

White Paper

2024 Blockchain Hardware Industry

2024.09



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EXECUTIVE SUMMARY

The global blockchain hardware industry is experiencing rapid development as blockchain technology becomes increasingly integrated into various sectors. This white paper explores the key trends, challenges, and opportunities in the blockchain hardware market, particularly in relation to cryptocurrency mining, decentralized applications, and other innovative uses of blockchain technology. The report outlines the industry's current state and provides forward-looking insights into its future evolution.

Blockchain Hardware: A Cornerstone of the Digital Economy

Blockchain hardware serves as the backbone of decentralized applications and the broader digital economy. From cryptocurrency mining to securing decentralized networks, blockchain hardware plays a critical role in enabling the operation of these technologies. With continuous advancements in hardware efficiency and performance, this sector is poised for significant growth as the adoption of blockchain technologies expands globally.

The Expansion of Decentralized Finance (DeFi) and NFT Markets

The rise of decentralized finance (DeFi) and non-fungible tokens (NFTs) has driven demand for more robust and scalable blockchain hardware. As these markets continue to expand, so does the need for powerful devices capable of supporting increased transaction volumes and securing decentralized networks. The white paper explores how hardware advancements are playing a pivotal role in the growth of DeFi and NFT markets.

The Global Market Outlook: Opportunities and Challenges

The global blockchain hardware market is projected to see steady growth over the coming years, driven by increased adoption of blockchain technology across various industries. However, the report also identifies key challenges, including regulatory uncertainties and the need for more sustainable energy solutions. By understanding these factors, stakeholders can better position themselves to capitalize on emerging opportunities.

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Chapter 1 — Overview of Global Blockchain and Cryptocurrency Industry

Blockchain's Versatile Application Across Sectors

Introduced in 2008, blockchain technology is a decentralized ledger system that enables secure, transparent transactions without the need for a central authority. Its ability to create immutable records in real-time has made it adaptable for a wide range of sectors, including cryptocurrency, financial services, cloud computing, and cybersecurity, highlighting its broad potential.

Factors Influencing Bitcoin Mining Profitability

The payoff period for Bitcoin mining machines is affected by multiple factors, including machine price, hash rate, electricity costs, and Bitcoin market prices. The exponential growth in total hash rate has increased competition, extending the payoff period for miners. Mining profitability is further influenced by electricity rates, with regions like Texas and Wyoming offering lower rates that enhance returns.

Diverse Regulatory Approaches Impact Blockchain Growth

Different countries have adopted varying stances on blockchain and cryptocurrency regulation. Major markets like China, the U.S., Sweden, South Korea, and Singapore each present unique challenges and opportunities based on their regulatory frameworks. While some nations encourage blockchain innovation, others impose stricter controls, influencing the overall development of blockchain-related businesses globally.



Chap 1.1

Introduction of Blockchain

Introduction of Blockchain

Brief Explanation of Blockchain

Blockchain, which debuted in 2008, is a distributed ledger technology designed to record both financial and non-financial transactions involving items of value. It functions as a distributed database, compiling records into blocks, each stamped with a timestamp and linked to the preceding block. Once data is entered into a block, it becomes immutable, preventing any alteration or tampering. This technology operates in real-time and bypasses the need for a central authority or third-party financial institution to validate transactions. It enables each node to generate unchangeable records, ensuring transparent, peer-to-peer transactions that are secure, efficient, and devoid of the need for trust. Owing to its extensive benefits, blockchain technology is adaptable for use across a myriad of sectors, including cryptocurrency, payments, financial services, cloud computing, and cybersecurity, to mention a few.

✓ **Decentralized Finance (DeFi):**

Blockchain supports a range of financial services, such as loans and insurance, accessible globally without traditional financial institutions.

✓ **Direct and Secure Transactions:**

Blockchain allows for direct transfers of digital assets over the internet without intermediaries, facilitating rapid, low-cost transactions. It ensures security through immutable data recording, making it nearly impossible for the transaction data to be altered or hacked.

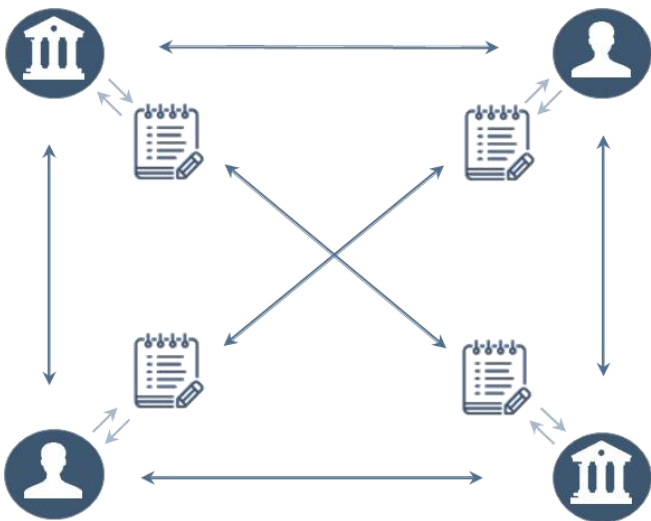
✓ **Privacy and Accessibility:**

The technology operates as a decentralized network, accessible to anyone with an internet connection. Transactions on blockchain do not require personal details, safeguarding against identity theft.

✓ **Advanced Applications:** Blockchain supports smart contracts that automatically execute when conditions are met, enhances supply chain transparency by verifying product histories, and enables asset tokenization for easier trading.

✓ **Integrity and Transparency:**

It offers robust solutions for delivering trusted historical data and can potentially transform voting systems by providing a secure, transparent, and tamper-proof voting mechanism.





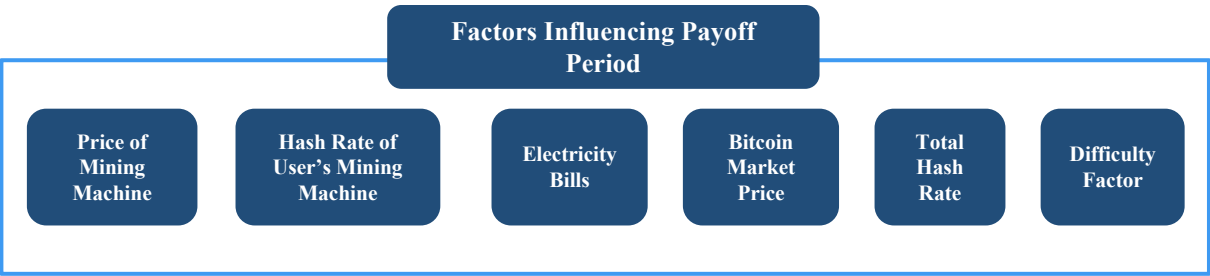
Chap 1.2

Payoff Period of Mining Machines

Payoff Period of Mining Machines

Payoff Period Calculation Factors

The payoff period for Bitcoin mining machines is determined by several critical factors, including the price of the machine, its hash rate, electricity costs, Bitcoin market prices, the total network hash rate, and the mining difficulty.



Two Key Calculation Formulas

As the demand for Bitcoin increases, the total hash rate has seen exponential growth, leading to reduced daily revenue and a longer payoff period for miners. To calculate payoff period, two key formulas are used. The first formula calculates daily revenue based on factors such as the Bitcoin market price, the hash rate of the machine, and electricity costs. The second formula determines the payoff period, indicating how long it will take for the mining machine to generate enough revenue to cover its initial cost.

Calculation of Daily Revenue

$$Daily\ Revenue = \frac{Bitcoin\ Market\ Price * Hash\ Rate\ Per\ Machine * Number\ of\ Reward\ Per\ Day}{Total\ Hash\ Rate} - Daily\ Utility\ Cost$$

$$Payoff\ Period = \frac{Price\ Of\ Mining\ Machine}{Daily\ Revenue}$$

Electricity Rates Impact

Bitcoin market price is affected by demand and supply and total hash rate is exponentially rising these days, thus reducing daily revenue and lengthen the pay off period of Bitcoin mining machine. The utility cost with mining activities in states like Texas, Wyoming, Washington, and Kentucky ranges from USD0.1 per KWH to USD0.12 per KWH. Some certain areas have even lower power costs.



Chap 1.3

Analysis of Regulation and Policy

Regulation and Policy in different Countries

Regulation and Policy Overview

Different countries and jurisdictions have expressed various attitudes towards blockchain and cryptocurrencies. Some of the key countries where cryptocurrency mining and trading have seen the highest activity include the PRC, the United States, Sweden, South Korea and Singapore. These countries represent some of the Company's key international markets, each offering unique opportunities and challenges based on their regulatory environments, technological infrastructure, and economic conditions. The varying attitudes toward cryptocurrencies in these regions significantly impact the growth and development of blockchain-related businesses, with some countries encouraging innovation and others implementing stricter controls.

Regulation and Policy in main Bitcoin Jurisdictions (1/2)

Jurisdiction	Analysis and Observations
The People’s Republic of China	Cryptocurrencies are not considered legal currencies, and cryptocurrency exchanges are illegal in the PRC. The Notice on Regulating the Mining Activities of Cryptocurrency issued by National Development and Reform Commission of China in 2021, requires local governments to figure out existing mining projects to limit their power supply, accelerate the exit of existing projects, and prohibit investments for newly mining projects in China. In addition, the Notice on Further Preventing and Addressing the Speculation Risk of Virtual Currency Transactions issued by the People's Bank of China, clearly states that cryptocurrencies such as Bitcoin and Ethereum do not have the same legal status as legal currencies, and relevant business activities are considered as illegal financial activities. And overseas cryptocurrency exchanges providing services to domestic residents through the Internet are also characterized as illegal financial activities.
The United States of America	Cryptocurrencies are not considered legal tender, but cryptocurrency exchanges are legal in the United States and fall under the regulatory scope of the Bank Secrecy Act (BSA). Despite court decisions stating that Bitcoin can be used as money and the Commodity Futures Trading Commission (“CFTC”) has designated Bitcoin as a commodity, the Securities and Exchange Commission(SEC) has issued investor alerts to warn against Bitcoin fraudulent investment schemes. The U.S. Department of Treasury’s Financial Crimes Enforcement Network has also issued guidelines instructing money transmitters to enforce Anti-Money Laundering (AML) and Know Your Client (KYC) measures. The Internal Revenue Service (IRS) classifies virtual currencies ("VCs), including BTC as describes Virtual Currencies (VCs) as “a digital representation of value that functions as a medium of exchange, a unit of account, and /or a store of value and does not have legal tender status in any jurisdiction.”
Sweden	Sweden is in favor of Bitcoin related businesses and users. Finansinspektionen, Sweden’s Financial Supervisory Authority take trade in BTC as a financial service and subject to its authority. Sveriges Riksbank, Sweden’s central bank, considers BTC as an asset only, but not as a currency. The Swedish Tax Agency has given a preliminary ruling on Value Added Tax (VAT) on Bitcoins, stating that trades in Bitcoins are not subject to Swedish VAT, but are instead subject to the regulations.

Regulation and Policy in different Countries

Regulation and Policy in main Bitcoin Jurisdictions (2/2)

Jurisdiction	Analysis and Observations
South Korea	Cryptocurrencies are not considered legal tender in South Korea, but cryptocurrency exchanges are legal and the country is a key player in the Bitcoin industry. South Korea has generally supported the growth of blockchain and cryptocurrency while implementing regulatory measures. In December 2017, the government expressed its willingness to facilitate the growth of blockchain technology and cryptocurrency and stated that evaluation of the regulatory framework for cryptocurrency trading is still undergoing. In March 2021, the government introduced legislation requiring exchanges to share account information with banks to strengthen Anti-Money Laundering (AML) practices. The government initially planned to impose a 20% tax on crypto profits exceeding 2.5 million won starting in January 2023, but this has been postponed to 2028.
Iceland	Cryptocurrency mining activities are legal in Iceland. Iceland has been cautious towards cryptocurrency business, especially trading business, to prevent capital outflow. There was no authorization in Iceland to purchase or transfer foreign currency on the basis of transactions with cryptocurrency. However, in 2017, the government amended the foreign exchange rules, and granted wide and general exemptions from the restrictions of the Foreign Exchange Act No. 87/1992, showing signs of easing restrictions of cryptocurrency trading activities. Moreover, in September 2018, the Financial Supervisory Authority (FME) announced the first registration of a cryptocurrency exchange, which features two trading pairs: ISK (Icelandic Krona)/AUR (Auroracoin), and BTC/ISK.
Singapore	Cryptocurrencies are not considered as legal tender, but cryptocurrency exchanges are legal in Singapore. The tax authority considers cryptocurrency as “goods”, and levies Goods and Services Tax on cryptocurrencies. However, from January 1, 2020, Singapore exempted digital payment tokens (like Bitcoin) from GST to promote the fintech industry. The Monetary Authority of Singapore (MAS) has issued warnings about the risks of cryptocurrency investments. In 2022, MAS introduced guidelines to curb public advertising of cryptocurrency services, reinforcing its cautious stance while allowing the sector to grow within a controlled environment .





Chapter 2 — Overview of Global Blockchain Hardware Industry

Expanding Applications of Blockchain Hardware

Blockchain hardware, traditionally dominated by cryptocurrency mining, is evolving beyond mining into new sectors like decentralized storage, Internet of Things (IoT), and edge computing. This shift reflects the growing demand for secure, decentralized data exchange across various industries, leveraging blockchain's unique capabilities for enhancing transparency and efficiency.

Value Chain Complexity and Infrastructure Growth

The blockchain hardware industry involves a complex value chain, from hardware suppliers like ASIC manufacturers to mining farms, pools, cryptocurrency exchanges, and payment processors. This interconnected system supports the growing infrastructure required for large-scale mining operations, which are increasingly centralized in facilities that optimize efficiency through economies of scale.

Volatility and Growth in the ASIC Mining Hardware Market

The market for ASIC-based Bitcoin mining hardware has experienced fluctuations driven by Bitcoin's price volatility. While there was a slight decline from 2018 to 2023, the market is expected to rebound significantly, reaching USD 11.9 billion by 2028 with a strong CAGR of 15.3%, assuming continued Bitcoin price increases. This growth highlights the ongoing importance of efficient, high-performance mining hardware in sustaining the blockchain network.



Chap 2.1

Definition and Classification of Blockchain Hardware

Definition and Classification of Blockchain Hardware

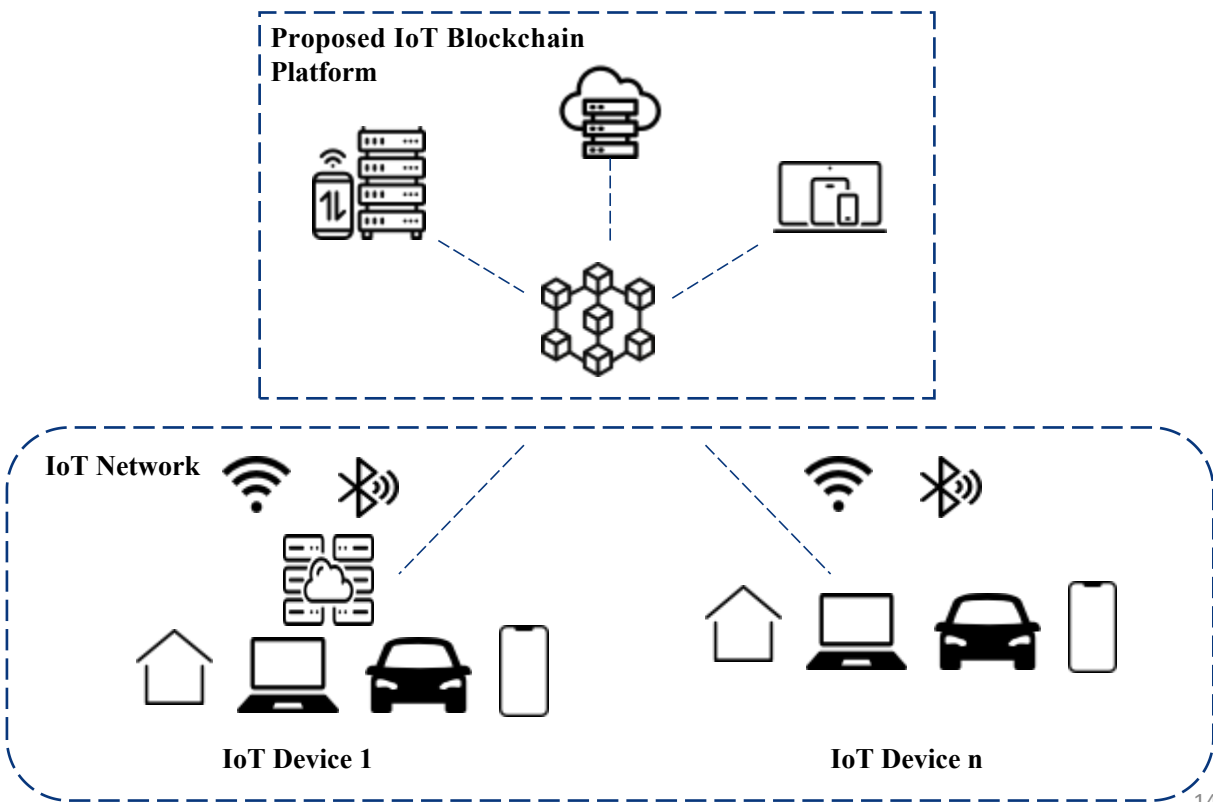
Definition of Blockchain Hardware

Blockchain hardware refers to electronic devices designed to support and facilitate the operation of blockchain technologies, enabling the execution of various blockchain-related functions. Typically, blockchain hardware has been predominantly used for cryptocurrency mining, where owners are rewarded with specific cryptocurrencies for contributing computing power, storage, bandwidth, or other resources to the network. High-performance devices, such as ASIC miners, continue to dominate this area.



In addition, the market is evolving, and blockchain hardware is increasingly being utilized in other emerging applications. These include decentralized storage and calculation solutions, such as Golem, that harness idle computing power. Additionally, blockchain hardware is gaining traction in the Internet of Things (IoT) and edge computing sectors, where it ensures secure and transparent data exchange between devices through blockchain technology.

IoT blockchain platform conceptual scenario



Definition and Classification of Blockchain Hardware

Classification of Blockchain Hardware



Mining Hardware

Mining hardware is specifically designed for mining cryptocurrencies, with four main types being ASICs, GPUs, FPGAs, and CPUs, each tailored for different performance needs. However, beyond these physical machines, many professionals are now opting for cloud mining services, which allow them to mine cryptocurrencies without the hassle of managing and maintaining their own hardware.

➤ ASIC Mining Hardware

Mining hardware with ASIC chips as preferred processors delivers specialized computing power for efficient cryptocurrency mining. Designed for specific tasks, ASICs are more powerful and cost-effective for certain cryptocurrencies, but their specialization limits flexibility to those they were designed for.

➤ GPU Mining Hardware

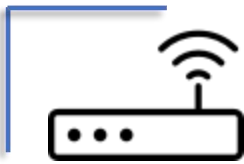
Unlike ASICs, which target specific cryptocurrencies, GPU mining machines are versatile, capable of mining a broader range of coins. This flexibility allows miners to adapt to various blockchain networks as market conditions change. However, GPUs' general-purpose design makes them less energy-efficient, resulting in higher electricity costs and lower hashing power.

➤ CPU and FPGA Mining Hardware

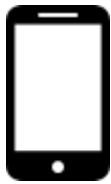
CPU and FPGA mining machines make up a small percentage of the overall market. Due to the relatively low computing efficiency of CPUs, they are rarely used in modern blockchain networks for mining.

Other Hardware

Other blockchain-related hardware includes devices such as blockchain routers, smartphones, public and private key storage systems, and other smart devices. These technologies integrate with the devices' features to enable decentralized transactions, enhancing security, transparency, and efficiency. By leveraging blockchain, these devices help reduce fraud and improve transaction integrity, driving new applications in decentralized finance and supply chain management.



Blockchain Router




Smartphone



Storage System



Smart Device



Chap 2.2

Value Chain of Blockchain Hardware Industry

Value Chain of Blockchain Hardware Industry

The Bitcoin industry is composed of five major segments: hardware supply, mining farm and mining pool operation, trading, and payment processing. Hardware suppliers, such as Canaan, which was the first Bitcoin mining hardware company to go public and ranked second in terms of computing power sold among all Bitcoin hardware providers for the year ending December 31, 2023, are primarily involved in the IC design, manufacturing, and sales of mining machines. This segment plays a crucial role in the industry's infrastructure, providing the specialized equipment necessary for efficient cryptocurrency mining

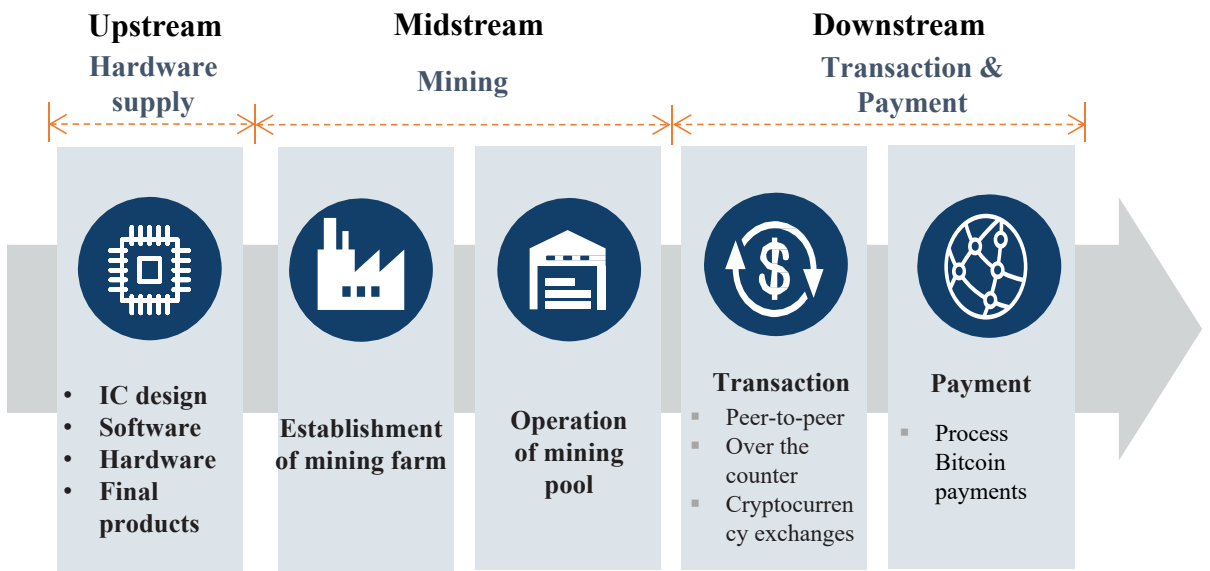


Mining venues typically refer to physical sites where operators offer custodial services for customers' mining hardware. These venues have become increasingly important as the scale of mining operations grows, requiring significant infrastructure and energy resources. The operation of mining pools, on the other hand, involves coordinating the collective computing power of miners, enabling them to share resources and split mining rewards more evenly. This approach helps individual miners reduce the volatility of their earnings and increases their chances of successfully mining blocks.

Trading services are provided by cryptocurrency exchanges, which facilitate the buying and selling of cryptocurrencies for consumers. These exchanges are critical to the liquidity and price discovery of Bitcoin and other digital assets, influencing market dynamics on a global scale.

Payment services are provided by Bitcoin payment processors, enabling merchants and businesses to accept Bitcoin payments from customers for goods and services. This segment is essential for integrating Bitcoin into the broader economy, allowing for its use as a medium of exchange and driving adoption among a wider audience.

Value Chain of Bitcoin Industry





Chap 2.3

Introduction of Bitcoin Mining Process

Introduction of Bitcoin Mining Process

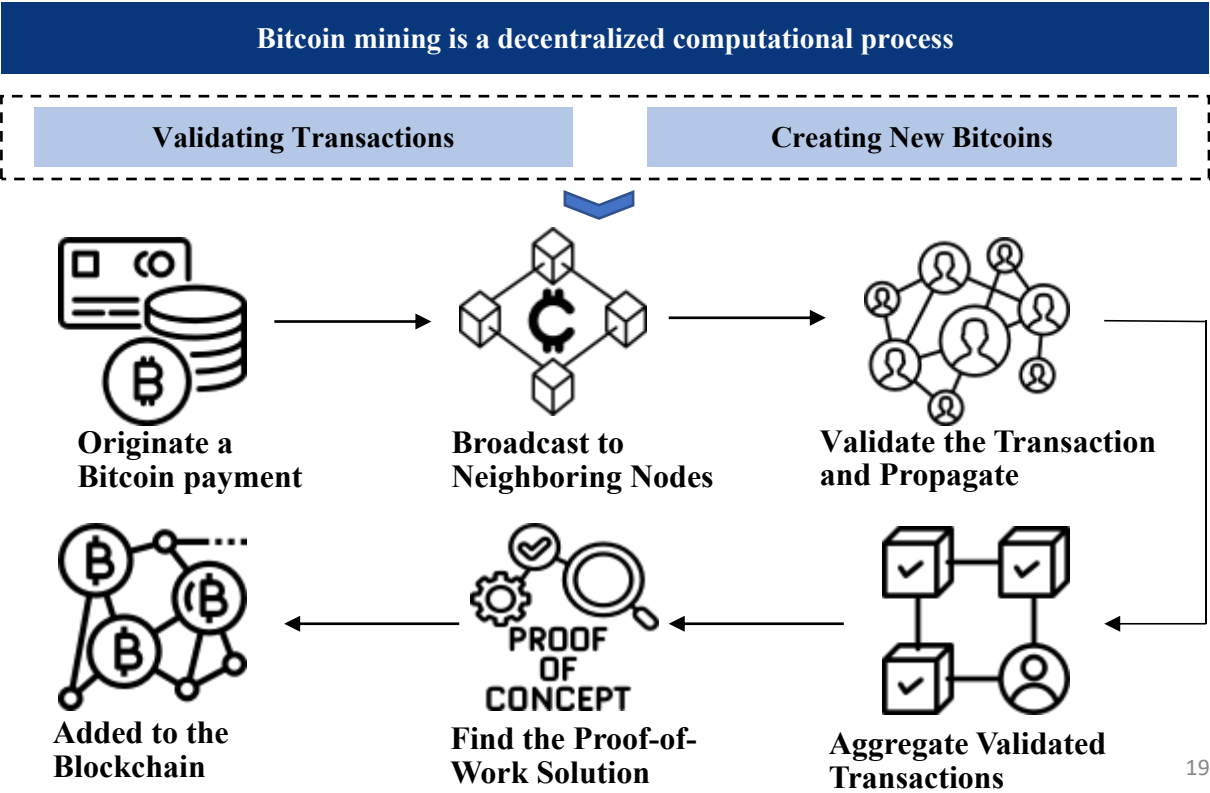
Bitcoin Mining Process

Bitcoin mining is a decentralized process, meaning no single entity controls the network, which ensures security and trust through a globally distributed system of participants. Miners play a vital role in the decentralized Bitcoin ecosystem, where they are incentivized through block rewards and transaction fees, paid in Bitcoin, while they validate and record transactions on the blockchain, ensuring that all transfers are legitimate and irreversible.



Mining is intentionally resource-intensive, with the difficulty of puzzles adjusting every 2,016 blocks (approximately every two weeks) to maintain a steady rate of block additions, regardless of the number of miners. This mechanism not only regulates the release of new Bitcoin but also enhances the network’s security by making it prohibitively costly for any single entity to alter the blockchain. However, as the Bitcoin market has grown, competition among miners has intensified, driving the development of increasingly advanced and energy-efficient mining equipment. Additionally, large-scale mining operations are often housed in dedicated facilities that leverage economies of scale, utilizing vast amounts of hardware and electricity to maximize their chances of solving blocks and earning rewards.

Bitcoin Mining Process





Chap 2.4

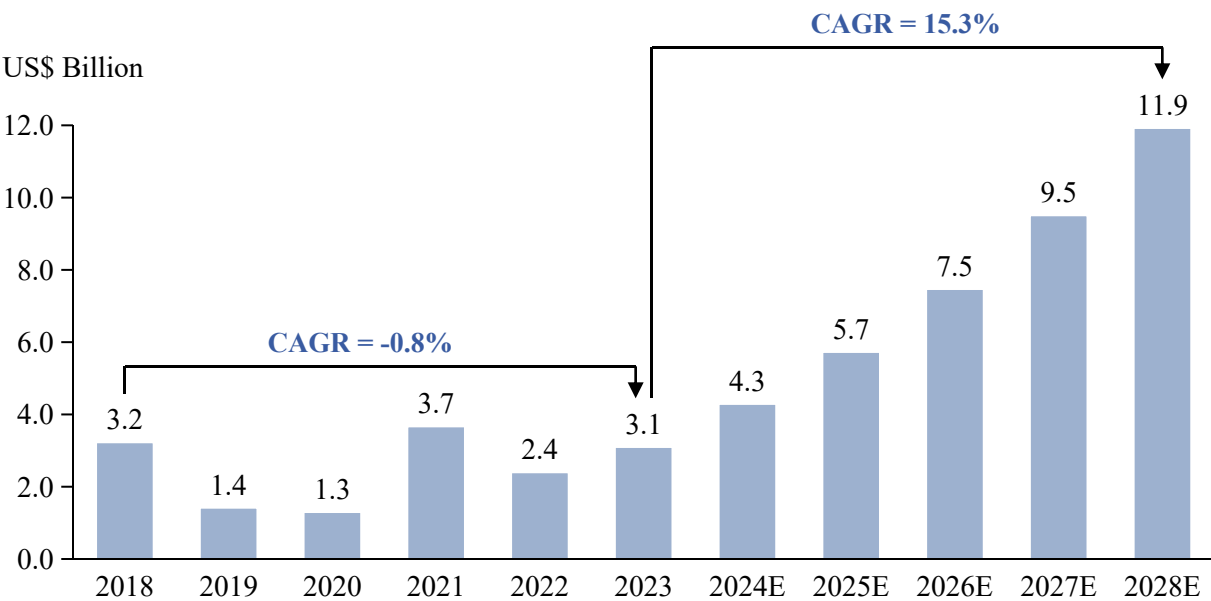
ASIC-based Bitcoin Mining Hardware Industry

ASIC-based Bitcoin Mining Hardware Industry



The ASIC-based Bitcoin mining hardware market has shown a fluctuating trend, primarily driven by Bitcoin price movements, as manufacturers typically price products based on a 400-500 day payback period for Bitcoin mining. The market size experienced a slight decline from US\$3.2 billion in 2018 to US\$3.1 billion in 2023, with a compound annual growth rate (CAGR) of -0.8%, largely due to Bitcoin price volatility. The significant increase in Bitcoin prices since the second half of 2020 substantially boosted sales revenue for ASIC-based mining hardware in 2021. Similarly, in the second half of 2023, another rise in Bitcoin prices led to market growth compared to 2022. The market is projected to continue expanding, reaching USD11.9 billion by 2028 with a CAGR of 15.3%, assuming Bitcoin prices continue to rise due to increased scarcity.

Market Size of ASIC-based Bitcoin Mining Hardware Industry, by Revenue (2018-2028E)





Chap 2.5

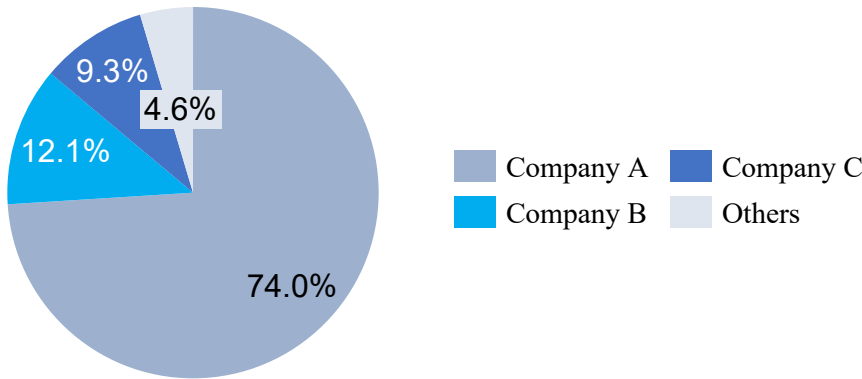
Competitive Landscape of ASIC-based Bitcoin Mining Hardware Industry

Competitive Landscape

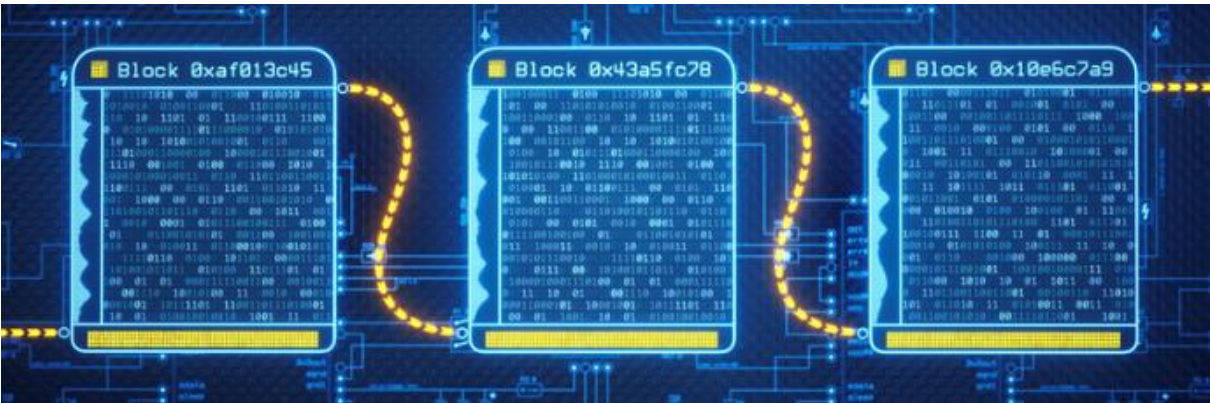
The global Bitcoin mining hardware market is highly concentrated, with the majority of leading players that originated from China. These companies dominate the market due to their advanced technological capabilities, large-scale manufacturing, and strategic positioning within the global supply chain.

Ranking of ASIC-based Bitcoin Mining Hardware Manufacturers, by Computing Power Sold

The ASIC-based Bitcoin mining hardware market, evaluated by computing power sold, is highly consolidated, with a few companies controlling a significant portion of global sales . As of 31 December 2023, the top three players in the market, measured by estimated computing power sold, represent a significant portion of global market share with 95.4%.



These market leaders benefit from continuous R&D investment, ensuring rapid innovation and improved mining efficiency. Additionally, their close partnerships with semiconductor foundries enable consistent hardware production amidst global chip shortages. The market’s competitive edge revolves around energy-efficient designs and high hash rate performance, where only a limited number of manufacturers have the capability to meet these demands at scale. This creates high entry barriers, further solidifying the dominance of existing players.





Chapter 3 — Market Trends and Opportunities of Blockchain Hardware Industry

DeFi, Cryptocurrencies, and NFTs Driving Blockchain Hardware Demand

The rapid growth of Decentralized Finance (DeFi), increasing cryptocurrency adoption, and the rise of Non-Fungible Tokens (NFTs) are significantly influencing the blockchain hardware market. The surge in platforms like Uniswap and government support for CBDCs have created a need for advanced, scalable hardware solutions to support the expanding decentralized financial ecosystem.

Technological Advancements and Green Technologies Shaping the Industry

Ongoing technological advancements, particularly in energy efficiency and sustainable operations, are crucial for the future of blockchain hardware. Innovations like liquid cooling systems and the rising use of renewable energy in mining operations highlight the industry's commitment to green technologies, driving further growth and reducing the environmental impact.

Emerging Markets and IoT Integration Offering Major Opportunities

Emerging markets like Africa and Southeast Asia present significant opportunities for blockchain hardware development, driven by rapid economic growth and digital adoption. The integration of blockchain with the Internet of Things (IoT) is also key, as industries like healthcare adopt blockchain to manage and secure vast data networks.



Chap 3.1

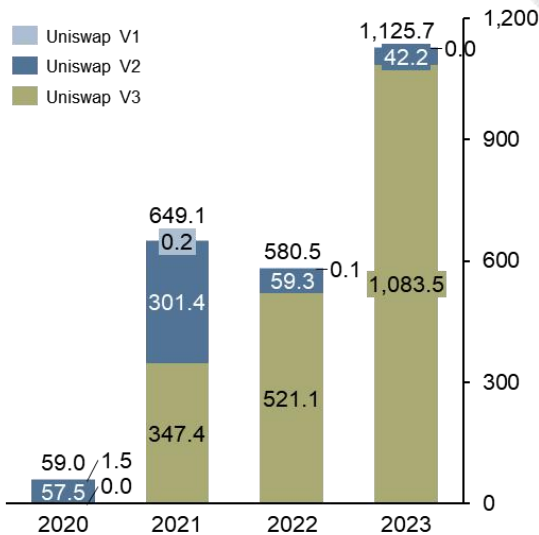
Market Trends

Decentralized Finance (DeFi) Growth

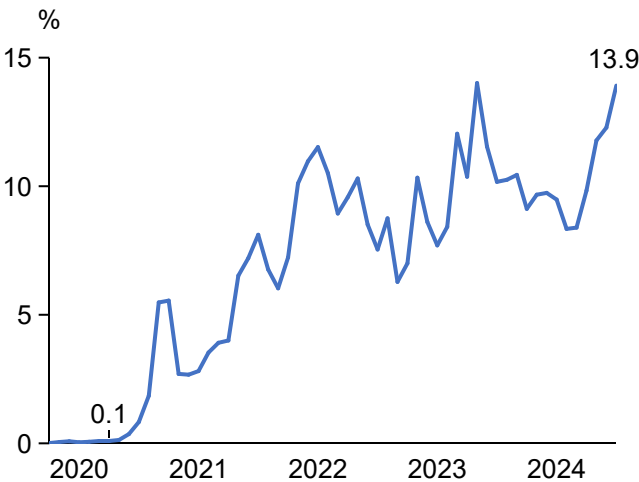
Uniswap Trading Volume Trends

The rapid expansion of Decentralized Finance (DeFi) is driving significant changes in the global blockchain hardware market. Uniswap's trading volume illustrates this rapid growth, surging from \$59.0 billion in 2020 to \$1,125.7 billion in 2023. This exponential increase underscores the rising importance of decentralized exchanges (DEXs) in the financial industry and highlights the growing need for more advanced and scalable blockchain infrastructure to support the expanding ecosystem. As platforms like Uniswap continue to gain traction, the demand for transparency, security, and user autonomy in financial transactions becomes increasingly vital.

Uniswap Trading Volume Trends, 2020 to 2024



DEX to CEX Spot Trade Volume Trends, 2020 to 2024



DEX to CEX Spot Trade Volume Trends

This trend is evident in the substantial increase in Uniswap's trading volume, which surged from USD59 billion in 2020 to over USD1 trillion by 2023. Additionally, the ratio of DEX to centralized exchange (CEX) spot trade volumes has steadily increased, reaching nearly 14% by 2024. These metrics highlight the growing market share of decentralized platforms and their influence on the overall blockchain ecosystem.

Conclusion

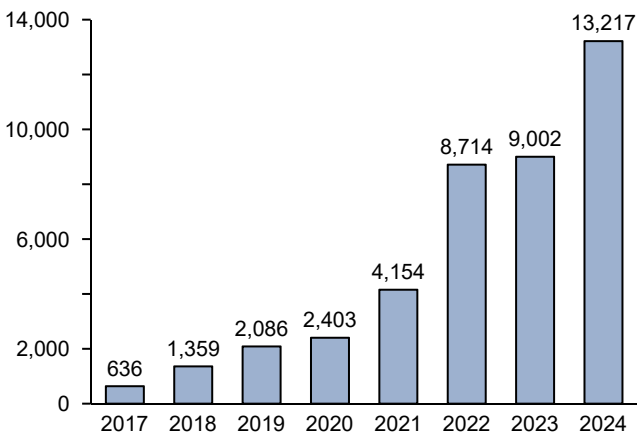
The rapid expansion of Decentralized Finance (DeFi) is fundamentally reshaping the blockchain ecosystem. As evidenced by Uniswap's significant growth in trading volumes, along with the rising ratio of decentralized exchanges (DEXs) to centralized exchanges (CEXs), the shift towards decentralized financial systems is becoming more pronounced. This evolution signals the increasing importance of transparency, security, and user autonomy in financial transactions. It highlights the urgent need for continual innovation in blockchain hardware to accommodate the scaling demands of the DeFi ecosystem, ensuring that it remains robust and adaptable in an ever-changing financial landscape.

Source: Frost & Sullivan

Note: 1) Uniswap is a leading representative of the DeFi movement, demonstrating the growing power and popularity of decentralized finance through significant trading volumes.
2) DEX to CEX Spot refers to monthly decentralized exchange volume divided by centralized exchange volume (as a percentage).

Increasing Adoption of Cryptocurrency and CBDCs

Number of Cryptocurrencies Worldwide, 2017 to 2024

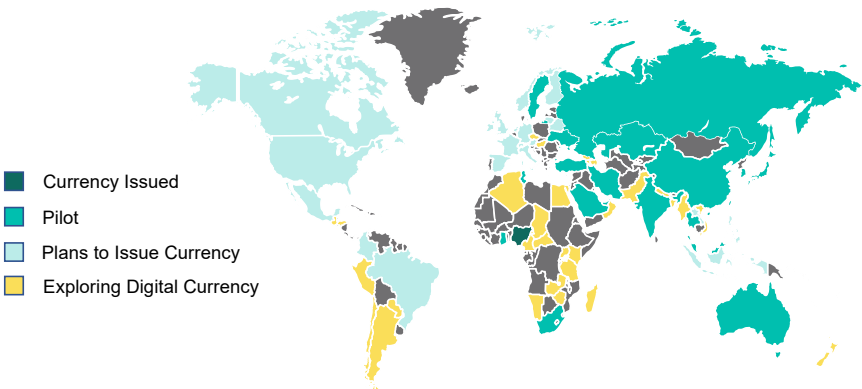


The increasing adoption of cryptocurrencies and CBDCs is a pivotal trend shaping the blockchain hardware industry. From just 636 cryptocurrencies in 2017 to over 13,000 by July 2024, the rapid expansion demonstrates not only market acceptance but also the growing integration of digital currencies into the global financial system. This surge reflects a broadening recognition of cryptocurrencies as legitimate financial instruments, necessitating the development of advanced blockchain hardware to support their widespread use.

Central Bank Digital Currency (CBDCs) Development

Governments are also playing a crucial role in this trend by endorsing and developing Central Bank Digital Currencies (CBDCs). Countries like Nigeria and the Bahamas have already launched their CBDCs, while major economies such as the European Union and China are actively exploring similar initiatives. These government-backed digital currencies further validate the role of digital assets, paving the way for broader public adoption.

Central Bank Digital Currency (CBDCs) Development Status



Conclusion

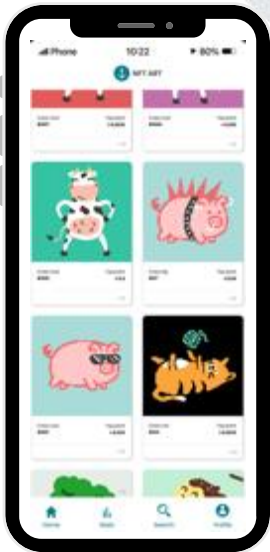
As market forces and government initiatives converge, the demand for secure, scalable blockchain infrastructure is set to grow. The adoption of cryptocurrencies and development of Central Bank Digital Currencies (CBDCs) marks a shift toward digital assets in the global financial landscape. This highlights the critical role cryptocurrencies play and emphasizes the need for robust hardware solutions to support this evolving market. As more countries embrace digital currencies, reliable blockchain hardware will be key to ensuring security, scalability, and seamless integration into global financial systems. Advancing blockchain technology will drive the future of digital finance and broader adoption.

Rise of NFTs and Digital Assets

Introduction of NFTs

An NFT (Non-Fungible Token) is a type of digital asset that represents ownership or proof of authenticity of a unique item or piece of content, stored on a blockchain. Unlike cryptocurrencies like Bitcoin or Ethereum, which are fungible (interchangeable with one another), non-fungible tokens are one-of-a-kind and cannot be exchanged on a one-to-one basis.\

- **Uniqueness:** Each NFT has a distinct value and cannot be duplicated. This is why they are used to represent items like digital art, music, virtual real estate, collectibles, and even in-game items.
- **Blockchain Technology:** NFTs are typically built on blockchain platforms like Ethereum. The blockchain records all transactions related to the NFT, ensuring transparency, security, and proof of ownership.



Overview of Major NFT Projects

Brand	NFT Project	Price Range	Platform	Note
Nike	Cryptokicks	\$1,000—\$10,000	28 OpenSea	Digital sneakers NFT, integrates AR technology
Coca-Cola	Friendship Box	\$1,000--\$5000	OpenSea	Charity-focused NFT, includes virtual clothing and art
Gucci	SuperGucci	\$2,000-\$50,000	SuperRare	Limited digital fashion NFTs, in collaboration with artists
Disney	Disney NFT Collection	\$60--\$5,000	VeVe	NFTs featuring classic Disney characters, aimed at fans
Louis Vuitton	Louis: The Game	Free(in game)	Proprietary Platform	Limited edition NFTs earned through in-game tasks

The rise of NFTs (Non-Fungible Tokens) and digital assets continues to be a major trend shaping the blockchain hardware industry. As of 2023, the global NFT market size was valued at approximately USD48.74 billion, up from just \$94 million in 2020. This explosive growth is driven by the increasing use of NFTs in various sectors, including digital art, gaming, and collectibles. Notably, digital assets accounted for the highest revenue share in the NFT market, with brands like Nike, Disney, and Gucci leveraging NFTs to engage with customers and create new revenue streams. These brands' ventures into NFTs underscore the commercial viability of digital assets and highlight a growing trend where major companies are not only adopting but also innovating within the NFT space.

Conclusion

This trend indicates that the blockchain hardware industry must continue to innovate to support the expanding needs of the NFT market. As more sectors embrace NFTs, the demand for advanced, scalable, and secure blockchain hardware solutions will only grow, making this a critical area for future development in the industry.

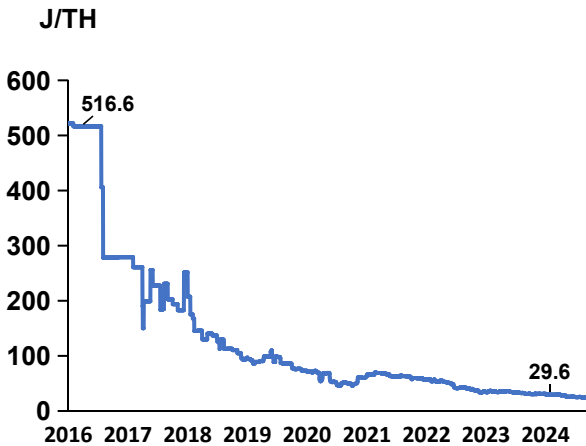
Technological Advancements and Green Technologies

The future of the blockchain hardware industry is being shaped by two major trends: technological advancements and a strong emphasis on green technologies. As the industry continues to innovate, there is a clear focus on improving energy efficiency and adopting more sustainable practices, such as advanced cooling systems and the increased use of renewable energy sources. These developments not only enhance hardware performance but also align with the growing demand for environmentally friendly blockchain solutions.

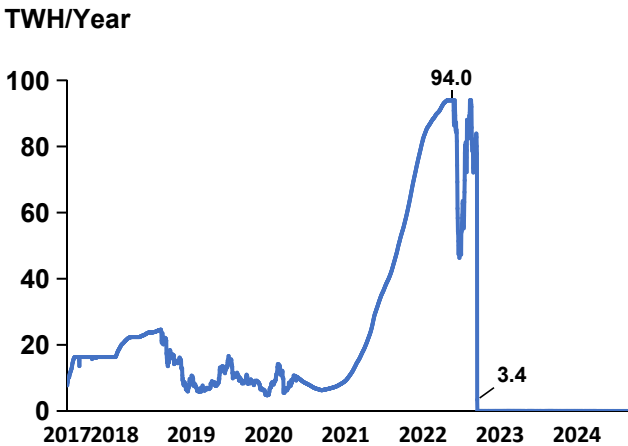


The global blockchain hardware industry is being shaped by significant Technological Advancements and Green Technologies. As seen in the charts, Bitcoin mining hardware has made impressive strides in reducing energy consumption, with energy efficiency improving from 516.6 J/TH in 2016 to just 29.6 J/TH in 2024. This reduction highlights the ongoing innovation in hardware design aimed at supporting more powerful, yet less energy-intensive, operations. Similarly, Ethereum's transition to Proof of Stake has drastically cut its energy use, from 94.0 TWh to 3.4 TWh annually, underscoring the industry's shift towards more sustainable blockchain solutions.

Energy Efficiency of Hardware, 2016 to 2024



Ethereum Energy Consumption, 2017 to 2024



Conclusion

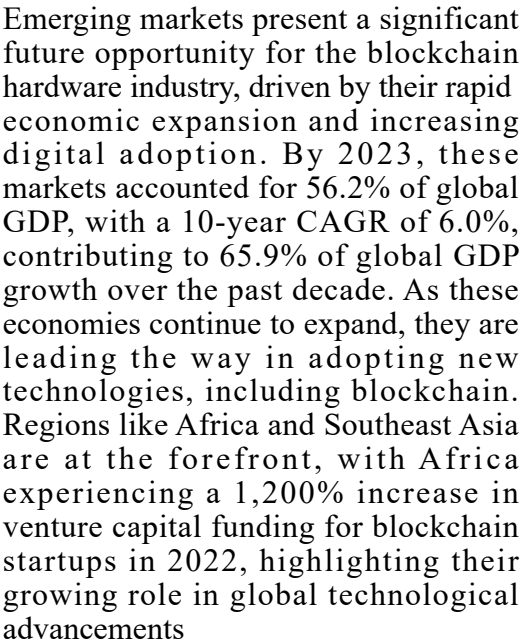
In addition to energy reductions, the adoption of advanced cooling technologies, like liquid cooling systems, reflects the industry's move towards greener operations. Companies like Canaan and MicroBT are leading this change by introducing hardware that enhances performance while minimizing environmental impact. The growing use of renewable energy in mining, now accounting for up to 78% of energy sources, further emphasizes the industry's commitment to sustainability. These developments indicate that the future growth of blockchain hardware will be driven by ongoing technological innovation and a strong focus on green technologies.



Chap 3.2

Future Opportunities

Emerging markets are set to play a key role in the global blockchain revolution, offering significant growth opportunities. With rising internet access and mobile adoption, these regions are embracing blockchain solutions in areas like financial inclusion and supply chain management. As demand for secure blockchain infrastructure grows, regions like Africa and Southeast Asia are expected to lead future advancements.



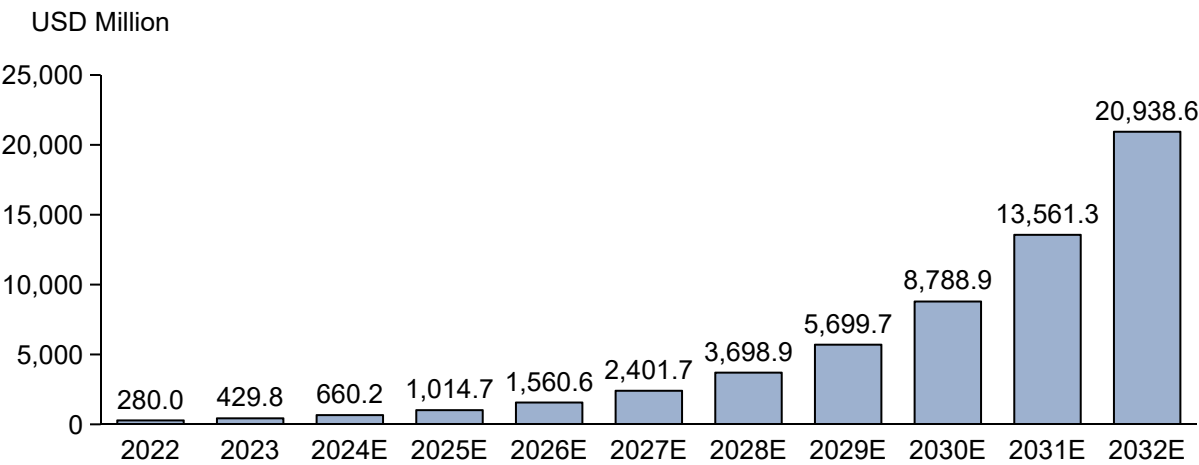
These emerging markets are uniquely positioned to propel blockchain hardware development. Large unbanked populations in these regions are increasingly adopting blockchain-based financial solutions, supported by the rapid expansion of mobile internet access. Moreover, governments in these markets are exploring blockchain applications in areas like land registry and supply chain management, further driving the demand for scalable and reliable blockchain hardware. As digital transformation accelerates in these regions, the blockchain hardware industry stands to benefit significantly from the growing infrastructure needs.



Integration with IoT

The integration of blockchain with the Internet of Things (IoT) offers a significant opportunity for the blockchain hardware market. As IoT devices expand across industries like healthcare and smart cities, the need for secure and scalable infrastructure grows. Blockchain’s decentralized nature ensures data integrity and secure device communication, making it an essential part of future IoT systems. This convergence is driving demand for advanced blockchain hardware capable of supporting large-scale IoT networks. Continued advancements in blockchain scalability and efficiency further enhance the potential for growth in this space, positioning it as a key area for future development.

Blockchain IoT Market Size, 2022 - 2032E



As IoT devices become increasingly common across sectors, the need for secure and scalable infrastructure is growing. Blockchain’s decentralized ledger provides an ideal solution for managing and securing the vast amounts of data generated by IoT devices. This trend is driving substantial growth in the blockchain IoT market, which is projected to exceed USD20,938.6 million by 2032. This indicates a rising demand for advanced blockchain hardware that can support large-scale IoT networks, particularly in industries like healthcare and smart cities. Moreover, blockchain technology enhances IoT systems by ensuring data integrity and enabling secure, seamless communication between devices.



Conclusion

As industries continue to adopt IoT solutions, the need for robust blockchain hardware will only increase. Advances in blockchain, such as more energy-efficient consensus mechanisms and greater scalability, are making it more practical to integrate with IoT on a broader scale. This growing adoption of IoT and blockchain across various sectors highlights the potential for significant expansion in the blockchain hardware market, positioning it as a key area for future growth.

Expansion of Blockchain-as-a-Service (BaaS)

The expansion of Blockchain-as-a-Service (BaaS) offers a key growth opportunity for the blockchain hardware industry. BaaS allows businesses to leverage blockchain technology without building their own infrastructure, which is driving widespread adoption across various sectors. The global BaaS market, valued at approximately USD2.11 billion in 2023, is projected to soar to USD56.97 billion by 2030. This growth is fueled by industries such as finance, healthcare, and supply chain management, where blockchain is increasingly used to enhance transparency and security. Leading companies like Microsoft Azure, IBM Blockchain, Amazon AWS, and Alibaba Cloud are at the forefront of this trend, providing scalable and secure blockchain services that meet the diverse needs of their clients.

These BaaS providers are empowering businesses across multiple industries to integrate blockchain into their operations efficiently. For example, Microsoft Azure and IBM Blockchain are instrumental in finance and supply chain sectors, helping giants like J.P. Morgan and Maersk optimize their processes. Similarly, Amazon AWS and Alibaba Cloud are enabling advancements in e-commerce and logistics, with major clients such as T-Mobile and S.F. Express. The involvement of such prominent companies underscores BaaS’s role as a pivotal driver of blockchain adoption, which in turn boosts the demand for advanced blockchain hardware to support these expanding networks.

Main Player of Blockchain-as-a-Service (BaaS)

Company	BaaS Launch Year	Field/Industry	Clients	Introduction
Microsoft Azure	2015	Finance, Supply Chain, Retail	J.P.Morgan, Starbucks, Xbox, GE Aviation	Azure Blockchain Service offers a fully managed ledger service with a range of tools for creating blockchain apps.
IBM Blockchain	2017	Finance, Healthcare, Supply Chain	Walmart, Maersk, Nestlé	IBM Blockchain provides secure and scalable blockchain solutions using Hyperledger Fabric, focusing on enterprise applications.
Amazon AWS	2018	Cross-Industry, including FinTech	T-Mobile, Pwc, Nestlé	AWS offers a managed blockchain service that supports multiple frameworks, including Hyperledger Fabric and Ethereum.
Alibaba Cloud	2018	E-commerce, Finance, Logistics	Cathay, Pacific, Baozun, S.F. Express	Alibaba Cloud Blockchain as a Service supports multiple blockchain frameworks, including Hyperledger Fabric, and focuses on integrating blockchain with cloud services for e-commerce and logistics.

Conclusion

The rise of Blockchain-as-a-Service (BaaS) offers a significant opportunity for the blockchain hardware industry. As businesses increasingly adopt BaaS to streamline operations, the demand for reliable and scalable blockchain infrastructure will grow. Leading providers like Microsoft, IBM, and Amazon are driving this trend, making blockchain more accessible across sectors. This underscores the critical role of advanced hardware in supporting BaaS growth and future adoption.

Methodology

Comprehensive Market Research Approach

Frost & Sullivan's Research Institute focuses on the Chinese market, conducting in-depth studies across 10 major industries and 54 vertical sectors, with nearly 500,000 industry research samples accumulated and over 10,000 independent research consulting projects completed.

Life Cycle Analysis of Industry Dynamics

Leveraging China's dynamic economic environment, the Research Institute explores fields such as social security, artificial intelligence, and big data, covering the entire life cycle of industries. This includes the establishment, growth, and expansion of companies, as well as their journey to IPO and maturity. Industry researchers evaluate and assess the evolving industrial models, business strategies, and operational models of companies, offering a professional perspective on the industry's development.

Integration of Traditional and Innovative Research Methods

The institute integrates traditional and new research methodologies, using proprietary algorithms and combining cross-sector big data analysis. By employing diversified research approaches, the team uncovers the logic behind quantitative data and explores the insights underlying qualitative content. This enables objective and authentic explanations of the industry's current state, along with forward-looking predictions of future trends. Each report produced by the Research Institute presents a comprehensive picture of the past, present, and future of the industry.

Adaptive and Continuous Data Refinement

The Research Institute closely monitors the latest developments in industry trends. The content and data in its reports are continuously updated and refined based on industry growth, technological advancements, changes in competitive landscapes, regulatory policies, and deeper market insights.

Strategic and Executional Perspective in Research

With a commitment to meticulous research and forward momentum, the Research Institute analyzes industries from a strategic viewpoint and interprets them from an execution perspective, offering valuable reports to readers seeking thorough and insightful industry analysis.

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