Advanced Programming: The Future Implication on Cryptocurrency-Digital Money Mining and Energy Consumption

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Abstract: **Advanced blockchain programming is extremely complex while the basic idea is simply to decentralize data storage so as not to own, control or manipulate such information by a central actor. This article focuses on the emerging phenomenon of energy sustainability mining cryptocurrencies. Cryptocurrencies are digital financial assets for which a cryptographic decentralized technology guarantees ownership and transfers of property. The increase in market value and the increasing global popularity of cryptocurrencies are giving rise to a number of energy consumption concerns. This introductory article discusses the main energy consumption trends in the academic study related to cryptocurrencies and underlines the contributions of the works selected in literature, using both descriptive and qualitative approaches. The information used is secondary, obtained from journals, conference papers examined, work paper and reports by consultants dealing with cryptocurrency mining's energy consumption. We argue that cryptocurrencies may perform useful functions and add value for money, but there are reasons for favoring market regulation. Although this goes against the original libertarian reasoning behind cryptocurrencies, it seems a step forward in improving the welfare of energy consumption.**

Keywords: **Miners, Cryptocurrency, Mining Machines, Proof of Power, Energy, Blockchain, Bitcoins, Atlercoins, Digital Assets**

I. INTRODUCTION

Currency transactions are mostly centralized and regulated by a third-party entity between people or businesses. A bank or credit card company must complete the transaction in a digital payment or currency transfer. This transaction system is normally centralized and all information and data is handled and administered by a third party rather than by the two main entities involved in the transaction. To resolve this problem, Blockchain technology was created. The objective of Blockchain technology is to build a decentralized system in which nobody controls transactions and information.

Cryptocurrencies can be considered as part of the wider class of financial assets, 'crypto assets' with identical digital pair-to-peer transactions, without interference in transaction certification purposes by any third-party institution. What makes cryptocurrencies different from other crypto assets? It depends on their intent, i.e., whether they are only issued for transfers or serve other functions as well. We should follow the distinctions set in the last regulatory reports in the overall category of crypto-assets, which separate two other sub-categories of crypto-assets from cryptocurrencies.

As suggested in the original whitepaper proposing the supporting technology for Bitcoin [27, 36], the word cryptocurrency and other terminology used by "coin' all suggest, the original developers deliberately tried to create a digital transfer system which would fit the direct transfer of the physical cash for payment or other financial assets, such as precious metals. Systems were originally based on paper but have been using mainframe and computer systems since the 1960s [1]. If the information system is faulty, such as a violation of a security which causes fraud, loss or failure to execute a transfer order, the financial institution is legally responsible for compensating the owner of the asset. With cryptocurrencies, both ownership and transfer are verified by supporting software [2]. There is no 'trustworthy third party' prerequisite [4]. This approach requires a complete historical record of previous transactions in cryptocurrency which traces every holding of cryptocurrency to its original development. This historical record is constructed on the connection between records ("blocks"), so that any new block contains knowledge about the previous blocks in the growing list of digital records ("chain"). To allow every member of the network to see the same transaction history, the entire network accepts a new block by agreement.

The advent of crypto exchanges, where everyone can open accounts and trade crypto assets both against each other and against fat currencies, has been a key development in increasing cryptocurrencies and other crypto assets. The creation of these exchanges has created a whole 'ecosystem' of services and participants, which aims at providing liquidity, exploiting market gaps to benefit and attracting retail and professional investors to invest in. This paper offers a diverse perspective on the phenomenon of cryptocurrency mining and sustainability of energy consumption. A selection of contributions aimed at extending existing information on cryptocurrencies, which represent innovative developments and technical changes, and may seem to be a profitable way of raising funds for small companies. The focus is placed on areas which are of specific concern to the journal, such as the climate, sustainability and social welfare.

II. FEATURES OF BLOCKCHAIN AND CRYPTOCURRENCY

Blockchain. This is a certain kind of database which differs from a standard database in the way that it stores information; the blockchains store data in chained blocks. When new data comes in, a new block is entered. Once the block is filled with data, it is chained to the previous block which chronologically chains the data together. There are various types of information on a blockchain, but the most frequent use to date was as a transaction ledger. In the case of Bitcoin, blockchain is used in a decentralized manner so that no single person or group controls all users keep the control collectively. Decentralized blockchains are unchanging, meaning that the entered data is irreversible. For Bitcoin, it means transactions can be saved and viewed permanently by anyone.

Cryptocurrency. All cryptocurrencies are crypto assets; all crypto assets are digital assets. Not all digital assets are crypto assets, and not all crypto assets are cryptocurrencies.

Token. A token is a rare digital asset that can be found on a coin or blockchain that exists.

Coins: A coin is the digital currency used by the network for cryptocurrencies.

Nodes. These are the people and machines in the blockchain (such as your computer and the computers of other cryptocurrency miners).

Miners. Individual nodes whose tasks in a blockchain are to search ("solve") unconfirmed blocks through hashes. The confirmed block would then be added to the blockchain after a mine verifies a block. A cryptocurrency is awarded to the first miner who tells the remaining nodes that they have resolved the hash.

Transactions. An exchange between two parties of cryptocurrencies is a transaction. Each transaction is grouped into a list to be added to an unconfirmed block. The miner nodes should then check each database block.

Hashes. These one-way encryption functions enable nodes to verify the validity of cryptocurrency mining transactions. A hash is a portion integral to each block in the blockchain. The Header Data from the previous blockchain block and a nonce are combined to create a hash.

Nonces. A nonce is a crypto-language number which is only used once. In theory, a nonce is defined by National Institute of Technology standards (NIST) as a "random or non-repeating value." With crypto mining, in any block of the blockchain, the nonce is applied to the hash and the figure for which miners resolve.

Consensus algorithm. This Protocol is a blockchain protocol that supports the agreement to validate the data in various notes within a distributed network. This is thought to be 'work proof' or PoW, the first form of consensus algorithm.

Blocks. These are the various sections which affect each blockchain overall. A list of completed transactions is found in each block. Blocks cannot be changed until confirmed. To make modifications to old block implies that all other nodes in the peer-to-peer network have the changed block hash as well as those of each block added to the blockchain, as that original block was written. Simply put, old blocks cannot be changed virtually.

III. CRYPTOCURRENCY MINING

The word "cryptocurrency" itself was the science of what is known as encryption. Cryptographers are looking at secrecy approaches that have deeper origins, over 4,000 years old. Modern cryptography interpretation is based on mathematical and computer science factors and is a method for encrypting data with a certain key that provides access to data decryption. Cryptography has evolved over its long history in several sub-species: the symmetrical encryption of the data sender and the receiver has the same keys to decrypt exchanged information; and the asymmetrical encryption of each of the participants in the network has a public key confirming the status of the participanthe characteristics of competition on the market for cryptocurrencies include continuous trade, mining and high market potential. This is because cryptocurrencies don't take money from competing cryptocurrencies when they are put on the market, but rather generate and attract additional funding which contributes to continuous market development. Each crypto-monetary platform seeks to capture its market share by incorporating open technology and technology in its systems. Since Bitcoin [27], the first cryptocurrency in 2009, there have been numerous additional alternatives to changed regulations for transacting and using such as Name Coin [18] that allow the automatic transfer of digital assets under the "Smart Contract," Namecoin provides the decentralized name registration [8]. At the time of publishing, the cryptocurrency market has more than 900 currencies, a total market limit exceeding $59 billion [10, 11, 22].

The Bitcoin initiative is operated on a versatile network computer. It also facilitates information sharing across the distributed network. Anyone with device and Internet access can easily download and run free software. Certain ports should be left available for communication. The node takes up a lot of resources and space in memory. The transactions spread across the network through known nodes, which in turn further spread them. Thus, transactions are distributed across the network very rapidly. Certain nodes are called miners and can behave like mining nodes. The miners split the complex mathematical puzzle known as "Proof of Work" (POW) in the Bitcoin program. Then miner attempts to locate a variety of nonces. This number is combined with the block's data. The hash function is then moved. If it results, it must fall within a certain range. The number is hard to imagine. The nonce value varies from 0 and 4,294,967,296. Mining's main aim is to produce and release coins into its coin economy. Whenever a transaction is carried out and validated, miners accumulate these transactions and include them in the current block. Before it is transmitted and placed in the block chain, every block must be solved. To resolve a block, the resulting outputs will be mathematical puzzles which are difficult to unlock and crack. It is only possible to add the block in the book while solving the mathematical puzzle and the coins are awarded. Mining ultimately leads to a mathematical puzzles competition to resolve for the prize of coins. This prevents miners from quickly obtaining coins and thus preserves the system's fairness [6, 7, 26].

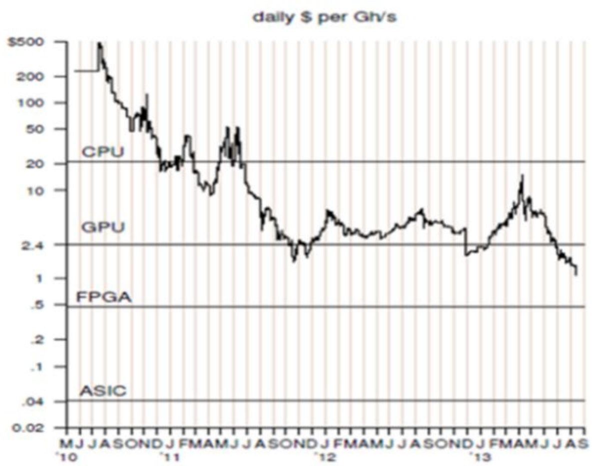

Figure 1. Revenue per GH/s vs. Energy costs. Source: Hari.

Crypto currency is mined by purpose-specific machines known as "Mining Machines." From the CPU to the currently used ASICs, the mining machines' dates back. The occasional increase in mining difficulties resulted in the development of new machines with increased efficiency than machines previously built. The mining machine's costs and efficiency decide its mining profits, and thus design and implementation in the mining industry are very critical. Similar mining machines are: CPU, GPU, FPGA (Field Programmable Gate Array), ASIC (Application Specific Integrated Circuit). Mining machines with their operation and production define the entire mining process. Figure 1 shows the GH/s revenues generated since 2010 by the bit coin network.

The horizontal lines represent CPU'S, GPU'S, FPGAS and ASICS' power costs per GH/s. If GH/s income goes below this cost, profits will turn out to be negative and machine should shut down. It does seem to be an easy deal, but it is not. A large number of mining nodes try to find the block and battle for the prize. It is just a question of chance. The more power a node has, the more likely it is the puzzle to solve and to get a reward. More computer power leads to higher electricity usage and thus the cost. By 2140, the whole of Bitcoins is expected to be mined. Just 21 million are in the maximum. As of this time, 17.3 million Bitcoins have been mined, which requires steady growth and decreases [3].

IV. REVIEW ON CRYPTOCURRENCY MINING ENERGY CONSUMPTION

In his paper Nakamoto discusses in depth the working rules of bitcoin mining [27]. Networking Bitcoin began with its special bitcoin or BTC currency in 2009. The more computing resources the miner has, the greater the proportion of the rewards awarded to that miner. This is the aspect of the bitcoin mining energy consumption. This introductory paper uses both a descriptive and qualitative approach to address the key patterns of energy use in academic research concerning cryptocurrencies, and highlights the contributions of selected papers to literature by concentrating on the usage of computer power during the Proof of Work (POW) and thus the mining phase alone.

Two hardware efficiencies were used by O'Dwyer and Malone [29], a high commodity hardware and a powerful ASIC computer. The overall demand for electricity, depending upon the hardware used in mining, was then determined between 0.1 and 10 GW. McCook estimated energy consumption by using the following models, ratios and energy consumption scenarios: Bitfury BF3500, Bitfury KnC Naptune, 25%, Cointerra TerraMiner IV, 20%, Antminer S2, 15%, Antminer S3, 5% of all hardware [20]. The annual energy consumption for 2014 was estimated as GJ 3.64 (about 1MWh). Hayes believed that, if bitcoin mining's marginal cost exceeds bitcoin price, the bitcoin mining will stop [15]. The hypothesis of upper limits for mining was based on an energy price of 13.952 c/kWh and hardware performance of 1.15 J/GH. The economist reports that KnCMiner in Boden, Sweden has a modern bitcoin mining power station using high-efficiency ASIC hardware and says that if all miners world-wide use the same hardware as Boden, then the annual global consumption of energy will amount to 1.46 TWh per year [35].

In comparing power usage in countries and power consumed by Bitcoin mining, Bitcoin mining exceeds a total of 175 countries, including a total of over 20 in Europe, in terms of electricity consumption. The amount of energy used for Bitcoin mining thus exceeds several countries' energy usage. Bitcoin falls in 50th position in terms of energy consumption, when viewed in a sequence of countries. In the case of 400 transactions per second, Bitcoin mining has been estimated to demand 30.582 MW of energy per month [25].

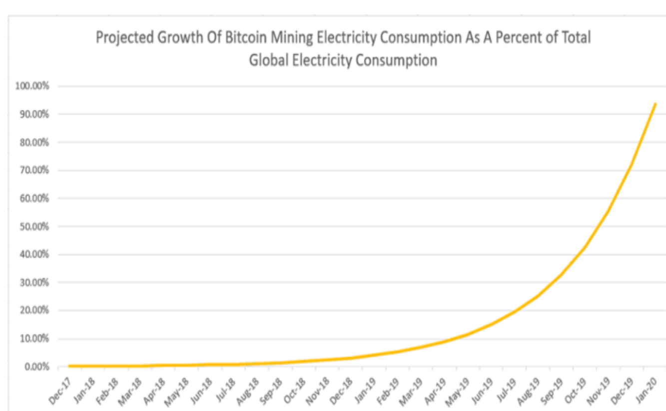

Figure 2. Growth of Electricity Consumption in Bitcoin Mining.

Source: Power Compare

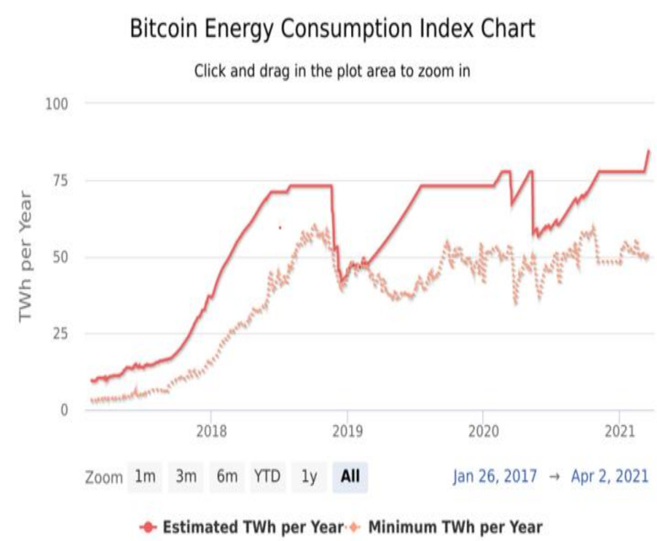

Figure 3. Bitcoin Energy Consumption Index Chart. Source: Digiconomist.

As shown in Figure 2 and 3, the energy demand of Bitcoin has reached huge levels and requires more energy than is consumed by most countries, as at February 2020 bitcoin world electricity consumption is 21,776 TWh [31, 35]. Except in a few countries on the African continent where Bitcoin requires more storage, Bitcoin uses approximately 13% of Turkish electricity. If Bitcoin's power consumption speed continues to increase in the same pace, energy equivalent to global energy consumption is expected to be required after a certain time. The findings of a Citigroup research report indicate that the Bitcoin system will fail if the volume of power needed by the Bitcoin system continues and increases [16, 33].

Figure 4 shows how much Bitcoin's energy consumption in each country is equivalent to 100% in comparison to that in each country. In Ireland, for example, electricity is currently approximately 25 TWh per year, so global Bitcoin mining is 116 percent, which is 16 percent more than they consume. UK uses an approximate 309 TWh of energy a year, so the worldwide use of Bitcoin mining is equal to only 9.4%. [31].

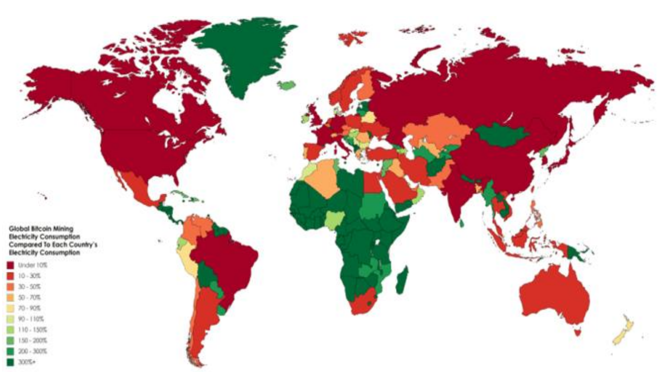

Figure 4. Global Bitcoin Mining consumption compared to each country's electricity consumption.

Source: Power Compare.

Bitcoin's current yearly electricity usage is expected to be at 29.05 TWh by Monday 20 November, 2017 according to the Digiconomist's Bitcoin Energy Consumption Index. That is 0.13 percent of global consumption of electricity. Although it doesn't sound like much, Bitcoin mining is now using more energy than 159 countries (as you can see from the map above). In addition to Ireland or Nigeria. If Bitcoin miners were a nation, they would be ranked 61st worldwide for energy use.

The energy usage of dominant Power Blockchains was analyzed by Johannes [17] and team. While energy consumption is still large, especially when compared with the amount of transactions they can operate, the environment has been greatly threatened, mainly because PoW blockchains' energy consumption doesn't dramatically increase when they carry out more transactions. They argued that while the energy consumption of non-PoW blockchains, in particular permitted blockchains, generally much greater than the non-Blockchain centralized systems, is several orders of magnitude less than the PoW cryptocurrencies such as Bitcoin. The article showed, however, that blockchain based solutions still need greater energy over non-blockchain centralized architectures due to consensus and inherent redundancy.

Three separate contributions are made in an empirical study on the environmental aspects of cryptocurrencies trading in its statistical connection to energy consumption [5, 9]. The demonstration by creating an unexplained degree of energy consumption of the exchange of crystal currencies. The trading rate of all cryptocurrencies has an important positive effect both on short-term and long-term energy consumption, which suggests a long-term deterioration of energy consumption. Bitcoin exchange tends to have a positive long-term effect on energy production that highlights its sustainability limitations. The article did not differentiate between the cryptocurrencies based on proof of work and the other algorithms. Mikhail [24] found that Bitcoin mining farms are consuming significant quantities of electricity and suggested the importance of reducing reactive energy, which is negative under these loads, to boost the quality of electricity. Reduce voltage imbalance that can result in malfunctioning equipment. Reduced harmonic levels in networks leading to increased energy consumptions, cable systems heating and customers offset short-term voltage drops and supply grid voltage spikes leading to a breakdown of mining farm service and its failure, and enhance transients in switched (switching) networks during line and lightning strikes. The Bitcoin energy consumer [19] study states that Bitcoin energy use is a very contentious issue because there are numerous estimates and the potential energy use of Bitcoin mining can hardly be precisely estimated for two purposes. First of all, Bitcoin prices impact mining directly and thus energy consumption. Another big factor is, hardware performance. Based on the option of hardware, as many as 269 different hardware models may be used in mining. The opinions on sustainability of smart cities in the context of energy challenges posed by cryptocurrency mining [30] has stressed that future research must investigate the current situation in terms of accurate value for energy used in digital mining currencies. It is important to explore the sustainability of smart cities in the field of energy mining. This is due to the lack of accuracy in most of the current approaches that sum up energy consumption.

V. CONCLUSION

While the energy consumption of the Bitcoin network is growing, some have wondered if the PoW algorithm is sustainable. A move to alternative protocols for validating transfers is an option to reduce the cryptocurrencies in energy consumption. PoW is the most frequently used at present. Other protocols such as Proof-of-Stake (PoS) and Proof-of-Authority (PoA) could also, however, achieve more energy-efficient validation. There are a number of other alternative algorithms. For example, some algorithms encourage scalability and others facilitate the speed of transactions. Each algorithm provides trade-offs [14, 23]. The potential implementation of blockchain technology in the energy (and other sectors) sector would depend on the capacity for open, encrypted, scalable and timely validation of transactions through these technologies.

A regulatory structure has already been implemented at this point confirming the status of cryptocurrencies in the following countries and regions: Malta, Japan, Germany, Belarus, Georgia, Estonia, Slovenia, Gibraltar, Switzerland, and Singapore. These countries welcome cryptocurrencies' corporate and organizational capabilities [13, 32]. There is currently no universally accepted system for classifying digital currencies, but a more detailed analysis of this phenomenon is possible through the systematization of the data collected. It is important to distinguish between their origin, meaning, role and properties to decide potential future cryptocurrencies [12, 21, 28, 34]. In addition to efforts to reduce regional growth effects in crypto-currency mining, the federal government could take options to increase the energy efficiency of mining operations. In addition, as the financial and energy industries discuss, among other things, blockchain adoptions, the Congress should seek ways to curb the technology's energy strength. The solution to minimize cryptocurrency energy consumption may involve setting minimum energy efficiency requirements for mining equipment or cooling equipment that work effectively.

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