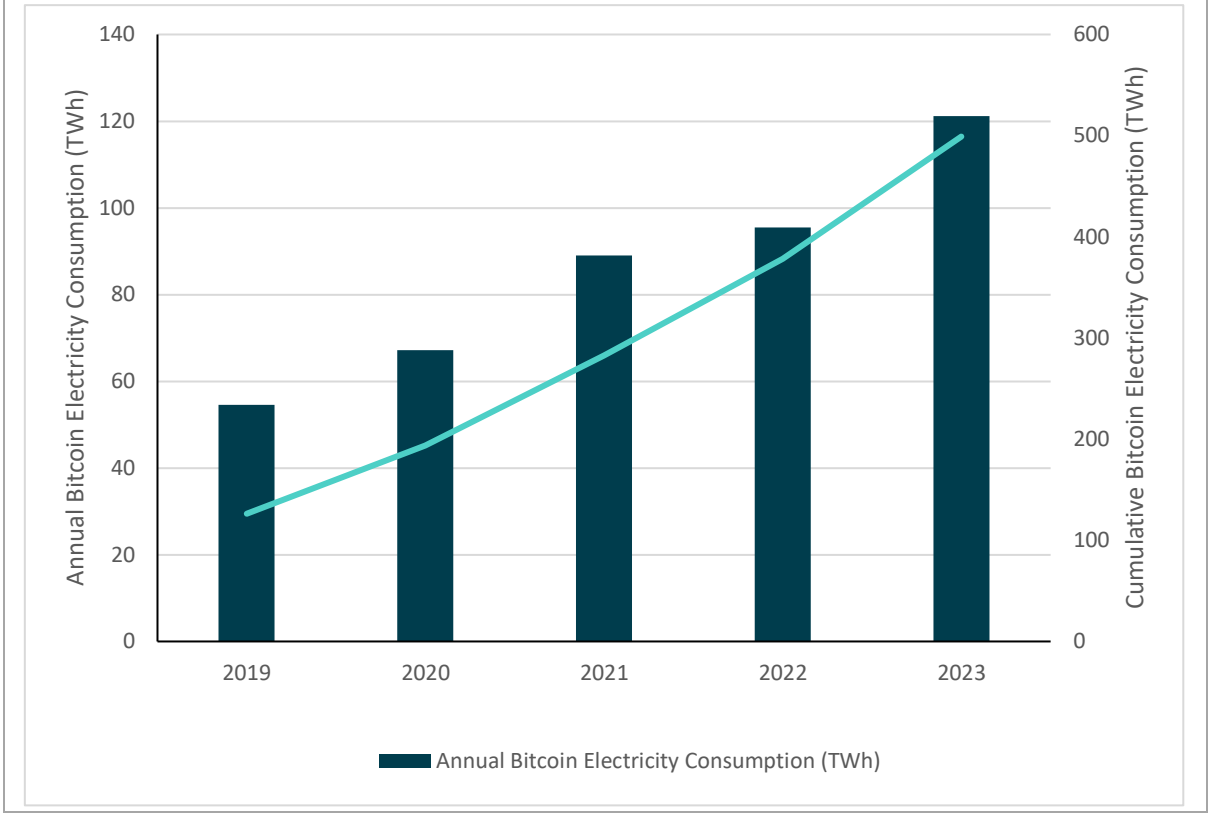
Source: Hashrate Index, AMINA Bank (4 September 2025)

Section 2.4: Energy Consumption Trends

The network's current power demand of 176 TWh annually is now sourced with over 55% from renewable energy. Public miners average 4.5 cents/kWh, while post-halving economics have significantly increased pressure on operations with higher energy costs

The chart below, with data published by CBECI, shows the estimated annualized consumption of energy by Bitcoin. The period analysed runs from January 1, 2020, to April 18, 2024, with Bitcoin's global electricity consumption estimated at 176.31 TWh, ranging from 90.81 TWh to 539.50 TWh.

Total Bitcoin Electricity Consumption



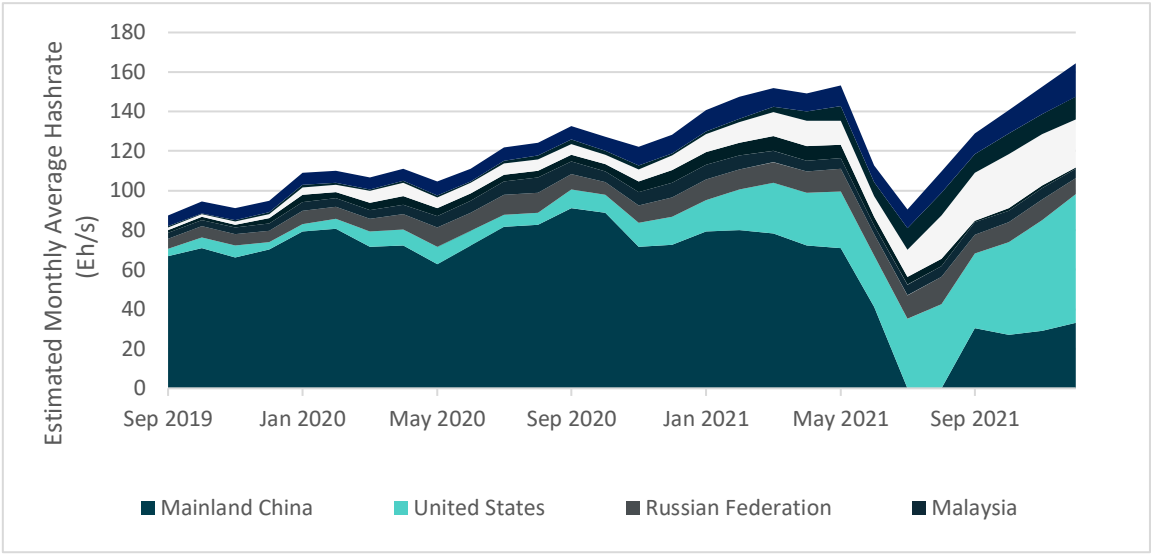
Source: AMINA Bank. CBECI (3 March 2025)

Section 2.5: Geographical Distribution of Mining Operations

Geographical Market Share and Strategic Approach

Prior to the 2024 Halving, as of January 2022, the United States, which held 37.84% of the global Bitcoin mining hashrate, remained the largest market. It benefited from stable regulations, abundant energy resources at relatively low costs, and easy access to capital. Major industry players included Marathon Holdings, Core Scientific, Riot, CleanSpark, and Bit Digital. However, despite these advantages, the U.S. market was deprioritised for 2024, mostly due to heightened competition and regulatory hurdles for crypto companies.

Evolution of Network Hashrate



Source: Cambridge Bitcoin Electricity Consumption Index (9 September 2025 but data only available up to December 2021)

The Asia-Pacific region (excluding China, Russia, and Kazakhstan) is a growing market, with countries like Singapore (1.96%), Australia (3.13%), Malaysia (2.51%), and Hong Kong (0.43%) contributing to the global hashrate. Key mining operations in this region included JKL Mining (Hong Kong), Bitdeer (Singapore), and Iris Energy (Australia). With increasing interest in mining hubs, particularly in Australia, the region presented expansion opportunities.

Canada, which represented 6.48% of the global hashrate, was home to established players such as Hut 8, Bitfarms, Hive, and DMG. While the country offered a stable environment for Bitcoin mining, the market's maturity suggested that further expansion required a feasibility study to assess its viability.

The Middle East, with a market share of 3-5%, presented promising opportunities for growth. The UAE led with 4% of the global hashrate, followed by Saudi Arabia and Oman, each contributing 0.10%. Phoenix Group and Zero Two were among the prominent mining firms operating in the region. With low energy prices, sustainability-focused initiatives leveraging natural gas and nuclear energy, and a favourable regulatory landscape for blockchain development, the Middle East was positioned as a strategic expansion region for miners.

Europe, which accounted for 5-10% of the global hashrate, offered attractive conditions for Bitcoin mining. Germany (3.06%), Ireland (1.97%), Sweden (0.84%), and Norway (0.74%) stood out as key locations. Northern Data, Argo Blockchain, and Genesis were major players in this region. The availability of renewable energy sources, a cool climate conducive to efficient mining operations, and strong access to capital made Europe a viable market for further expansion for miners.

China, Kazakhstan and Russia, which collectively held more than 40% of the global market share in 2021, has been deprioritised despite their significant contribution. China accounted for 21.11%, Kazakhstan for 13.22%, and Russia for 4.66% of the global hashrate. Bitmain remained a dominant player in these regions. However, due to regulatory crackdowns and increasing restrictions on cryptocurrency mining, these markets were no longer considered strategically important for 2024.

Table: *Geographical distribution of mining operations pre-Halving.*

Geographies	Market size – Hashrate share per country (%)	Largest player	Market observations
USA (38%)	USA: 37.84%	Marathon Holdings (24.7 EH/s) Core Scientific (22 EH/s) Riot (20.1 EH/s) CleanSpark (10.08 EH/s) Cypher Mining (7.2 EH/s) Terawulf (6.0 EH/s) Bit Digital (7.3 EH/s)	• Largest crypto mining market • Stable and clear policy environment • Abundant energy resources with relatively low prices • Easy access to capital
APAC ex. China/ Russia/Kazakhstan (7%)	Singapore: 1.96% Hong Kong: 0.43% Australia: 0.36% Malaysia: 2.51% Thailand: 0.96%	JKL Mining (Hong Kong) Bitdeer (Singapore, 2.1 EH/s) Iris Energy (Aus., 0.7 EH/s) BTC (3.2 EH/s)	Variety of markets in APAC becoming more relevant (e.g., Australia – Iris Energy)
Canada (6%)	Canada: 6.48%	Hut 8 (21.6 EH/s) Bitfarms (6.5 EH/s) Hive (3.32 EH/s) Sato (0.6 EH/s) DMG (0.6 EH/s)	Large established players already present in Canada (Hut 8, Bitfarms)
Middle East (3 to 5%)	UAE: 4% (according to 2023 data) KSA: 0.10% Oman: 0.10% Kuwait: 0.05% Turkey: 0.04%	Phoenix Group Zero Two	• Low energy price • ESG-friendly with natural gas and nuclear • Pro-Web3 destination with friendly policies and tax rates
Europe (5 to 10%)	Germany: 3.06% Ireland: 1.97% Sweden: 0.98% Norway: 0.74%	Northern Data (3.8 EH/s) Argo Blockchain plc (2.8 EH/s) Genesis (2.0 EH/s)	• Renewable energy resources in countries like Iceland, Norway, and Sweden • Cool climate = Northern European countries • Access to capital
Other (more than 40%)	China: 21.11% Kazakhstan: 13.22% Russia: 4.66%	Bitmain	Used to be prominent – crackdown on mining in China and Kazakhstan

Source: Statista, Cambridge Centre for Alternative Finance, Cointelegraph, Capital IQ. (February 2024)

Pre-Halving, the world's top Bitcoin mining pools all came from the USA and China, with top two pools (Foundry USA and AntPool) being responsible for more than half of Bitcoin's network hash.

Geographical Distribution of Mining Operations (Source)

- According to CBECI data from January 2022, the average monthly hashrate share by country was as follows:

Country	Hashrate share (%)
US	37.84%
China	21.11%
Kazakhstan	13.22%
Canada	6.48%
Russia	4.66%
Germany	3.06%
Malaysia	2.51%
Ireland	1.97%
Iran	0.12%
Other	9.02%

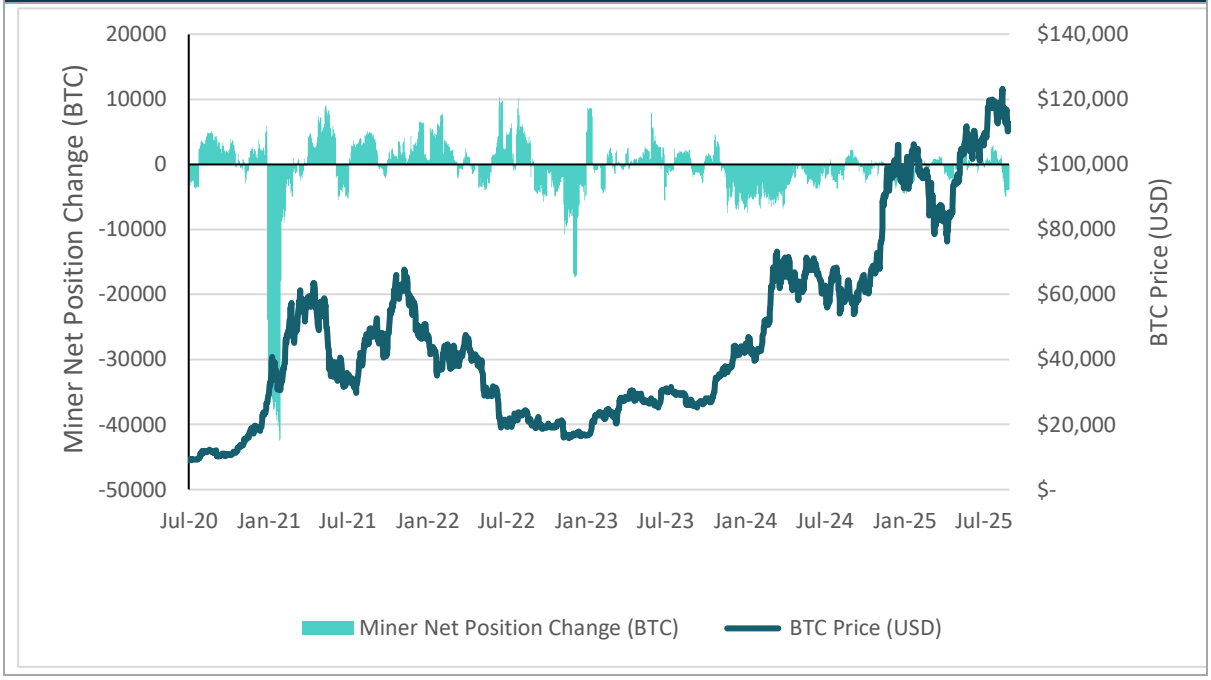
Since 2022, significant changes have taken place due to key cost factors and regulatory pressures on Bitcoin mining, influencing the global distribution. The approximate hashrate distribution as of November 2024 is as follows:

Country	Approx. Hashrate Share (%)
US	37%
China	20%
Kazakhstan	13%
Russia	11%
Canada	6%
Germany	5%
Iran	4%
Malaysia	3%
Norway	2%
Venezuela	1%

Section 2.6: Strategic Selling by Miners before Halving

The 2024 halving marked a significant departure from historical patterns, with miners liquidating holdings rather than accumulating reserves. This strategic shift was largely motivated by Bitcoin's unprecedented price surge beyond $73,000, providing opportunities to secure profits and fund operational improvements before the reward reduction.

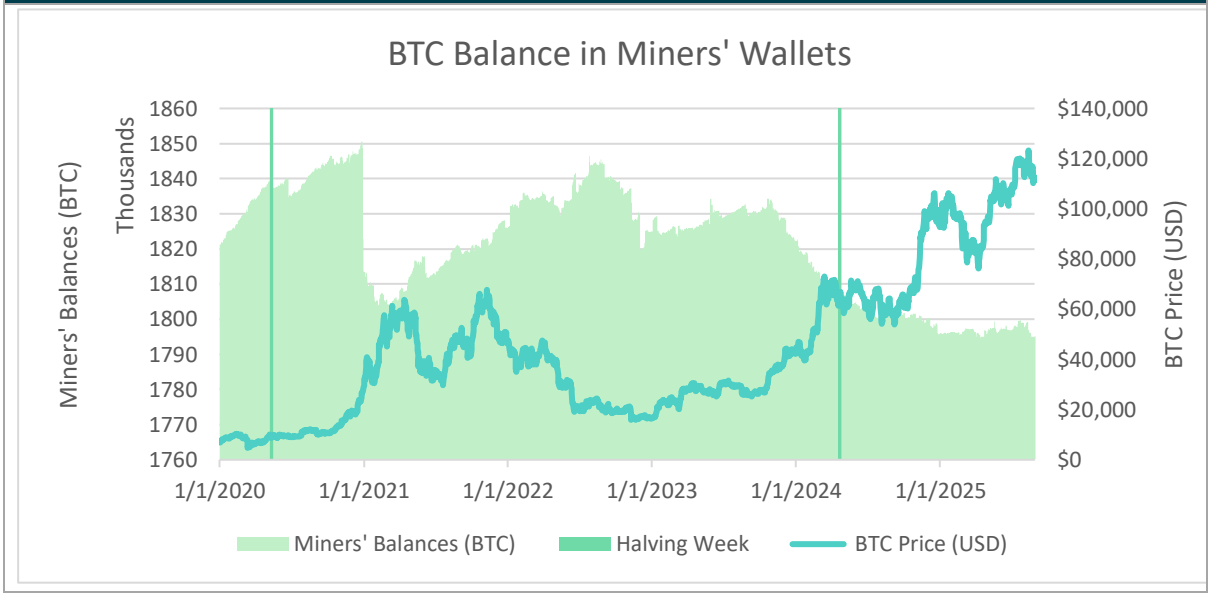
Miners' Net Position Change



Source: AMINA Bank, Glassnode (4 September 2025)

BTC miners experienced significant capitulation around April 2024, forcing less efficient operations out of the market. However, since July 2024, the mining landscape has shown resilience with reduced Bitcoin selling.

BTC Balance in Miners' Wallets



Source: AMINA Bank, Glassnode (4 September 2025)

Section 2.7: Consolidation in the Bitcoin Mining Industry

Major Bitcoin miners presented below are selected based on market capitalization, operational scale, and innovation in response to mining difficulty and environmental concerns.

1. **Marathon Digital Holdings:** Known for its aggressive expansion strategies, Marathon operates some of the largest mining farms in North America and continuously invests in state-of-the-art mining equipment to increase its hashrate.
2. **CleanSpark:** A pioneer in sustainable mining, CleanSpark integrates renewable energy sources into its operations, reducing its carbon footprint while maintaining strong hashrates and competitive share prices.
3. **Riot Blockchain:** Headquartered in North America, Riot Blockchain has made significant investments in mining equipment to boost its hashrate and expand its mining capacity.
4. **Core Scientific:** Known for technological innovation, Core Scientific operates advanced mining farms globally and emphasizes research and development to maintain high profitability and efficiency.
5. **Bitdeer Technologies Group:** A global leader offering a full suite of services from mining operations to hosting and cloud solutions, with a diverse business model and strong technological capabilities.
6. **Other notable players** include Hut 8 Mining Corp, Hive Digital Technologies, Canaan Inc., and Bit Digital Inc.

The performance of publicly traded Bitcoin mining stocks has exhibited higher volatility compared to Bitcoin's price movements, with companies possessing stronger balance sheets and more efficient mining equipment, such as Hut8, Bitdeer and Core Scientific, outperforming their peers.

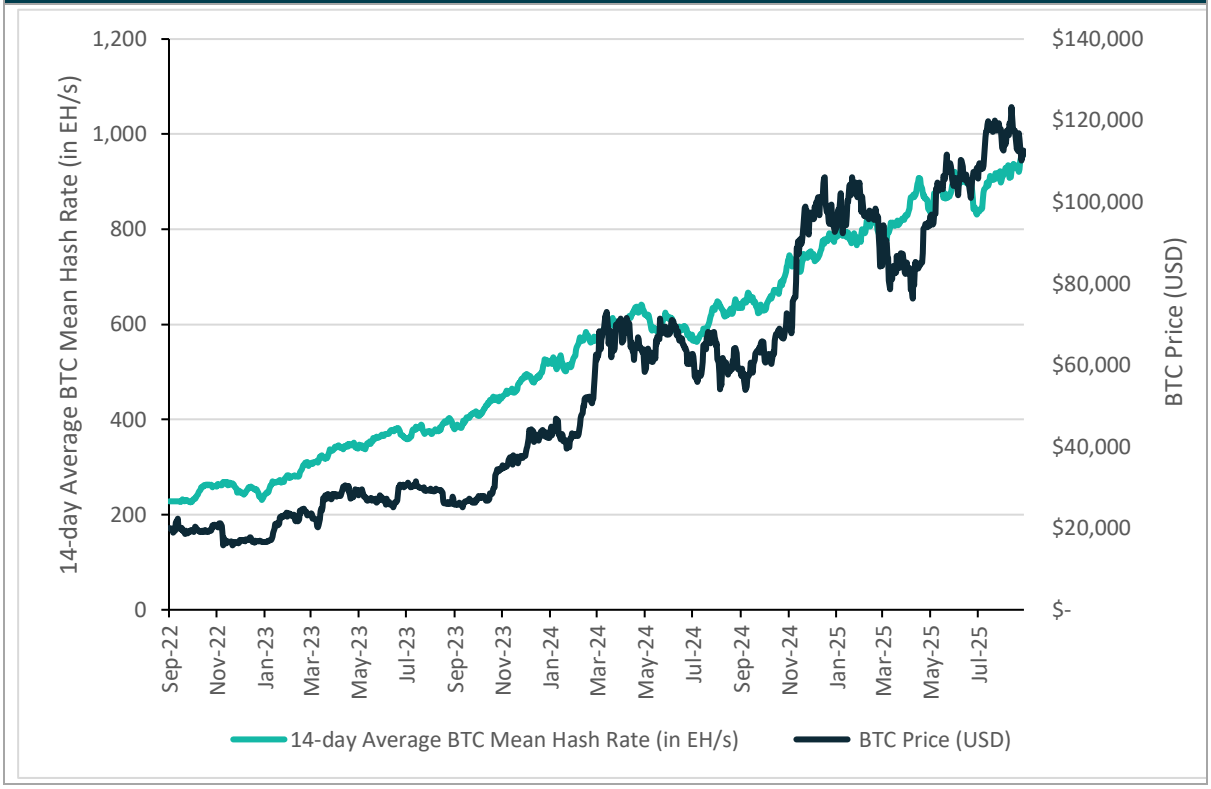
At the time of the 2024 Halving, the largest public miners were Bitfarms Ltd. (BITF), Marathon Digital Holdings (MARA), Bit Digital (BTBT), CleanSpark Inc. (CLSK) and Iris Energy (IREN). Not surprisingly, their Bitcoin balances were near an all-time low. This came at the back of heavy selling as they scrambled to take profits ahead of the halving. Over time, miners build up a reserve of the bitcoins they receive, and oftentimes those are sold ahead of halving events to cover costs of operations and equipment as mining gets more competitive.

Section 3: Industry Response: Strategy, Risk, and Innovation

Section 3.1: Operational Adjustments

The 2024 halving significantly impacted the mining industry, with difficulty increases in the months leading up to the event as miners maximized rewards before the cut.

Bitcoin Hashrate

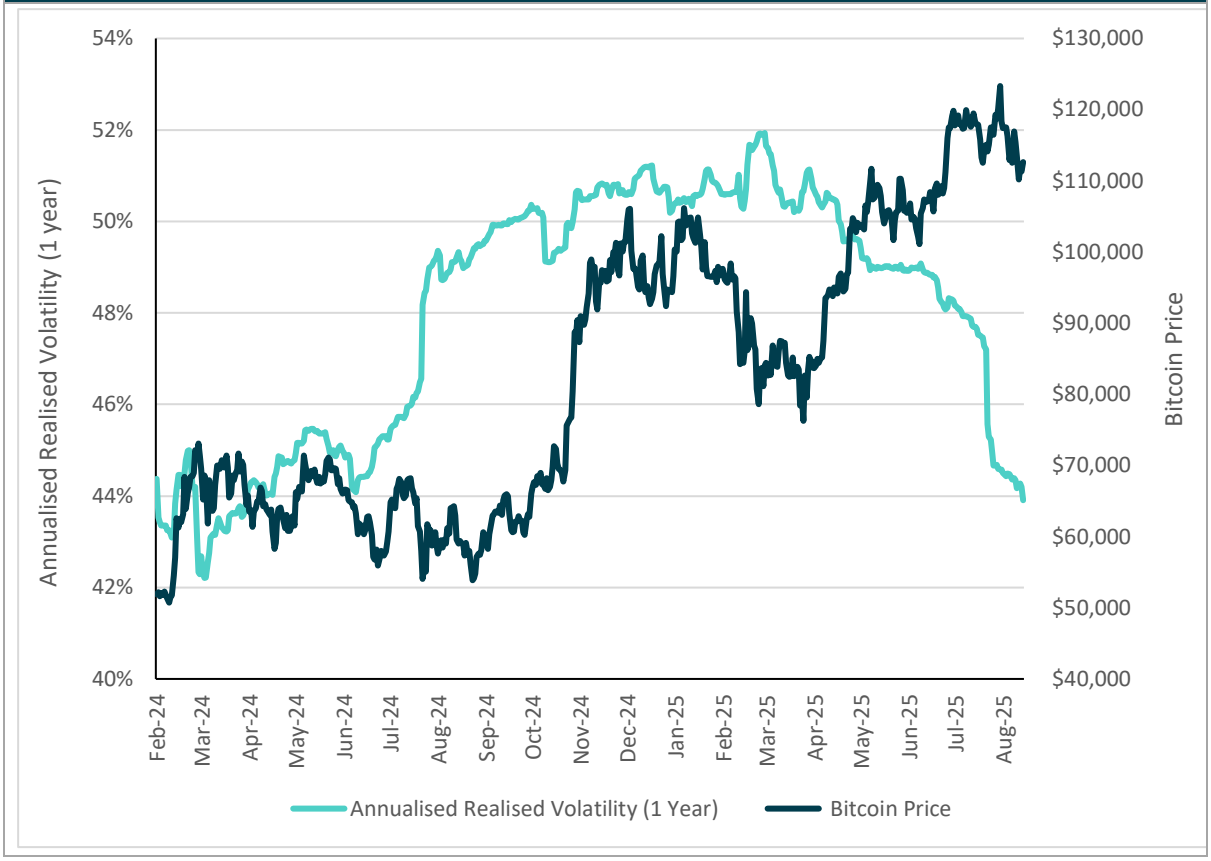


Source: AMINA Bank, Glassnode (4 September 2025)

Hedging

Bitcoin's volatility averages 8x that of high yield bonds and 4x that of domestic equities, making hedging critical for mining operations.

Bitcoin Hashrate



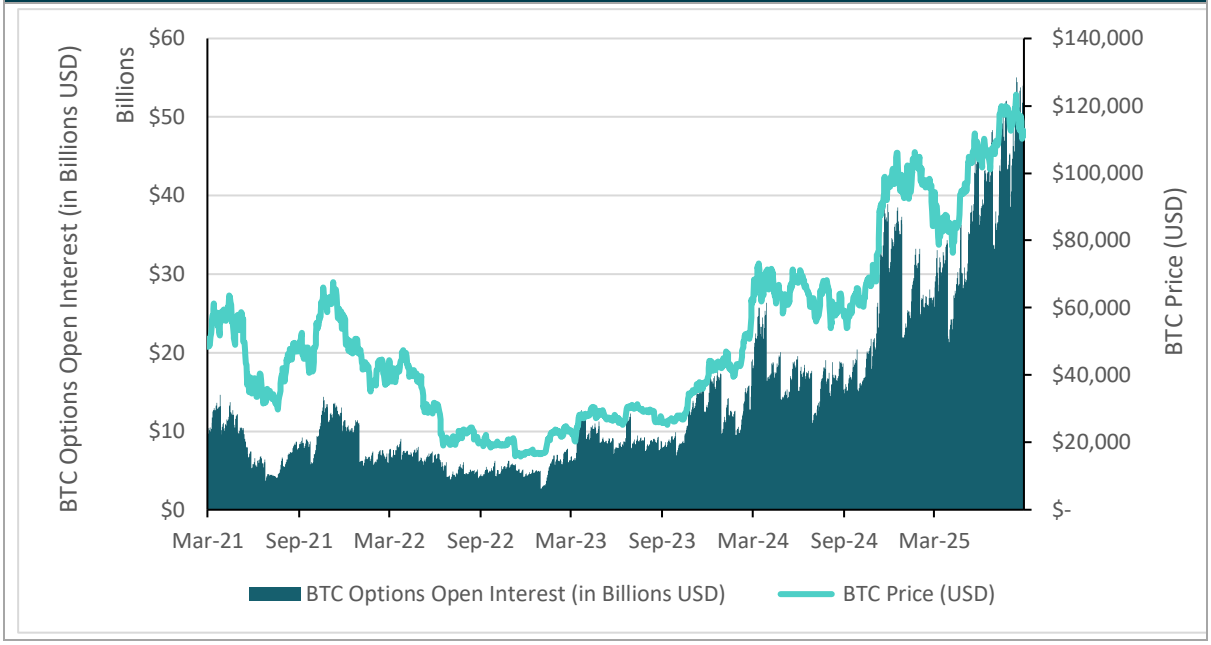
Source: AMINA Bak, Glassnode (4 September 2025)

Miners use derivatives to protect against volatility, including forward swaps to lock in prices above spot and put options for minimum price protection. These transactions enable pre-set profitability levels and cash flow certainty.

Hedged miners may benefit from price drawdowns, as hedges offset price falls while potentially increasing market share if hashrate declines.

Sharp increase in BTC futures open interest around halving suggest hedging activities by sophisticated players.

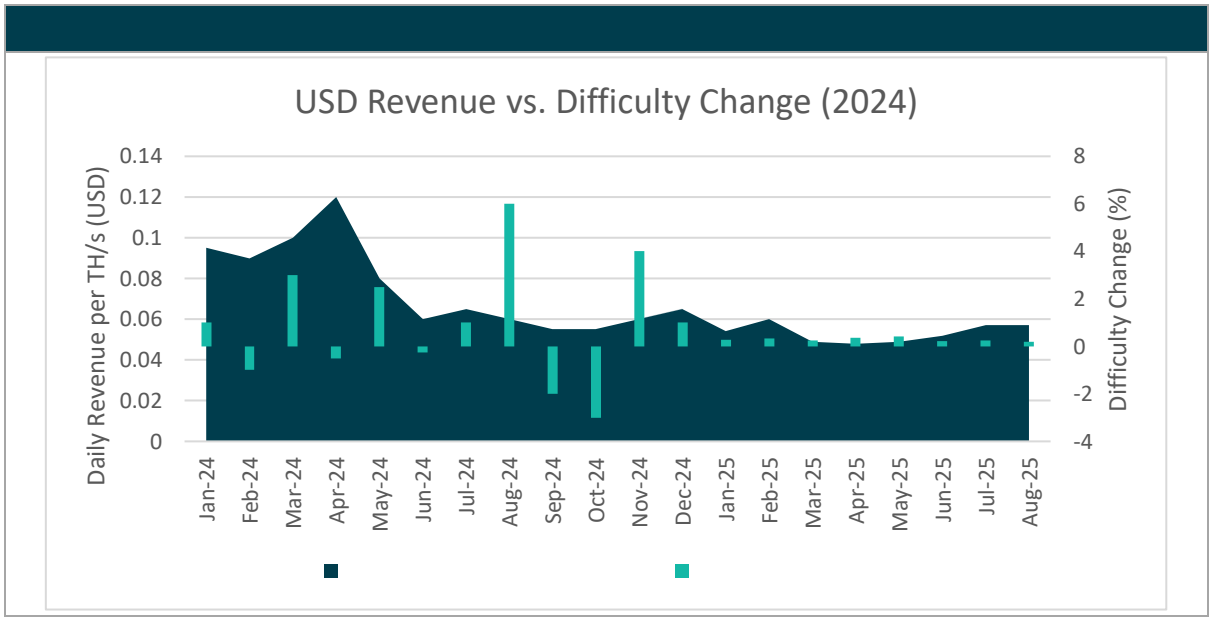
BTC: Options Open Interest



Source: AMINA Bank, Glassnode (4 September 2025)

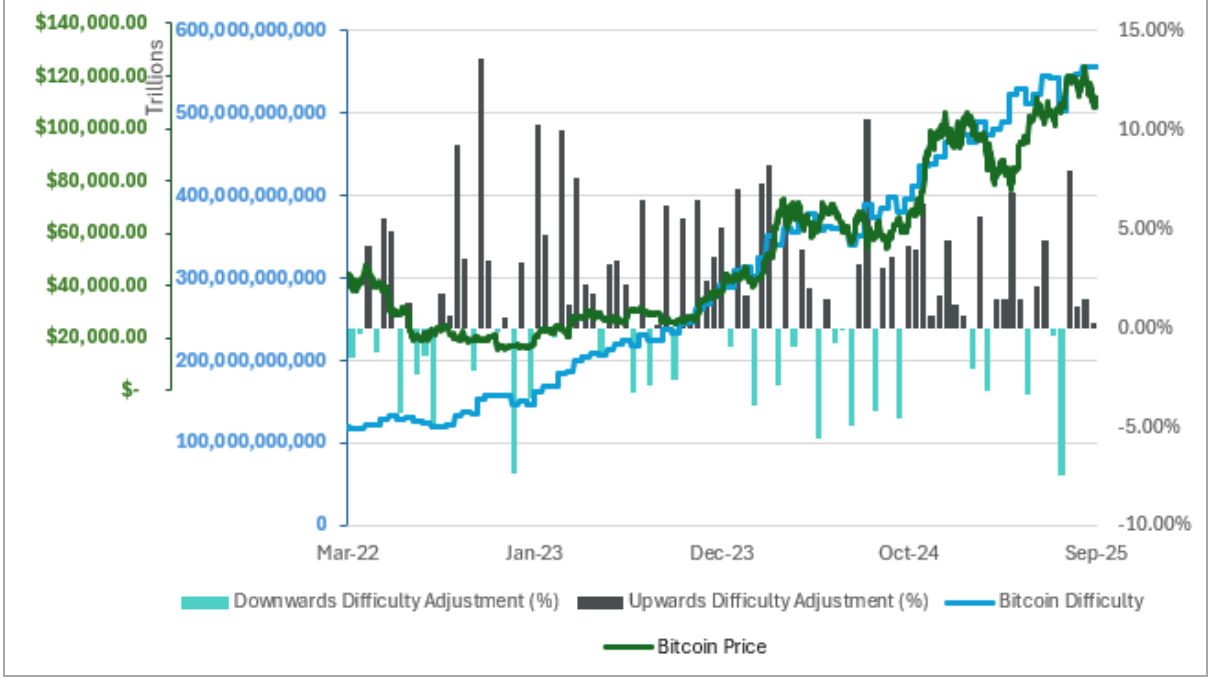
Turning off inefficient rigs

Post-halving, simple measures of revenue indicate the mining industry's income remains relatively elevated, averaging close to $30M per day.



As evidenced by an 11.2% drop in weekly hashrate from 650 EH/s to 577 EH/s, miners are assessing the viability of their operations under tighter margins. However, Bitcoin's recent -5.62% difficulty adjustment - the largest downward move since late 2022 - will alleviate some pressure by easing the work required for mining new blocks.

Bitcoin Difficulty Adjustment (%)



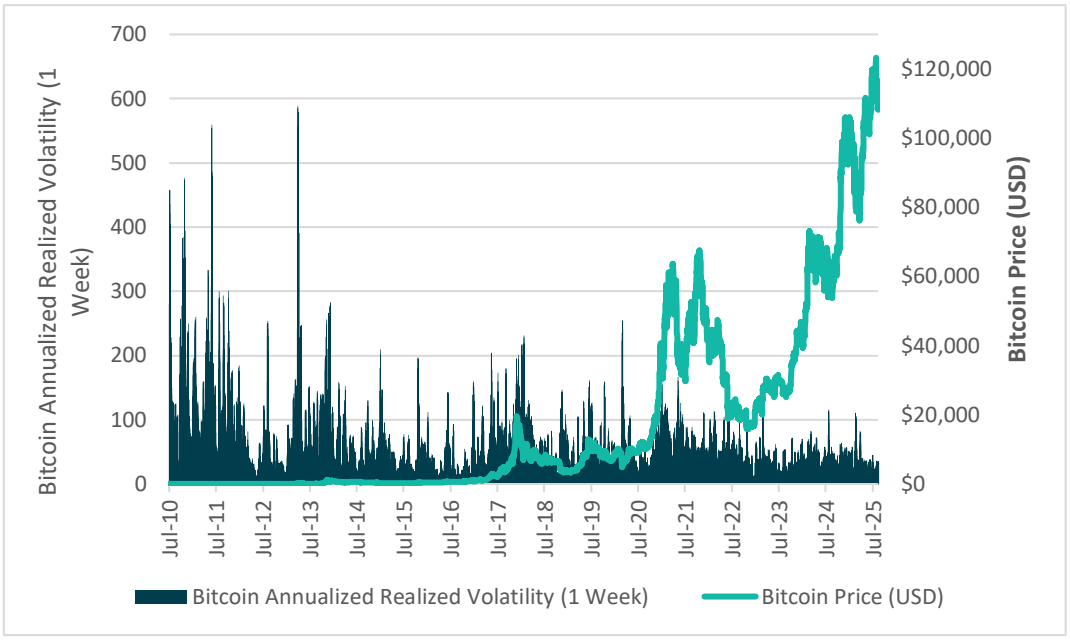
Source: AMINA Bank, Glassnode (4 September 2025)

Section 3.2: Navigating Market Volatility

Despite the predictable nature of halving, questions remained about the mining industry's resilience, transaction fee compensation, and broader market implications. Though the block subsidy was predictably slashed 50% on block 840,000, mining revenue concerns were temporarily alleviated by the flurry of fees that followed.

1. Increased Volatility
   - Halving events lead to heightened market volatility, with immediate price surges and potential periods of consolidation.

BTC Annualized Realised Volatility (1 week)



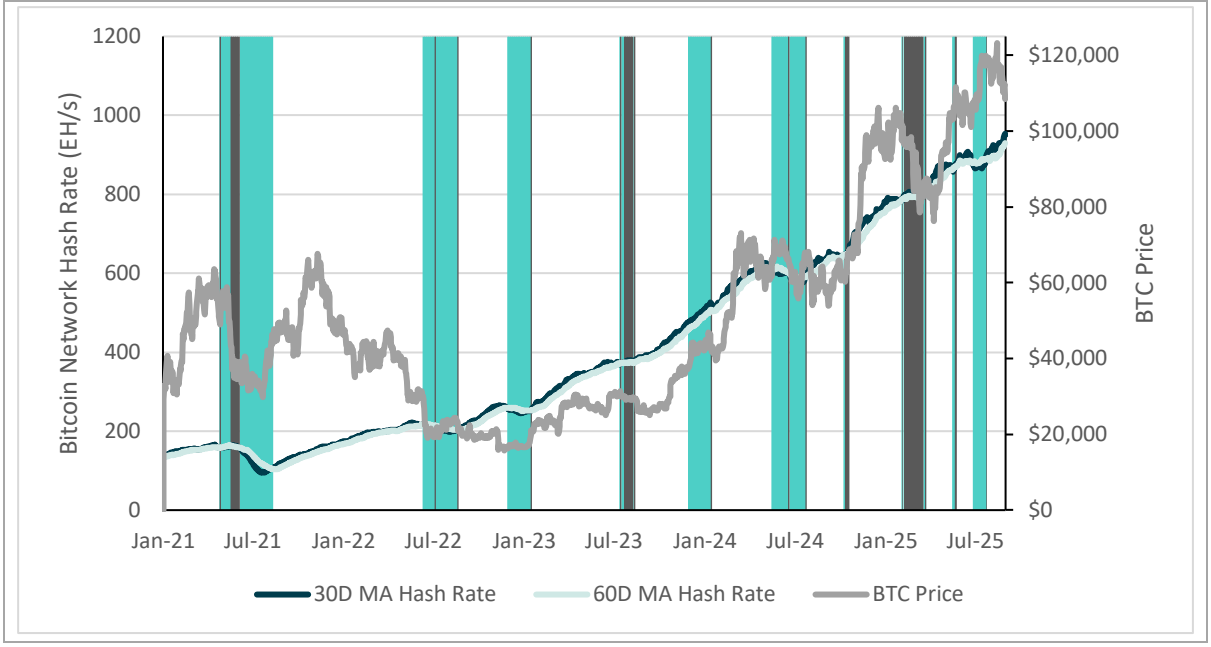
Source: AMINA Bank, Glassnode (4 September 2025)

2. Market Sentiment and Speculation

Post-halving, miner revenue dropped significantly due to reduced rewards and low transaction fees, with revenue falling below $0.05 per terahash leading to miner capitulation.

The Hash Ribbons Indicator, a blend of short and long-term hash rate moving averages recently flashed a classic Bitcoin buy signal. When the 30-day moving average (blue line) crosses back above the 60-day (orange line), it signals the end of miner capitulation and the beginning of renewed miner strength. Visually, the background of the chart shifts from red to white when this crossover occurs. This has often marked powerful inflection points for BTC price.

Hash Ribbon



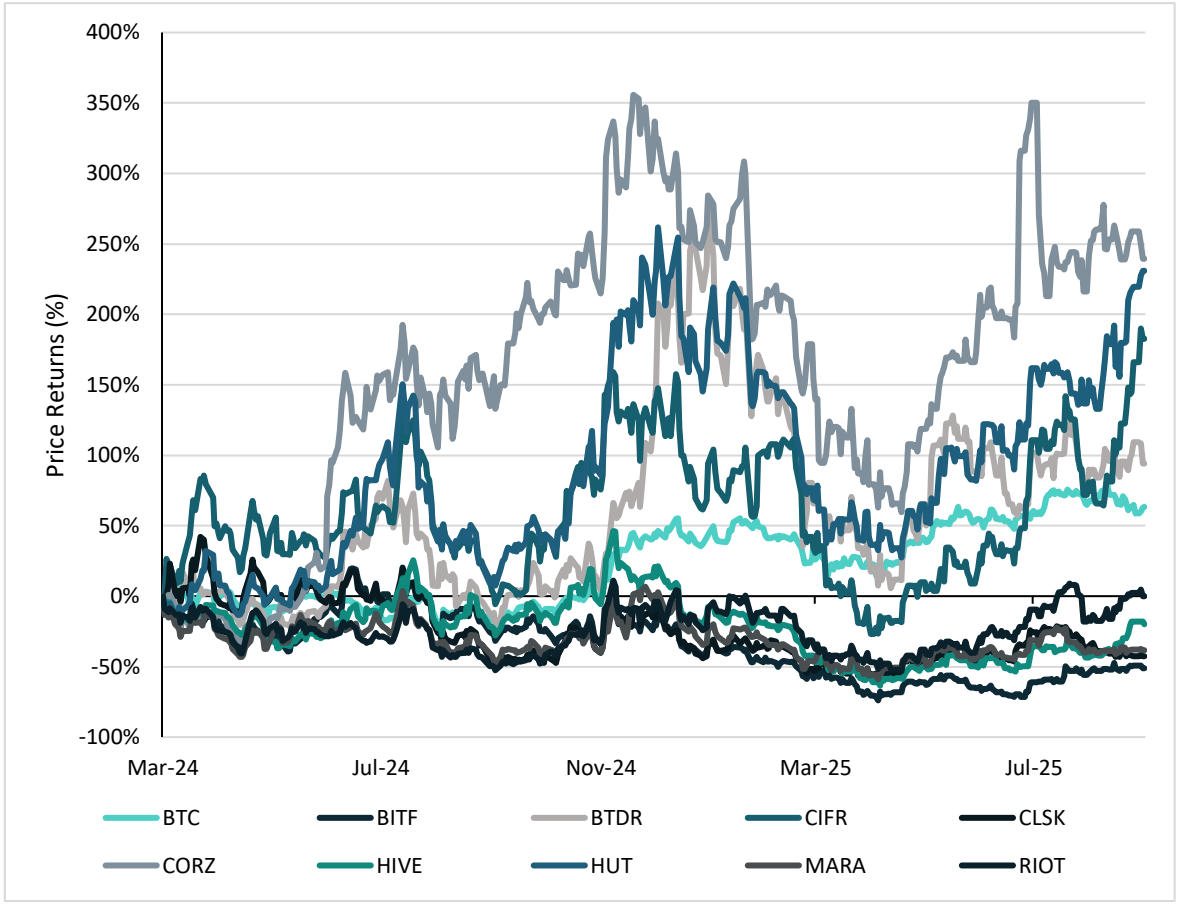
Source: AMINA Bank, Glassnode (4 September 2025)

Section 3.3: Performance of Publicly Traded Bitcoin Mining Stocks

The performance of publicly traded Bitcoin mining stocks has shown strong correlation with Bitcoin's price movements, but with notably higher volatility. As Bitcoin has reached new all-time highs in 2024, mining companies have experienced significant price appreciation, though their trajectories have varied based on factors like operational efficiency, debt levels and mining capacity.

Key mining companies like Marathon Digital Holdings (MARA), Riot Platforms (RIOT) and CleanSpark (CLSK) have seen their stock prices surge several hundred percent from their 2023 lows, though performance varied based on balance sheet strength and equipment efficiency.

Price Returns of Public Bitcoin Mining Companies and BTC



Source: AMINA Bank, Glassnode (4 September 2025)

Several factors are driving this price action. Mining companies have high fixed costs in terms of equipment and electricity, meaning that increases in Bitcoin's price can lead to greater improvements in profitability. This explains why mining stocks often exhibit greater volatility than Bitcoin itself, which appreciated in value by 54.3% during the same period.

The Bitcoin halving impacts valuations as investors price in both the reduction in mining rewards and the historical pattern of price appreciation, while many miners' Bitcoin holdings have strengthened their positions.

However, it's important to note that these stocks face unique risks beyond Bitcoin's price movements. Energy costs, equipment obsolescence and regulatory concerns can significantly impact their performance. Additionally, competition in the mining space continues to intensify, potentially pressuring margins even in a rising Bitcoin price environment, which could lead to M&A activity and consolidation in the mining industry.

Section 4: Mining Infrastructure and Technology Landscape

The crypto mining industry is undergoing significant long-term changes, particularly in response to the recent Bitcoin halving and ongoing market pressures. These changes are characterized by strategic adjustments in mining operations, consolidation of firms, and varying impacts on smaller players compared to larger entities.

Section 4.1: Mergers and Acquisitions

Financial difficulties have prompted speculation about bankruptcies and acquisitions within mining industry, with larger operators seizing opportunities as smaller firms struggle, leading to industry M&A activity.

Chart: Major Mining Pools Before and After 2024 Halving

Before Halving (1 Feb 2024)		Current (1 Sep 2025)	
Foundry USA	30.22%	Foundry USA	27.66%
AntPool	25.50%	AntPool	13.98%
ViaBTC	12.62%	ViaBTC	13.68%
F2Pool	12.54%	F2Pool	12.16%
Binance Pool	4.27%	SpiderPool	10.33%
MARA Pool	2.71%	SecPool	2.43%
Luxor	2.42%	MARA Pool	3.95%
SBI Crypto	1.95%	SBI Crypto	2.74%
SecPool	1.71%	Other	2.43%
BTC.com	1.53%	Luxor	4.26%
BraiinsPool	1.50%	Binance Pool	1.22%
Poolin	0.97%	BraiinsPool	1.82%
Other	0.95%	Poolin	0.3%
White Pool	0.42%	Ocean	2.13%
Ultimus Pool	0.32%	BTC.com	0.3%
Ocean	0.21%	Mining Core	0.61%
1Thash	0.08%		
Mining Dutch	0.03%		
Solo CK	0.03%		
SpiderPool	0.02%		

Source: Hashrate Index (1 September 2025)

Foundry USA, already the world's largest Bitcoin mining pool by hashrate, more than doubled its computing power, starting the year at 157 EH/s in January and closing it at an impressive 280 EH/s by December 2024. This is a growth of 68% within one year and thus puts Foundry in charge of 36.5% of the total hashrate on the Bitcoin network.

The **MARA Pool** also grew remarkably to scale its hashrate to 32 EH/s, which accounted for 4.35% of global hash power. Combined, these pools have played a key role in increasing the U.S. share of Bitcoin mining power.

Chinese mining pools command an estimated 55% of the global hashrate, according to CryptoQuant CEO Ki Young Ju. That's despite a 2021 ban on cryptocurrency mining in China. Chinese miners continue to circumvent restrictions through virtual private networks (VPNs) and P2P applications that allow them to contribute to mining pools anonymously.

Geographical distribution is complex, with mining polls headquartered in specific countries but hashrate coming from international participants. For example, Bitmain, a leading mining hardware manufacturer, reportedly sold 32 EH/s of U.S.-generated hashrate to a Chinese company in late 2024, further blurring regional distinctions.

Foundry USA's hashrate grew exponentially over the year, widening its lead over Antpool by nearly 100%. According to real-time data from Cloverpool (formerly BTC.com), Foundry's hashrate increased from 157 EH/s at the beginning of the year to approximately 280 EH/s by December 2024. In contrast, **Antpool's** growth was more modest, rising from 130 EH/s to just 147 EH/s—well below bitcoin's overall network hashrate growth of 49%, which surged from 521 EH/s to 778 EH/s during the same period.

By December, two U.S.-based pools—Foundry and MARA Pool—were responsible for 38.5% of all bitcoin blocks mined, up from 32.4% at the start of the year and a mere 18% in January 2022, as shown in the chart above. This percentage doesn't even account for U.S.-based hashrate connected to smaller pools like Luxor, which mines about 1.5% of bitcoin blocks with 60-80% of its hashrate from U.S. customers. Additionally, there's the opaque segment of U.S.-based hashrate tied to international pools. For example, Bitmain sold approximately 32 EH/s of U.S.-energized hashrate to a Chinese company in November, potentially contributing another 4% to the U.S.-based total, albeit likely connected to Antpool.

It's worth noting that some growth may stem from hashrate redirection. Nevertheless, Foundry and MARA Pool posted annual growth rates of 68% and 168%, respectively outpacing bitcoin's network growth and underscoring the rapid acceleration of North American bitcoin mining.

Impact on Small Operators

- For smaller Bitcoin mining companies, the halving can be particularly challenging.
- Larger mining firms generally have better access to financing options, enabling them to invest in advanced technology and infrastructure. In contrast, smaller miners may struggle with high debt levels and limited financial resilience, making it difficult for them to survive prolonged downturns in profitability.
- These companies may struggle to maintain profitability due to the reduced rewards and may face increased operational costs. This could lead to a consolidation in the mining industry, where smaller miners either exit the market or are acquired by larger, more efficient mining operations.
- As consolidation continues, the industry risks becoming dominated by a few large players. This shift could undermine the decentralized ethos that Bitcoin was originally designed to promote, as fewer entities control a greater share of the mining capacity.

Following the Halving, vertical integration became a key approach to business expansion for miners. According to a report by Galaxy Digital, public miners invested approximately $404,000

per MW for power access post-Halving, encompassing both immediate and future needs. Additionally, with a rise in demand for power, even economically weak miners with access to power assets became attractive acquisition targets. Hyperscalers, for example, faced a shortage of power capacity relative to their service demand needs and were willing to pay substantial premiums for it. Last year, Amazon Web Services purchased capacity for $677,000 per MW, significantly higher than the average mining transaction cost per MW in 2024.

Bitfarms' (BITF) planned acquisition of Stronghold Digital Mining (SDIG) is evidence of the M&A trend post-Halving. Meanwhile, Hut 8 Mining and US Bitcoin Corp. closed a "merger of equals" in November. Additionally, Marathon Digital more recently acquired sites in Nebraska and Texas, while CleanSpark bought three facilities in Mississippi.

Section 4.2: Exploring Different Revenue Streams

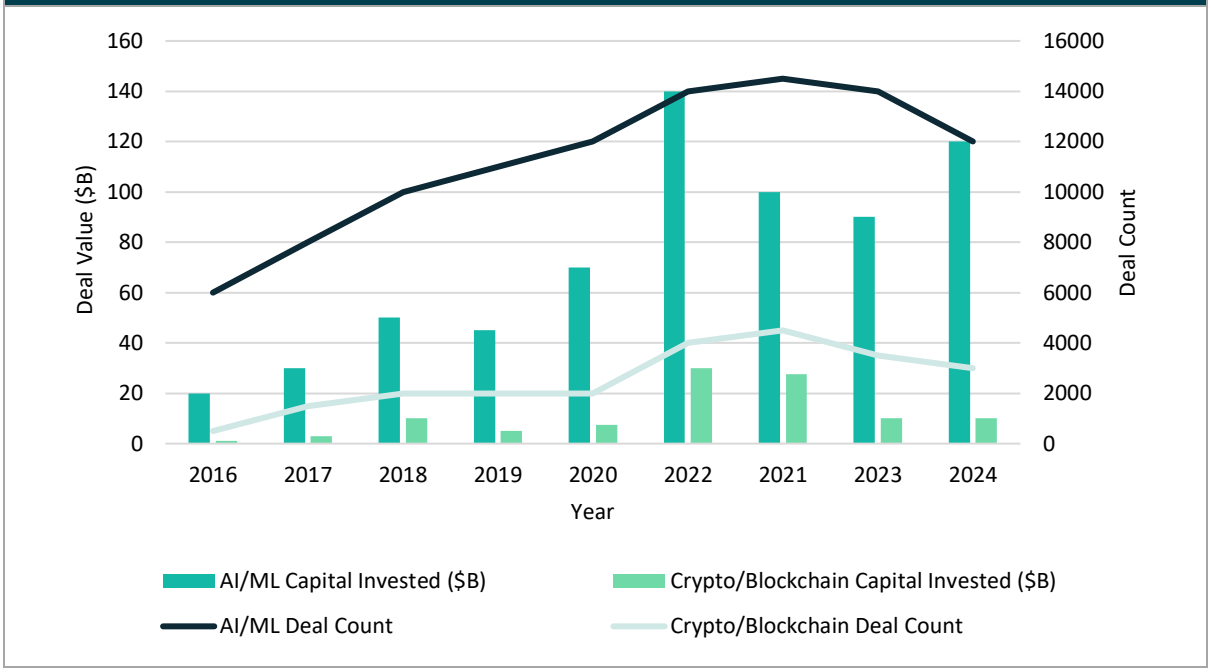
Many operators are diversifying beyond pure-play mining, reinventing themselves as generalized infrastructure providers in an attempt to secure hosting contracts for power-hungry AI applications. At the same time, improvements in chip efficiency continue unabated, forcing miners to contemplate whether to push forward with aging ASIC hardware or perform comprehensive fleet upgrades.

Section 4.2.1: AI and High-Performance Computing Opportunities

Another interesting possible future for miners is where players who combine mining with artificial Intelligence (AI) computing and chip manufacturing gain a competitive edge. Bitdeer, for example, is currently utilizing only 36% of its power and is evaluating the potential of allocating its energy resources to AI and high-performance computing (HPC) companies to generate income. The company has established numerous data centres and is assessing their suitability for use as AI or HPC data centres. Additionally, Bitdeer is venturing into the production of chips specifically designed for Bitcoin mining.

According to Pitchbook, more than $680bn has been invested into AI and machine learning startups across more than 100k deals since 2016, with $120bn invested just in 2024. This surge in AI and high-performance computing (HPC) is creating massive demand for data centre capacity.

AI/ML vs Crypto/Blockchain Venture Investment vs Deal Count (2016-2024)



Source: Galaxy Digital (15 January 2025)

Bitcoin miners are positioned to supply the energy demands needed from hyperscalers because they possess large-scale, power-ready facilities. By stepping into these power-ready Bitcoin mining sites, hyperscalers can bypass the lengthy process of securing energy availability and focus on retrofitting and customizing the infrastructure to meet their specific needs. Despite key differences between traditional Bitcoin mines and AI data centres, miners bring valuable experience in large-scale construction and data centre management, often with established electrical, mechanical, facilities, and security teams in place. This expertise can further streamline the transition for hyperscalers looking to scale quickly.

However, not all miners could be able to profit from this opportunity. To build AI/HPC suitable data centres, several critical factors must be met, including access to large scale acreage, water for cooling, dark fibre, reliable power, and a skilled labour force. Unfortunately, even if these qualifications are met, companies that don't already have the necessary approvals in place (i.e. for power capacity, land, and zoning) or already possess critical long-lead time infrastructure components will encounter roadblocks and delays in development. Another critical reason why not all Bitcoin miners can capitalize on the AI/HPC opportunity is that existing infrastructure for miners is not directly transferable or suitable for AI data centres due to differences in design and operational requirements. While there are some similarities on the key electrical infrastructure, including high voltage substation components and the distributions systems, there are specific requirements for AI data centres that require nuanced expertise and a skilled labour force.

Value Creation Through AI/HPC Transition

So, for those miners who take a leap into this AI revolution, what can we expect? Companies reallocating their power and data centre resources from Bitcoin mining to AI/High-Performance Computing (HPC) can realise significant value accretion. One notable advantage is the high cash flow margin and predictability offered by AI/HPC data centre operations. These setups are supported by long-term contracts with fixed and recurring cash flows often secured before the

construction of the data centre. These contracts typically involve creditworthy counterparties and enable operators to pass costs, including energy and operational expenses, to tenants depending on the lease structure. This results in predictable, high-margin revenue streams.

Additionally, AI/HPC operations offer diversification of cash flows, providing revenues that are not only more predictable than Bitcoin mining but also uncorrelated with the volatile crypto markets. This smooths revenue profiles for companies exposed to crypto, enhancing financial stability, especially during Bitcoin bear markets. Such stability enables miners to raise equity or debt capital with reduced dilution or interest burdens.

Another key benefit lies in the access to deep capital markets that can aid in scaling operations. Although data centre infrastructure is costlier than Bitcoin mining, its predictable cash flows make it more straightforward to underwrite investments. This opens opportunities to secure funding from private equity firms, infrastructure investors, pension funds and life insurance companies eager to gain exposure to the data centre sector for its attractive yields. Operators with creditworthy lease agreements can leverage these to raise substantial project financing for data centre construction.

Finally, there is significant valuation accretion potential in shifting to AI/HPC. Stabilised data centre assets command substantially higher valuations compared to Bitcoin mining operations, thanks to their high margins, predictable cash flows and reduced market volatility.

Financing Strategies for AI/HPC Transitions

Financing strategies for AI/HPC transitions leverage existing mining infrastructure for high-value computing applications. Bitcoin miners can unlock this liquidity by entering sale-and-leaseback agreements on their ASIC fleets, retaining the flexibility to retrofit GPUs or FPGAs later. They may also secure revolving credit lines backed by existing hardware at more attractive rates than unsecured borrowing.

Some operators have even turned to tokenising compute capacity. This involves issuing digital tokens that grant future AI/HPC cycles and raise capital up front. Long-term, off-peak power-purchase agreements financed by third parties enable miners to cover electricity costs today in exchange for a share of tomorrow's AI-derived revenue.

Another low-cost strategy is issuing convertible debt at lower interest rates. Convertible debt instruments tied to AI revenue milestones allow outstanding obligations to convert seamlessly into equity or profit shares once targets are met. Additionally, miners can apply for government and industry grants aimed at high-performance computing, using their current data-centre footprint as matching collateral. Finally, strategic partnerships with hyperscale or specialised AI cloud providers can bring co-investment and priority access to premium workloads by offering partial infrastructure ownership.

Section 4.2.2: Partnership structures for Infrastructure Sharing

Partnership structures for infrastructure sharing enable cost optimization and risk distribution among mining operators. Miners can form a joint-venture special purpose vehicle (SPV) to co-own a dedicated facility, pooling capital for power contracts and hardware purchases. In this structure, each operator holds equity proportional to their investment, so both upside and downside are shared fairly.

Miners can also join a co-location consortium, aggregating demand in a neutral data-centre to negotiate bulk-rate electricity and rack-space discounts. Operating expenses like cooling and maintenance are split by rack usage, so no single miner bears the full cost if prices spike.

Another approach is for miners to opt for a revenue-sharing hosting agreement, where a host installs and maintains the facility and takes a percentage of mining rewards instead of fixed fees. This aligns the host's incentives with uptime and shifting part of the capital risk off the miners' balance sheets. Miners can also co-invest in mining units deployed at multiple sites, sharing ownership of each module. When demand grows, they buy more at volume discounts, and when markets soften, they can redeploy units without any one single miner shouldering the entire burden.

Lastly, miners can even spin off their real-estate and power assets into an infrastructure real estate investment trust (REIT), leasing back capacity at predictable rates and earning dividends from institutional investment. This removes heavy upfront site costs and unlocks liquidity for further expansion.

Section 4.3: Treasury Strategy Framework

Competitive Bitcoin miners implement sophisticated treasury strategies to navigate the volatile cryptocurrency landscape while maintaining operational sustainability. The framework centres on three core pillars: hedging strategies using derivatives, strategic asset liquidation decisions and comprehensive cash flow management during market volatility.

Section 4.3.1: Hedging Strategies

Hedging strategies using hashrate derivatives and Bitcoin forwards is a common approach to risk management for Bitcoin miners. Hashrate derivatives allow miners to hedge against fluctuations in mining revenue by locking in fixed prices for future hashrate. These financial contracts function similarly to commodity futures, allowing miners to secure predictable cash flows regardless of Bitcoin price volatility or network difficulty changes. Network hashrate futures provide agreements to buy or sell hashrates at future dates for agreed-upon prices. The instrument is settled in cash, meaning instead of the hashrate exchanging hands (which would be pretty difficult), it's executed using the Hashprice Index, which is the cash value of the hashrate. OTC hashrate derivatives and fee swaps offer customized hedging solutions for larger operators.

Example:

Let's say you're running a mid-sized mining farm and you're producing 500 PH/s of hashrate. It's February, and you're worried that your mining revenue will fall after the halving in April. So, you sell a three-month hashrate futures contract for April delivery at $70 per PH/day.

Now, when April rolls around, suppose the hash price actually drops to $55 per PH/day. Because you locked in $70, your futures contract pays out the difference—$15 per PH/day. That helps cushion the blow to your operations.

On the flip side, the buyer of your contract believed revenue would rise. They were wrong and absorbed the loss this time, just like in any other market.

Section 4.3.2: Cash Flow Management

Cash flow management during volatile periods for Bitcoin is another key factor for long-term survival. This demands strong financial controls and risk monitoring systems. Miners need to maintain cash reserves in non-crypto currencies or in stablecoins (which are cryptocurrencies pegged to a fiat currency of their choice), manage leverage carefully, and prepare for margin

calls on their Bitcoin-collateralised debt positions. Successful operators generally implement monitoring systems measuring different metrics.

For example, Bitcoin mining pool distribution reveals concentration risk by showing if too much hashrate is tied to a single pool, helping miners hedge against sudden reward shifts. Monitoring block difficulty adjustments helps in identifying upcoming changes in required compute power, allowing miners to anticipate rising energy and hardware costs. Tracking miner revenue per terahash tracks real-time profitability metrics, enabling miners to adjust operations or switch pools before margins erode. Ultimately, integrating disciplined cash management with real-time risk monitoring helps miners to weather market volatility and sustain long-term profitability.

Section 4.4: Banking and Financial Services

The specialised nature of the Bitcoin mining business model requires tailored financial services that understand the unique challenges and opportunities within the cryptocurrency ecosystem.

Specialised Crypto-friendly Banking Options

In the past, miners often found their Bitcoin proceeds trapped in traditional bank accounts: payments would be delayed for days, high fees and unfavourable exchange rates ate into margins. Compliance teams sometimes froze accounts at the slightest hint of crypto activity. This forced many to rely on informal money-service operators or delay critical purchases of power and equipment.

However, times have changed. Crypto-friendly banking options have emerged in the last decade to serve miners' complex needs. Offering comprehensive business banking tailored to Bitcoin miners, these banks provide both fiat and crypto deposit options, competitive overdraft facilities and streamlined payment solutions. This lets miners turn their Bitcoin earnings into ready cash in seconds so they can cover energy bills or buy new rigs without waiting days for settlements. Low-fee OTC trading, efficient cross-border fund management, institution-grade KYC/AML compliance processes and support specifically designed for mining operations is the need of the hour, and these banks deliver this.

Equipment Financing alternatives

These new-age crypto-first banking institutions provide crucial capital access for mining expansion. For example, Bitcoin-collateralised loans enable miners to leverage existing Bitcoin holdings without selling at attractive interest rates depending on duration and loan-to-value ratios.

Working Capital Solutions

Working capital solutions for mid-tier operations focus on operational cash flow optimisation and liquidity management. Mid-tier miners benefit from company cards for streamlined business and employee payments, with built-in tracking, auditing, and forecasting capabilities. Access to competitive overdraft facilities helps manage short-term cash flow fluctuations common in mining operations. Crypto-friendly banks also offer treasury management solutions that centralise Bitcoin operations through APIs, enabling efficient liquidity management, risk mitigation and payment processing.

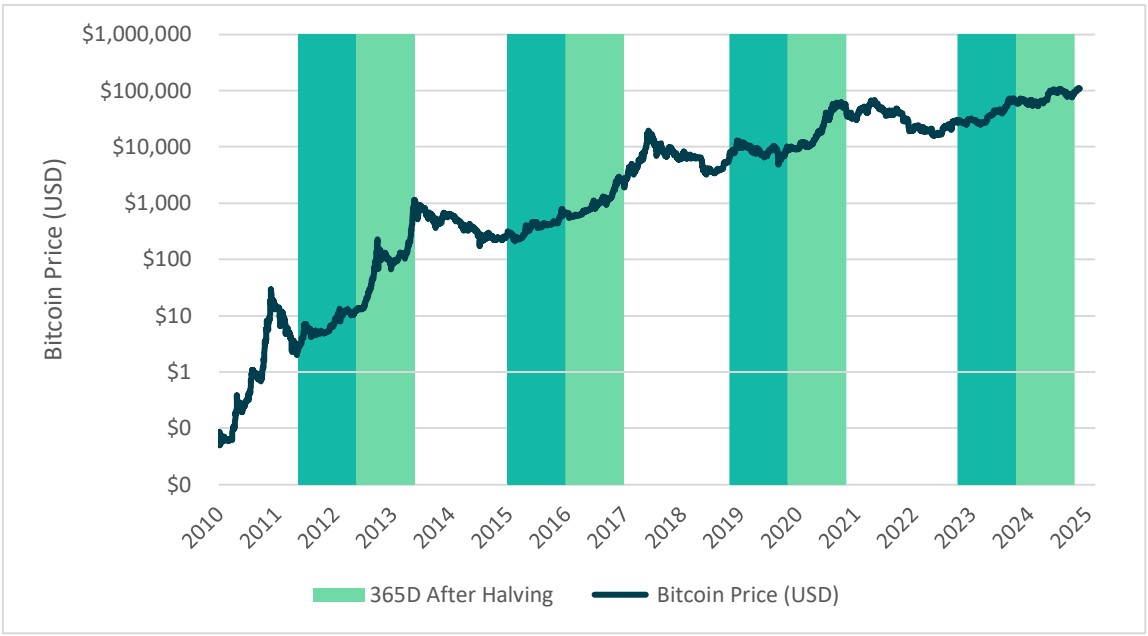
Section 5: Economic and Environmental Impact

Section 5.1: Economic outcomes for miners

While the halving of mining rewards is the most obvious economic impact that the halving event has on miners, the reality is more multifaceted. The overall economic impact on miners and on the crypto market is not that straightforward because every halving event has multiple direct and indirect economic consequences, all steered by the interplay of market dynamics and dependencies between cryptocurrencies.

The halving of the mining rate reinforces Bitcoin's scarcity by reducing new supply flow, while miner Bitcoin accumulation further reduces circulation. Lower annual inflation rates increase Bitcoin's appeal as an inflation hedge, potentially driving demand. In fact, significant price increases have been observed following the halving events in 2012, 2016 and 2020, and 2024 appears to follow suit in this regard.

Bitcoin's Halving Timeline



Source: Glassnode, AMINA Bank (4 September 2025)

Historical price patterns create market expectations and speculative trading, potentially leading to self-fulfilling prophecies amplified by increased media attention and adoption.

As a result of these factors, any upward trend in the price of Bitcoin following a halving event may partially or completely eliminate the direct effect that the halving event has on mining rewards. The price of Bitcoin on 18 April 2024, i.e. one day before the halving event was around USD 63.5k and as of 17 December 2024, the price reached its peak at USD 106.5k. Hence, while the mining rewards dropped by 50%, the price increased by 68%, meaning miners rewards increased by 16% in USD terms between the two dates, rather than decreasing by 50%.

Nevertheless, any reduction in profitability puts smaller, less efficient mining operations under pressure, especially over longer time periods. Hence, the weakest ones become unprofitable and have to exit the market.

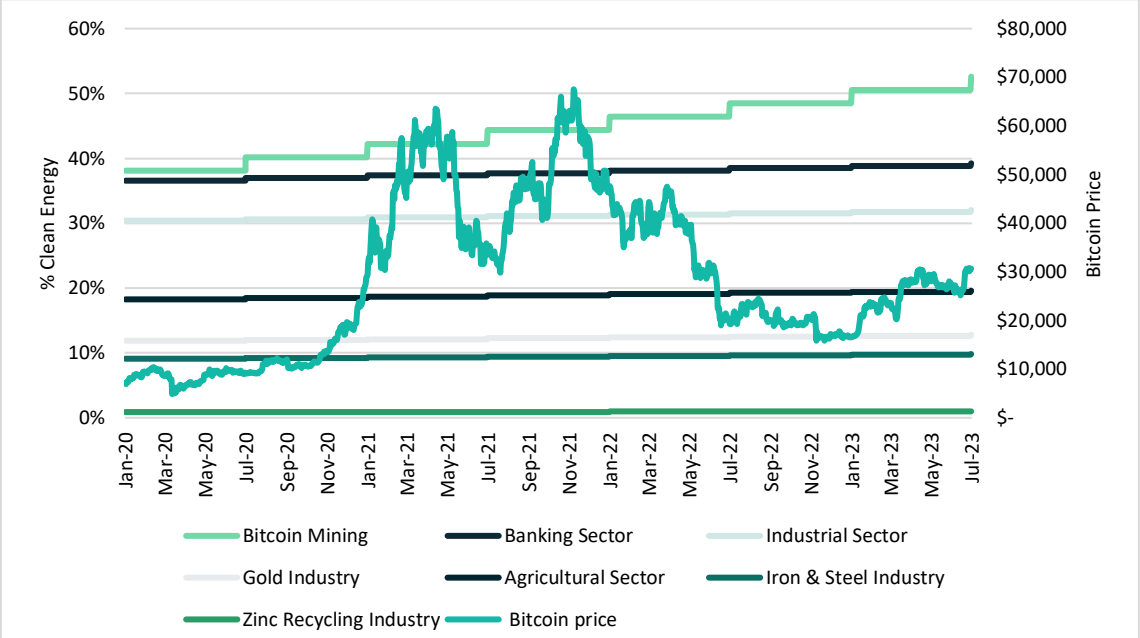
Additionally, less efficient miners may also shift their focus to generating transaction fees or mining other cryptocurrencies with higher rewards, with altcoin correlation to Bitcoin affecting these decisions. Therefore, Bitcoin halving events have a strong economic impact on the overall crypto market and all its participants.

Industry consolidation among larger Bitcoin mining operations is the consequence, which in turn also leads to some form of margin expansion as the remaining miners get a larger share of the rewards. The surviving miners are those that adopt more efficient hardware which consumes less energy and those that face lower energy costs. This is the crucial point driving the Bitcoin mining sector towards environmental sustainability.

Section 5.2: Changes in Energy Consumption Patterns

As a lesser-known matter of fact, the majority of energy consumed by Bitcoin mining has already been coming from sustainable energy sources for a couple of years, as illustrated below.

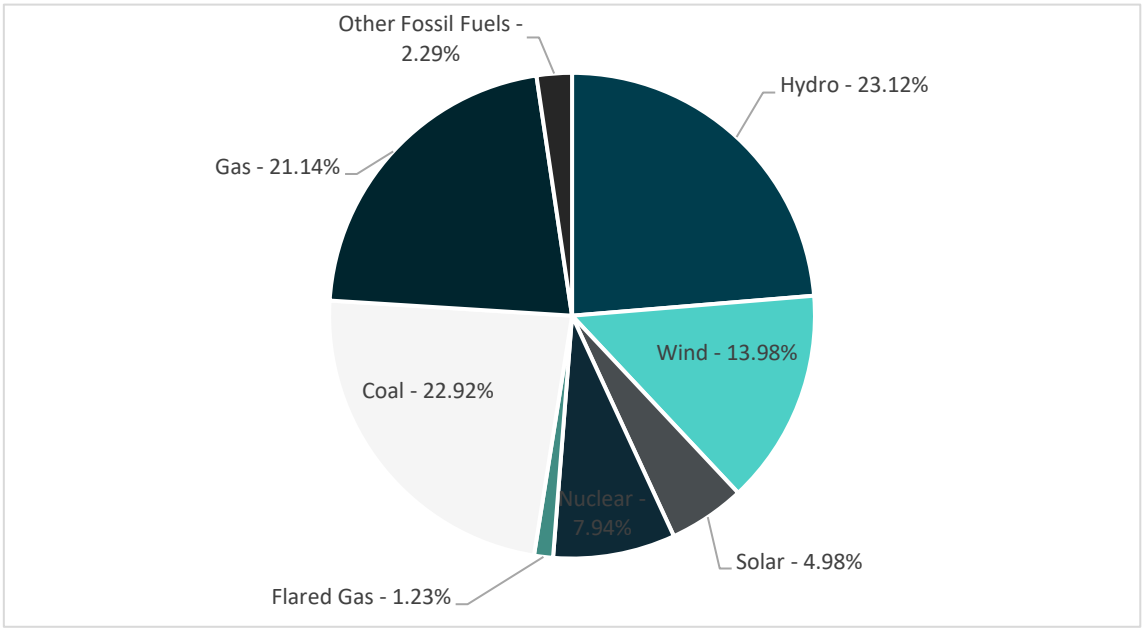
Share of sustainable energy by industry



Source: Batcoinz.com (3 March 2025)

In 2023, the share of sustainable energy sources consumed by Bitcoin miners already exceeded 52%, with hydro contributing the most along other sustainable forms of energy such as wind and solar.

Bitcoin Mining Energy Sources

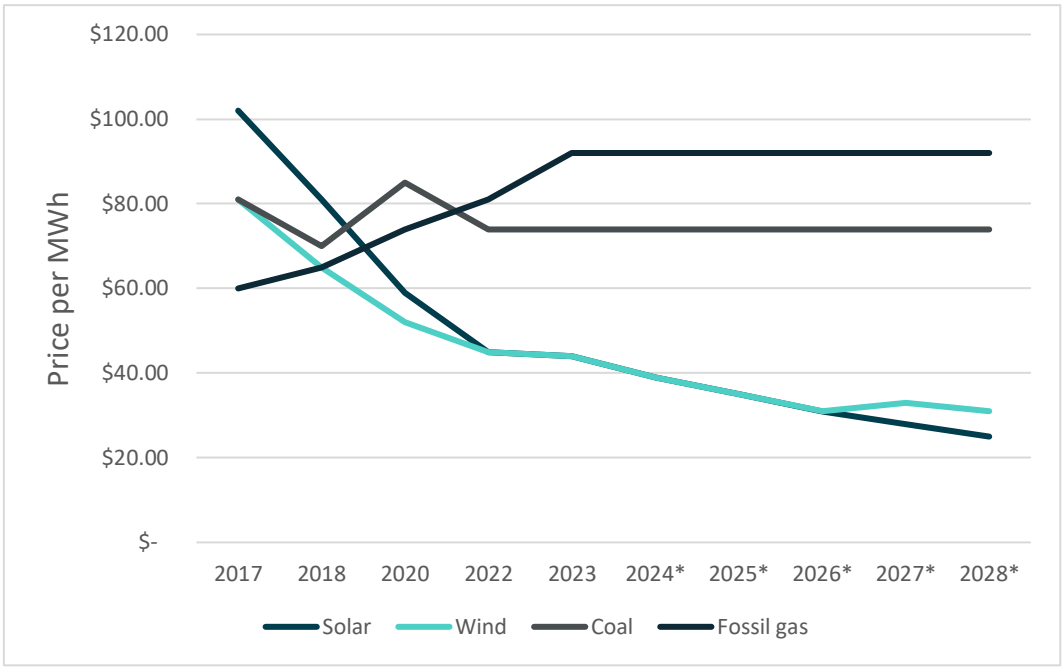


Source : Ezblockchain.net (5 April 2024)

By January 2024, the share of sustainable energy stood at 54.5%[4]. The overall trend towards environment-friendly energy sources within the Bitcoin mining sector will only continue to strengthen, following the latest halving event. In order to stay competitive, Bitcoin miners have to look into how to reduce their cost of energy, either by consuming less energy or finding cheaper sources of energy.

The prices of wind and solar energy are already cheaper than energy generated from fossil fuels, with the price gap projected to further widen in the next years to the benefit of wind and solar energy, as illustrated below.

Historical and forecasted worldwide development of energy prices by source



Source: Batcoinz.com (15 Jan 2024)

Full transition to sustainable energy is economically supported, while unprofitable miner exits should temporarily reduce overall electricity consumption.

Bitcoin energy consumption worldwide from February 2017 to January 8, 2025

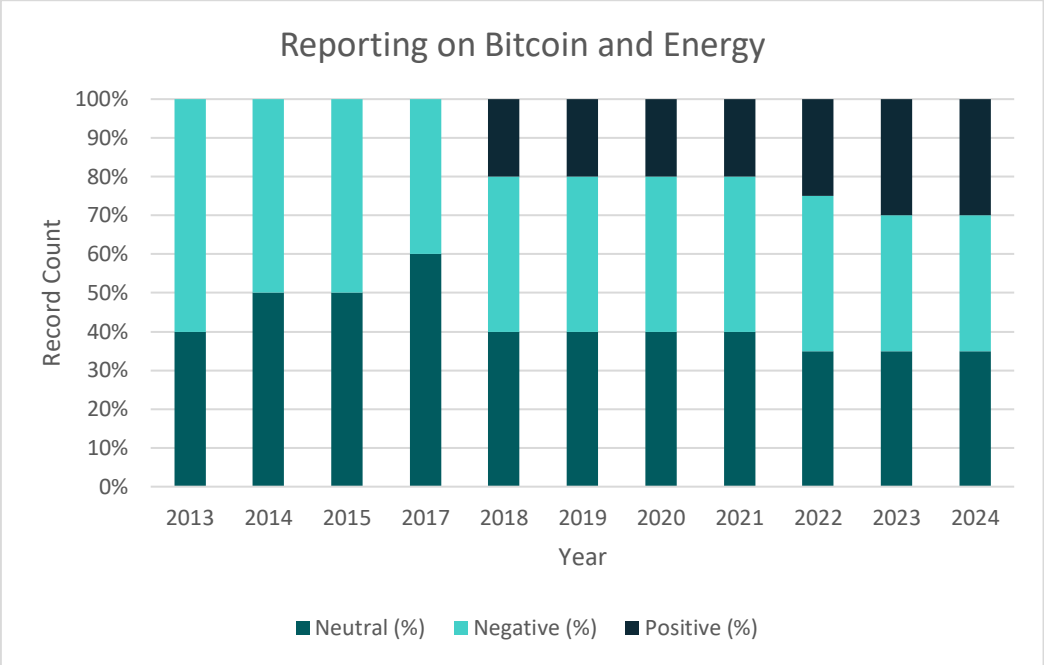
Source: Digiconomist (4 September 2025)

How fast a 100% sustainable energy share will be reached should thus only depend on the development of sustainable energy prices within the countries that contribute the most towards Bitcoin mining.

Section 5.3: Regulatory changes towards crypto mining.

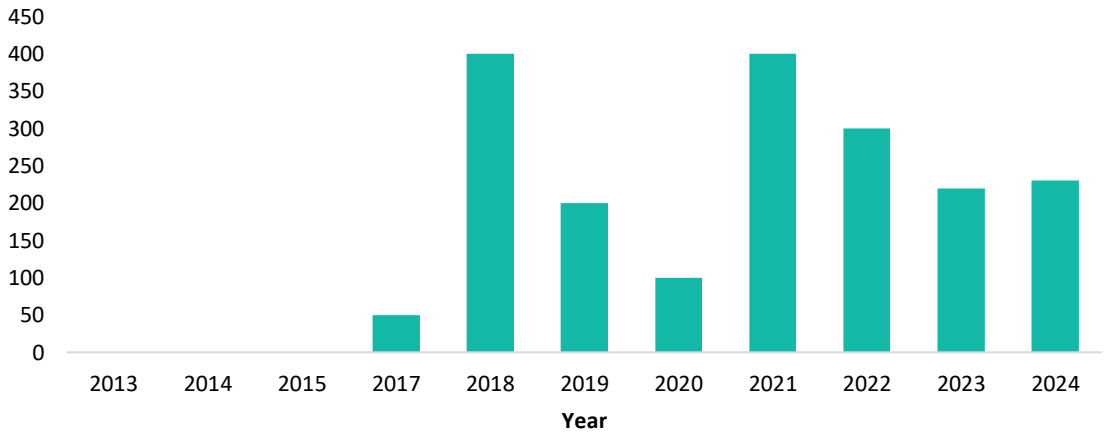
The attitude regarding the environmental friendliness of Bitcoin mining has been predominantly negative or neutral in the past, as measured by the count of reporting on "Bitcoin" and "Energy", lagging the real development of the sector transitioning towards sustainable energies. Only within the past year, has an equilibrium between negative and positive reporting been reached, as illustrated below, while the overall amount of reporting has come down significantly from its peak in 2021.

Reporting on Bitcoin and Energy[7]



Source: Batcoinz.com (January 2025)

Number of Articles



Source: AMINA Bank, Google (January 2025)

Despite sustainability improvements, some countries have increased regulation or banned mining. Even regions with high renewable energy, such as Scandinavia, have introduced restrictions. For example, Sweden, increased taxes by 6000% per kWh in 2023, thereby driving mining operations to move elsewhere.

As mentioned, a consolidation within the Bitcoin mining industry may temporarily reduce electricity output and ease regulatory pressure. In the long term, the halving event encourages the adoption of energy-efficient hardware.

It is however important to note that rising Bitcoin prices, especially in the short-term, offset any effects of the halving event as they will lead to less efficient miners staying profitable. Likewise, future price increases will attract new Bitcoin miners which will then lead to energy consumption increases, potentially offsetting any environmental benefits and requiring stricter regulation in some countries. This in turn will lead to mining operations moving across countries with lax regulation and cheap energy until advanced mining technology makes Bitcoin mining efficient enough to be profitable in even highly regulated countries.

Section 6: Conclusion

The 2024 Bitcoin halving proved to be far more than a predictable protocol event-it was a pivotal moment that reshaped the structure, strategy, and outlook of the global mining industry. While the halving halved rewards, it also accelerated the maturation of an industry that is rapidly professionalizing and diversifying. What emerged in its aftermath is a clearer separation between miners operating at scale with institutional-grade practices and those struggling to remain viable amid shrinking margins and rising operational complexity.

By the first quarter of 2025, the mining landscape reflected deep structural shifts: consolidation among top players, a pivot toward energy-efficient and sustainable infrastructure, and growing engagement with financial and strategic advisors. The lines between crypto mining, energy infrastructure, and high-performance computing are beginning to blur—presenting miners not just with challenges, but with an opportunity to redefine their role in the broader digital and data economy.

Looking ahead, the industry is entering a new era marked by greater volatility, tighter regulation, and expanding technological overlap with AI, cloud, and edge computing. In this environment, operational agility, sound financial planning, and cybersecurity resilience will be as important as access to cheap energy or advanced ASICs. Importantly, miners who partner with crypto-native financial institutions and specialized advisors will be better equipped to navigate complexity, streamline strategic decisions, and capture emerging growth opportunities.

Ultimately, the 2024 halving reinforced Bitcoin's core principles—scarcity, decentralization, and incentive alignment—while underscoring the need for miners to evolve. Those who lead with foresight, discipline, and execution will define the next phase of mining's institutional journey.