Chapter 11

Bitcoin and Blockchain: From Acquiring Coins to Earning Mining Rewards

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Abstract

Launched in 2008, Bitcoin and its innovative technology, the blockchain, have changed the world of digital money and distributed environments. This chapter explores the nature of Bitcoin and blockchain from an economic perspective. The characteristics of decentralization, transparency, and security are explained as aspects that result in blockchain's dependability, while the ways and means of acquiring Bitcoin, its storage, and the mining process are discussed to reveal their workings and the associated problems. In this chapter we discuss the economic and environmental consequences in terms of their energy consumptions, possible solutions through renewable energy, and new reward distribution schemes of the Bitcoin mining. Apart from the current definition of blockchain, it also discusses its future, its advantages and disadvantages, issues in the scale, legal issues faced and ethical issues. This chapter explains Bitcoin and blockchain, which are understood and used to demonstrate how they can be applied in different fields and how they are expanding while developing sustainably with the right governance. In addition, they discuss the problems arising from blockchain and what the perspectives on its future are when it comes to the system's ability to grow and legal restrictions. Overall, this chapter presents a short history of Bitcoin and the development of blockchain technologies, where they have shown a positive effect in many fields and call for a sustainable approach and strong management to thrive.

Keywords

Bitcoin, Blockchain technology, Cryptocurrency mining, Mining Rewards, Bitcoin mining

1. Introduction

In 2008, Nakamoto introduced the first digital decentralized currency, Bitcoin. Like the traditional money system, Bitcoin is peer-to-peer, without central banks or intermediaries. In other words, it is blockchain technology in terms of immutability, security, and transparency. The blockchain consists of a chain of data blocks, with each block linked to another one, secured through cryptographic techniques, and each block records a timestamp and information about the transactions.

In conventional systems, Bitcoin and blockchain core principles are meant to be brought into transparency, security, and decentralization. However, this is the closest form of decentralization we can obtain, taking away the transaction cost and delay, doing away with central authorities, and making it more private. This principle has been adopted by Zhuo et al. (2024) to explain trust in systems when authoritative institutions cannot be trusted. Another component of a blockchain network design is transparency, allowing any member of the blockchain network to look through transactions. As Adhikari (2024) notes, helps businesses have higher transparency and, consequently, to be more ethical and create more economic justice.

The third feature that makes both Blockchain and Bitcoin reliable and safe is security. Proof-of-work methods usually make it practically impossible to change the content of transactions without the consent of the network. Eyal and Sirer (2018) explained the inefficiencies of mining protocols, as well as the network's resilience to meddling and invasion. These principles define Bitcoin and blockchain as revolutionary approaches for the construction of trust less systems, particularly that worth constructing in a trust less manner.

From its beginning, the Bitcoin technical specifications and properties, as well as its principles, were applied to financial operations as a whole, and the concept of blockchain usage was further expanded. From decentralized finance (DeFi) to the supply chain, these innovations have continuously reimagined this interaction and trust formation process in the contemporary world.

2. Literature Review

The literature on Bitcoin and blockchain has developed following the introduction of Bitcoin by Nakamoto (2008). Some of the most basic concepts are included in previous research including cryptocurrencies security, decentralized consensus model and miners in the system (Antonopoulos, 2014). According to Zheng et al. (2017) and not just for Bitcoin, blockchain is a distributed technology that offers a distributed ledger to international industries. Together, these studies demonstrate how blockchain can be used to create new forms of trust and transformation in digital transactions.

The issues of scalability and transaction speed of Bitcoin have been a concern and answers like the Lightning Network by Poon and Dryja (2016). This type of solution is regarded as being an off-chain method of payment with the intention of executing speedy and inexpensive operations and to decrease the load on the blockchain system. In Conti et al. (2018), we see that, Comprehensive security and privacy risks of the Bitcoin are examined in terms of the selected attacks, including double spending as well as smaller mining pools. In their view, Tapscott and Tapscott (2016) note that blockchain is capable of revolutionising social and economic structures in the world.

The impact and knowledge of adoption by using bitcoin and its economic consequences is well established. In the same year, Böhme et al. (2015) describe the relationship between governance and technical characteristics of Bitcoin and Polasik et al. (2015) investigate factors that determine the Bitcoin price and its adoption as currency and valuable item. A study by Glaser et al., (2014) when looking at the users' motivations described the as being of speculative as well as transactional. Rabhi & Soujaa (2024) enter this discussion by identifying macro-signals that inform cryptocurrency adoption across the two dimensions of financial insecurity and technological advancement.

In many ways, the foundation of the Bitcoin Network mining has changed a great deal. Eyal and Sirer (2018) show that the mining protocols are malleable and claim that such protocols do not guarantee network security even if they are controlled by the majority. Specifically, Gudmundsson and Hougaard (2024) elaborate on the complexity of mining pools that heavily rely on decentralized reward sharing mechanisms that are meant to stimulate participation. The impact of mining on the environment was however growing in importance. As evidenced by Onat et al. (2024) and Matthews (2024), global carbon emissions attributable to Bitcoin mining diminish air quality and human wellbeing, and hence can only be managed by a sustainable practice.

This acts as a disadvantage to the central economies because the introduction of the Bitcoin does not necessitate the central authority to enforce its execution. Yermack (2018) provides a brief summary of Bitcoin as constituting an emergent system of digital money and Narayanan (2016) situates Bitcoin in the broader paradigm of the new/crypto economy. They include research articles like Adhikari (2024) which focus on how blockchain technology can meet the criterion of sustainable business and therefore economic growth. However, in a recent study by Landormy (2024), the author applies highly complex econometric models and explores the process of Bitcoin's price discovery and influential macroeconomic and behavioural factors.

However, there are problems of regulation, ethics, and risks associated with Bitcoins. As Schuler, Kendall, Sych, and Sandil mentioned in their work, there are many facets to regulating DeFI and how the authorities try to introduce changes, while still keeping it in check. Sestino et al (2024), brought out the fact that because of the unethical use of such currencies it would like to restrict the usage and acceptance of such coins especially in the developing world. Albeit, Zhuo et al., (2024) perform a systematic literature review of blockchain research in this aspect, it is asserted that emphasis should be placed on addressed these challenges to ensure the sustainability of the blockchain.

3. Acquiring Bitcoin

As mentioned earlier, it is very easy to obtain Bitcoin since it can be done through the following multiple processes that are inclusive of the level of approach of a specific user. The most often-used technique is through digital currency exchanges which are basically the internet-based marketplace for buying, selling and exchanging bitcoins. As highlighted by Nassar and Yaacoub (2024), these exchanges provide front-end that is easy to use and real-time market price thus being appropriate for the new trader as well as the professional trader. In another model users can transact among themselves or an individual can buy the Bitcoin directly instead of buying it through an exchange as highlighted by Al-Mezel et al (2024). Almost all P2P systems employ blockchain technology to enable transparent and secure transactions with the merchandise required to be sold through the system with payment options.

Another way to get Bitcoin is through merchant services which allows people to convert their fiat money to Bitcoin during trading. Also, about the extension of use of Bitcoin acquisition, Boumaiza (2024) wrote that through the use of blockchain solutions on P2P trading modules in energy microgrids, the adoption of Bitcoin is also extended. These different methods show how Bitcoin can be used in different transactions that may be required in some instances, while remaining de-central to users.

It's important that before you get the Bitcoin, you know where to store them and so it's advisable that you select that wallet to have hold of your Bitcoin assets and safe them from theft. Wallets can be broadly categorized into two types: hot and cold. In Mirza, Rahulamathavan (2023) discusses how these hot wallets, which are connected to the Internet, are easy to access via frequent transactions. This means, though, that their online nature makes them more vulnerable to attacks by cyberspace. In contrast, cold wallets, offline Bitcoin storage, are less vulnerable to hacking but they are harder to use. As pointed out by Kanetkar and Kanetkar (2023), one definitely needs to understand these wallet types to enjoy convenience without paying a heavy price on the security side as each user has different usage patterns and risk tolerance.

It is very crucial to store Bitcoins and be secure with them. The analysis of wallet vulnerabilities (Jokić 2018) warns about the lack of awakening and some robust encryption. With contemporary development like blockchain based scalable solutions to p2p frameworks from Boumaza (2024) and beyond, processing and storing of personal information in wallets becomes more efficient and secure. Held (2024) states that these storage challenges are issues to be resolved as Bitcoin evolves and that Bitcoin should be a trusted financial asset to a wider population.

To sum it up, there are ways to buy Bitcoin through exchanges, peer to peer systems and merchant services, which all offer something different. So when it comes to saving your Bitcoins safely, there are three options: hot or cold wallets and either how available / secure you want it to be. The space of wallet technology and P2P frameworks still see continued innovation, and Bitcoin remains a safe, powerful and flexible digital currency that can be used by a wide variety of people.

4. Understanding Blockchain Technology

Blockchain technology is a revolutionary way to record the transactions in a safe and transparent manner with a help of decentralized ledger system. Each block is a series of blocks, having transaction data, timestamp and hash (which references to previous block). This structure also asserts data integrity and doesn't allow for tampering because when changing one block you have to change all subsequent blocks (Nakamoto, 2008). Cryptographic hashing is a fundamental algorithm, converting input data to a unique fixed length digital signature that protects data from unauthorized change (Held, 2024).

Consensus mechanisms are used to validate transactions and maintain ledger integrity within blockchain functionality. The most prevalent means based on solving computationally expensive puzzles to inherently sustain decentralization and security (Zheng et al., 2017) is proof of work (PoW). The problems regarding the use of PoW in Bitcoin include high energy consumption, which makes the search for alternative proof of stake (PoS) and Lightning Network as a solution to scalability and efficiency (Gervais et al., 2016) Holds the key to several Blockchain applications such as cryptocurrency and decentralized finance (Van Valkenburgh, 2019).

Cryptographic hashing is used as the security framework for the blockchain. Hash functions give a fixed length output from the input; a slight change in the input yields hash quite different. This is the mechanism that gives blockchain its immutability as well as eases prevention of fraudulent transactions (Antonopoulos 2014). This links the hash of each block to the previous block, forming a chain that is basically immutably, except if you have control over half the network once you lost all your bitcoins in the initial 2009 theft, a problem that Eyal and Sirer (2018) explore.

Now blockchain is no longer just a currency: It is also directly applicable to carbon trading, peer to peer energy systems and supply chain transparency. For example, Boumaiza contrasted blockchain trading of energy with the findings of Al Mezel et al. (2024) on issues of the hybrid blockchain trading with virtual assets. However, Sestino et al. (2024) and Matthews (2024) point out limitations of scalability, excessive energy usage, and regulatory issues. As they propose it, in decentralization, this new arising technology called blockchain puts its trust.

5. Understanding Bitcoin Mining: Process, Technology, and Requirements

In other words, in the Bitcoin blockchain, through the mining process, new transactions are reviewed and added into the fundamental chain of Bitcoin blockchain. The decisive action is to perform complex mathematical puzzles by computational power to verify all transactions in the network are proper and no double spending takes place. The miners solve these puzzles, they validate the transactions, they incorporate the transactions in the blocks, and expand the chain of blocks. Every time a miner solves the puzzle and confirms the block, the mine earns newly generated Bitcoins and fees from the transactions. Hence, a decentralized verification system is needed for the Bitcoin network to suppress fraud, maintain blockchains' blockchain characteristic (unicity, indelibility), and sustain security around Bitcoin (Bhaskar et al. 2024).

Particularities of hardware and software require special attention when it comes to Bitcoin mining. Mining equipment is usually composed of some high-performance machines known as Application-Specific Integrated Circuits (ASICs) or Graphics Processing Units (GPUs) because of the complexity of the mining algorithms. For instance, ASICs are designed for mining activity, and are much more efficient than PCs and other standard computers (Klinkmüller et al., 2019). In addition to the hardware, the mining application provides the miners with an interface to connect to the Bitcoin network and it can join a pool and mine for a block alone. Software helps to manage mining devices and interact with the blockchain network in the mining process (Bizzaro et al., 2020).

Consensus algorithms are involved, for instance, the process of mining indicates how through computational work a miner was before a new block added to the block chain. Discussions on relatively more sustainable approaches to using Bitcoin has been because of worries about energy consumption and impact on the environment (Chithaluru et al., 2024). However, PoW remains the most widespread strategy focused on the safeguarding of the Bitcoin network, and the effectiveness of this approach in preventing fraudulent activity and in preserving the blockchain is beyond debate (Rouhani & Deters, 2021).

With regard to the industry trends, the Bitcoin mining is changing with the rise of mining difficulty and the centralized large-scale mining farms. As a result, the mining power is concentrated, which is not desirable since only those individuals who can afford the necessary equipment can participate in this endeavor (Ste-panova et al., p. 78). Therefore, the blockchain community has had interests in new consensus mechanisms and mining techniques that is efficient and power-efficient.

6. Earning Mining Rewards

Bitcoin mining rewards are got by miners through transaction confirmation and integration of this into a block. It's a process of solving large sets of great mathematical problems so the capacity defines as the possible amount of computationally intensive work. Bitcoin currency means that solving for the puzzle allows the creation of the currency, the miner that solved the puzzle receives it. They are at the initial stage a fixed value, then are cut in half every time after having handled the number of blocks, thus it is a diminishing feature. That is why it is designed to manage as many Bitcoins as possible and the amount cannot be more than 21 million pieces.

Therefore, there are a couple of things that are taken into consideration in order to find out the mining rewards. One of them is to pay miners a predetermined number of Bitcoins per mined block of a certain difficulty level. The miners also earn some money commissions from the fees in those confirmed transactions. The compensation given for each block is reducing by fifty percent in an event referred to as 'halving', which takes approximately four years or for every 210,000 blocks confirmed. This event decreases the proportion of new Bitcoins into circulation and, therefore, slows the net rate of inflation of Bitcoins in the long-run. Halving events create pressure for decrease of supply of the new bitcoins (Papathanasiou et al., 2024, Cho et al., 2024) making bitcoins even more scarce and possibly more valuable.

Mining rewards are highly sensitive to halving, which in the past has led to significant price growth due to reducing the incentive to mine and a decline in the inflow of new coins. On the other hand, halving cycle also poses miners' challenges and opportunities at the same time, halving cycle presents miner challenges and opportunities. To make up for this loss of block reward, miners are able to look into transaction fees as an added source of income. However, the mining business's profitability is also influenced by external parameters such as energy cost and the Bitcoin's average price (Tedeschi et al., 2024). However, miners have no influence over these parameters and have to adjust their approach to making a profit for instance, by improving the mining hardware, or by proceeding with joining larger mining pools to be more likely to earn rewards (Houy 2016; Salimitari et al. 2017).

The possibilities of halving, therefore, depend on the ability of the mining ecosystem to sustain itself in the long-run. This is because with each half the rewards for those individual miners reduce hence increasing the likelihood of centralization among the big mining companies. This may hinder decentralisation of the network and even the blockchain security as stated by Bertucci et al., 2024. Moreover, the economic burden of mining Bitcoins rests with the price of the Bitcoins; miners must be certain that the value of the rewards corresponds to the approximate cost of hashing (Rosenfeld, 2011; Fabus et al., 2024).

We finally conclude that Bitcoin mining rewards are structured in this way to incentivise miners and suppress Bitcoin supply over time. Halfing events matter a great deal for miners and the Bitcoin ecosystem as a whole because they affect profitability and sustainability throughout the mining process. The halving events (Cho et al., 2024; Tedeschi et al., 2024) and mining operations that are important because it affects the strategic management to maintain the profitability and ensure the long-term viability of Bitcoin mining operations.

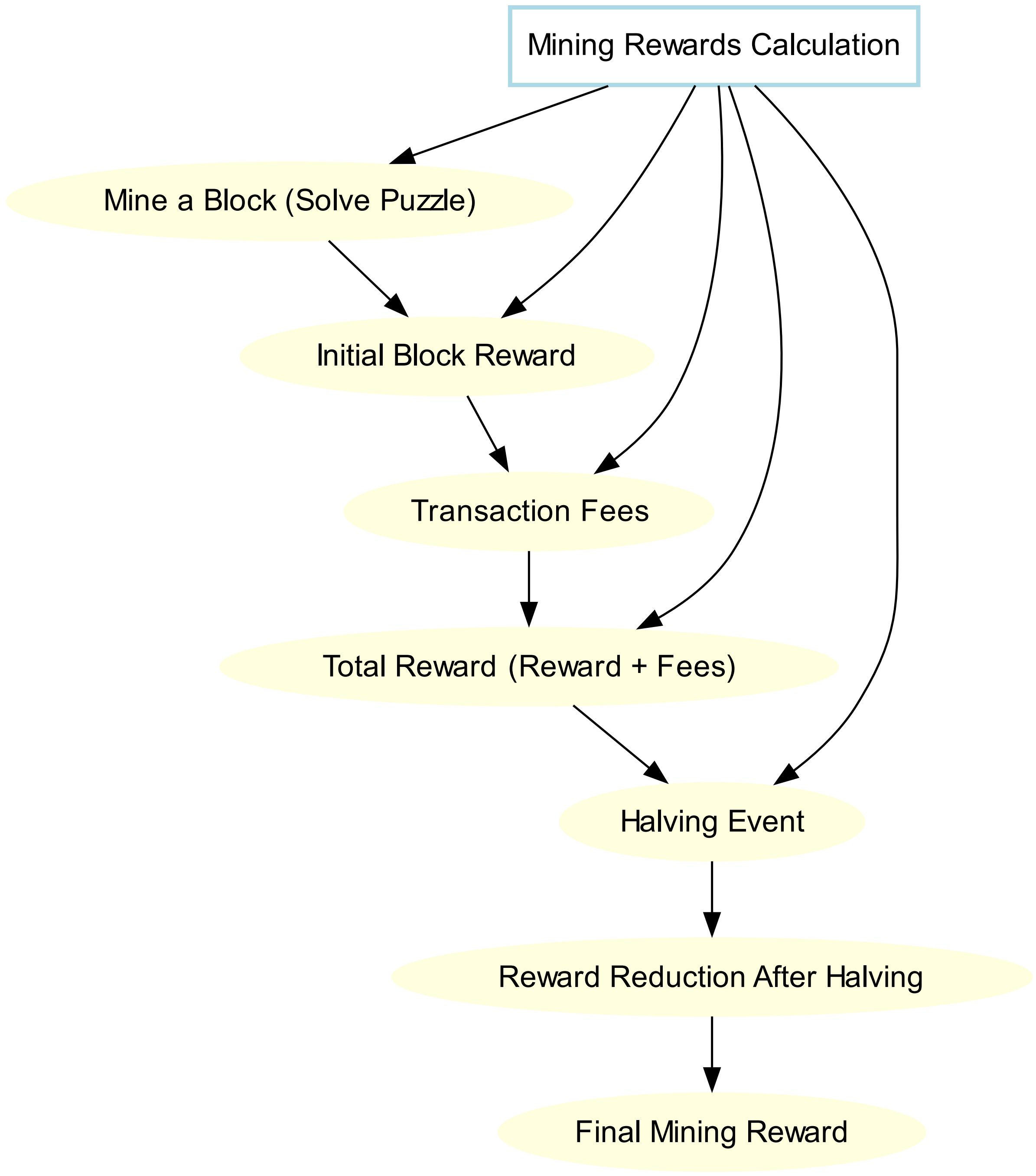

Fig. 1 Conceptual Diagram by Author

7. Economic and Environmental Aspects of Mining

This can be said to be one of the widely known facts regarding Bitcoin mining so far, the high energy-consumption proof-of-work (PoW) that is inherent in bitcoin with Bitcoin mining. In the study conducted by Onat et al (2024), the authors indicate that the carbon footprints of global Bitcoin mining are transnational. Also, Matthews (2024) has highlighted every mining activity and crypto damage concerning air pollution and public health. Other issues have invariably emerged all over the world due to the increased utilization of computational capabilities.

This energy demand does vary from region to region since regions differ by energy prices and other types of renewable power. This energy demand does vary from region to region since regions differ by energy prices and other types of renewable power. Bhaskar et al. (2024) describe some regions with excess of the RE satisfying the same as popular mining destinations. According to Boumaiza in 2024 such blockchain based energy trading systems can be utilized as systems for the accomplishment of integration of renewable sources and the minimization of the impact on the environment.

Another factor that affects the mining feasibility is a direct impact on operational cost of a Bitcoin mining enterprise. In the past, the areas that offered affordable electricity rates, or subsidized power including certain parts of China and Kazakhstan, were sufficiently compelling to promote mining and became entrenched (Ste., et al., 2024). However, issues of regulation and concern for the environment have led the mines towards those areas that have sound policies and are less reckless on the environment (Bhaskar et al., 2024).

From an incentive angle, Boumaiza (2024) examined how carbon and energy trading could encourage the use of cleaner energy in order to enhance the profitability of mining. Similarly, Gudmundsson and Hougaard (2024) proposed decentralized reward sharing model to improve mining pool economic efficiency when energy cost different across regions.

Mining practices are aligned with technology solutions with regards to long-term environmental impact. An example is blockchain scalability solutions and peer-to-peer trading by microgrids as methods to reduce energy cost (Boumaiza, 2024). In addition, Tedeschi et al. (2024) note user-miner equilibria's role in cost efficiency, which, therefore, must be perpetually pursued while optimizing profits with environ- mental sustainability.

New technologies and progressive legislation introduce new order to the mining industry, and opens up a new, more efficient form of mining that can help reduce the Warner Brothers sized environmental impact that mining now demands.

8. Challenges and Future Prospects of Bitcoin and Blockchain Technology

The risks are high while the opportunities are vast for both bitcoin and blockchain technologies. The greatest concern is more than likely regulatory factors. Specifications and requirements of regulations may be different across jurisdictions, which makes them unpredictable for users, developers, and businesses. The legal status of Bitcoin involves tax and regulation depending on whether it is considered a commodity, currency, or an asset. The uncertainty hinders the use of Bitcoin and new block chain technologies in the global markets. Works that discuss the problem by demonstrating that contention regulation faces challenges as shown in Schuler et al.'s (2024) work also add to the arguments that regulatory measures are slow in adapting to current technological advancement. Also, Sestino et al. (2024) observe that the associated linkages with unethical activities such as money laundering are also an impediment to the use of Bitcoin.

There are also adoption barriers that originate from Bitcoin itself because it is a volatile asset. Stablecoins are unstable in terms of value that makes them unsuitable to be used to facilitate exchange of value or even be used as a store of value. As noted by Polasik et al. (2015), this major fluctuation highly impact Bitcoin's realistic usability and limits general operations. That is why Bitcoin is still largely an investment currency and not completely a usable currency.

Several innovations have appeared concerning Bitcoin since it emerged and began its operation. At the time when Nakamoto described it in 2008 as a peer-to-peer electronic cash system, no one could have thought that it would turn into a tool growing and occupying as many spheres of the financial field and becoming the base for decentralized applications. Another significant challenge popular in the Bitcoin system is scalability, and while there have been partial solutions of the Bitcoin scalability problem employing the implementation of Poon and Dryja (2016) known as the Lighting Network, the problem remains unsolved. This made the use of Bitcoin better by enabling faster and cheaper transactions thus an off-chain solution. Besides the utilization of the blockchain as a supportive platform for the Bitcoin, there have been developments towards the application of the technology. The usefulness of blockchain in the context of carbon and energy trading was discussed in Boumaiza (2024), highlighting that this opportunity contributes to effective sustainable business development. In addition, to optimize performance, there is the emergence of solutions such as smart contract-based decentralization of mining pool described by Papathanasiou et al. Al (2024), are also examples of how blockchain can progress to enhance the efficiency of the network.

The analyses of the future of bitcoin and blockchains indicate so much potential for growth. As found by Adhikari (2024), over time, the application of the blockchain technologies in sustainable business practices is bound to rise. However, there is an issue of environmental influence such as the amount of carbon emission which come with the use of Bitcoin mining. Matthews (2024) established that the mining industry needs to harness electrical energy from renewable sources in their practices to reduce the effects on the environment. This means that people from different backgrounds academics, industries, and governments will have to come together and ensure that the advancement of this technology aligns with the sustainable development goals. However, the further development of Bitcoin and the blockchain concept as the change is gradual can contribute to the enhancement of the financial environment as a positive shift and has the prospects to become the basis for the innovative shift in the given diverse industries.

9. Conclusion

Bitcoin and its associated technologies of blockchain allow for the introduction of decentralisation, transparency and security in the financial systems. Some of the impacts of Bitcoin mining as the process advanced with technology include high energy consumption, environment degradation, and regulatory risks. The halving mechanism ensures the scarcity of the bitcoin, impacts the mining economics and aligns with the trends in the market. Although these are challenges, blockchain is not limited to be just a currency there are many uses in different fields whether it is in the supply chain or renewable energy. In the context of this argument, Blockchain requires top-notch capacity on one side and, on the other, it needs to be regulated, to abstract from the evidently destructive states and to maintain its ethical and sustainable potential for changes.

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