

Undergraduate Thesis Prospectus

Preventing Environmental Damage from Cryptocurrency Mining

(technical research project in Computer Science)

The Competitive Subculture of Cryptocurrency Mining

(sociotechnical research project)

by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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General research problem: Making cryptocurrency mining more beneficial for everyone

Taking into account social, environmental, technical, and economic values, how may the cost-benefit ratio of cryptocurrency be reduced? Cryptocurrency mining is lucrative; one mined bitcoin block yields 6.25 bitcoin or \$125,000 (Hamdy, n.d.). Yet bitcoin mining causes environmental harm, drives up graphics card prices and can have troubling implications for governing.

Preventing Environmental Damage from Cryptocurrency Mining

How can cryptocurrency mining be more environmentally friendly? Cryptocurrency mining has emitted an estimated 27.4 million tons of carbon dioxide between 2021 and 2022; three times more than the largest coal mine in the US (DeRoche, 2022). The cryptocurrencies most responsible for this are “proof-of-work currencies” (POW currencies). These cryptocurrencies requiring large computational power done through graphics cards or ASICs (application-specific integrated circuits) which are very energy inefficient. And the popularity of POW currencies has been growing.

A popular POW currency, Bitcoin, has seen much of this growth. In December 2021, Bitcoin had a 41% market capitalization among all cryptocurrencies (Jones, 2022). Its growing popularity has also caused significant growth in environmental damages. Researchers from the University of New Mexico found that “a BTC mined in 2021 is responsible for emitting 126 times the CO₂e as a BTC mined in 2016—increasing from 0.9 to 113 tonnes (t) CO₂e per coin from 2016 to 2021” (Jones, Goodkind & Berrens, 2022). There are methods that can reduce this.

Another popular POW currency, Ethereum, has a market capitalization of about 17% as of 2022, making it second in popularity only to Bitcoin. Ethereum has recently gone from POW

to proof-of-stake (POS) in October 2022. This means that it's difficulty in mining, and therefore energy use, has dropped significantly, using almost 100% less energy than POW (Marquit, 2022). This can be done because – instead of anyone being able to compete to mine a block in the blockchain, POS gives priority to miners that “stake” the most cryptocurrency. For a given block, that miner is the only person that can mine that block, allowing for the difficulty of the mining to be dropped since there is no competition then.

However, POS also has its own drawbacks. It doesn't allow for those that don't own much cryptocurrency to mine a block by themselves. This also allows more possibility for a 51% attack, which is where a hacker gains control of 51% of all the cryptocurrency and can build whatever block they want. Therefore, POS is not very feasible for smaller cryptocurrencies, where it is easier to execute a 51% attack. To solve this, I will be looking at methods to generate a more environmentally sustainable approach for mining smaller cryptocurrencies. I will be researching methods that don't require heavy mining use and that don't require one to have a larger share of the cryptocurrency and allow for a higher possibility of a 51% attack. There is no technical advisor for this project, and I plan to work on this by myself. If it is successful, I will have generated a method for cryptocurrency blocks to be mined in a more environmentally sustainable way which also being secure.

The Competitive Subculture of Cryptocurrency Mining

As a compound subculture, how do various types of cryptocurrency miners perceive each other, compete for status within the subculture, and respond to outsiders? Cryptocurrency mining is computationally intensive; for high returns, miners need graphics cards or application-specific integrated circuits (ASICs). The more that is used, the higher the return rate. On a

blockchain, an algorithm responds to the consequent congestion by increasing the difficulty of mining, which can curtail profits (Altman, n.d.). To mine a block and gain the reward, cryptocurrency miners therefore strive for more computational power in proof of work (PoW) currencies. Hackers, miners, and cryptocurrency mining equipment manufacturers shape the subculture of cryptocurrency mining.

Some miners have attempted to simplify mining through malicious distributed denial-of-service (DDoS) hacking attacks on mining pools (Wu et al., 2020). Such attacks sabotage rivals mining the same currency. Wu et al. propose a Nash learning algorithm for optimal attacks (2020). Because cryptocurrency is decentralized, hackers have sufficient anonymity to steal currency.

Most miners work in pools that combine their computational power, usually to mine a block and spread the reward. For Bitcoin, highest hashrate pool is foundrydigital.com at 67.83 EH/s as of December 9, 2022 (MiningPoolStats, n.d). This is equivalent to about 574,576,271,186 RTX 4090 graphics cards hashing at 118 MH/s (Tarman, 2022).

To get started, there are also many upfront costs. Miners need to take into account electricity costs, graphics card/ASIC costs, computer costs, and the volatility of the cryptocurrency they are mining (Sloan, 2022).

Many cryptocurrency miners are seeking to make extra money on the side. One miner who worked from his college dorm reported: ““It was unbearable... I had fans running, I had the window open.”” He used dryer tubes to direct hot air out of his room (Rothaar, 2018). Sometimes, employees use their employer’s resources to mine cryptocurrency: “In March 2018, an employee at Florida’s Department of Citrus (FDoC) was arrested on charges of allegedly using state-owned computers to mine Bitcoin and Litecoin. It was alleged that he had used

\$22,000 worth of state money to purchase 24 graphic processing units and had caused the department's utility bills to rise by over 40%" (Rothaar, 2018).

Cryptocurrency miners compete with PC gamers for a limited supply of graphics cards, driving prices up and causing tension. In August 2021, at a peak in mining profitability, the average price on eBay for a 3080 10GB graphics card was \$1643 (Schiesser, 2021). The MSRP for this card was only \$599. Many gamers go to social media platforms such as Reddit to voice their complaints: "I don't think any one minded crypto mining a decade ago, because it wasn't causing any issues. But as more people jumped on that band wagon, It created a card shortage and price hikes. Many gamers only wanted a single card..." "they just wanted a nice one, and that was something they just couldn't get" (OHwenWOWsen, 2022).

Among the many cryptocurrency mining communities on the internet, the Reddit subreddit "r/HeliumNetwork" has 101 thousand members and thousands of daily active users. Miners share techniques and offer advice. To boost rewards, on Reddit user "Swapped out to a 5.8 dBi placed 11.5 ft up on my roof, reporting: "Uptick in rewards almost immediately. Now witnessing 20+ hotspots daily and rewards have bumped up to \$2-3 every 24 hours" (fees_waved, 2022).

Since May 2021, when China banned cryptocurrency mining, many miners relocated from China to the United States. For U.S. cryptocurrency mining facilities, such demand has meant growth. Christopher Herbig, the lead technician at Compute North in Nebraska, reports: "We doubled in size" (Ruwitch & Feng, 2022). Mining hardware companies AMD and Nvidia are competing for the fast-growing market (Delventhal, 2022).

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