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# “Investor’s perceptions of cryptocurrency’s substantial energy consumption and environmental impact of Bitcoin mining“

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# TABLE OF CONTENTS

# ABSTRACT

The paper focused on describing the current situation with cryptocurrency and bitcoin mining. Main investigation was based through evaluation of various hardware, its potential and real impact to the environment. Descriptions on current regulations in Europe and other countries helped to propose the hypothesis and research questions towards investors' attitude about cryptocurrencie's environmental footprint. The paper covers the theoretical part of main parts of cryptocurrency, such as blockchain and consensus mechanisms. Possible alternative solutions are presented in the second section of the paper, also stating the potential sources of green energy. a discussion of Social Responsibilty Index and Corporate Social Responsibility for potential investors, drawing a connection towards contemporary tendency and how it is covered by the government. The empirical study consisted of a survey that was conducted within a company that is highly interactive with cryptocurrency. The information gathered allowed us to understand how demographics characteristics affect the investors decision with existing environmental problems. While the study faces a certain limitation about the obtained information it sets up the potential future research ideas that could have been implemented.

Keywords: bitcoin, blockchain, environment, consensus mechanisms, mining, SRI, cryptocurrency, green energy, empirical study

# INTRODUCTION

Nowadays, modern technology rapidly improves and becomes more sophisticated each day. One of these technologies is Bitcoin. Bitcoin is the type of cryptocurrency that was invented by a group of people under an alias name of Satoshi Nakomoto on 1 November 2008 and brought a new peer-to-peer electronic cash payment system that was launched and described as a revolution in FinTech (2008). The term “Bitcoin” has gained a significant amount of popularity in recent years. Blockchain technology serves as an immutable ledger which allows transactions to be processed in a decentralised manner. Blockchain-based applications are constantly rising in usage, covering various fields including financial services, reputation management systems, etc., (Zheng 2017). Adeel Malik, 2021 claims that in the network Bitcoin transactions are announced and all the transactions are registered by the network participants themselves and valid transactions are put into blocks every ten minutes on average. The price of Bitcoin has been on the rise for the past years, which drew a lot of attention from common people and inventors. Everyone is trying to take part in the operations that are somehow interconnected with blockchain. But mining itself requires substantial energy to mine a coin for the miners and causes a significant environmental footprint for ecology. These factors have raised the awareness from the government to change the industry into a greener way, however most of the investors do not see any problems.

According to Aste, 2016 Most of the miners use the system of proof of work was developed to avoid having false duplications, using Satoshi words:“ One CPU one vote”, making this operation very costly for most of the people who mine, but in the end the incentive they receive is higher than the cost of electricity. The main reason is that most miners do not do it at home with their personal computer, they use a specialised hardware, with an obsolete period of roughly 1.29 years, which makes it so environmentally unfriendly.

Today there are a lot of discussions where mining can become greener or the way we could find a solution for e-waste. This paper will mainly focus on:

1) Is the energy consumption of Bitcoin mining too much nowadays and should it be decreased?
2) Environmental footprints of mining and investor's perception of potential future
3) Do alternative mechanisms exist to cut down on E-waste?

At the very beginning of mining, the hardware that was used did not consume that much energy, such as GPU'S and CPU's. When the Bitcoin reached its peak moment in price, the "miners' " turned into a "savage battle" for Bitcoin. More and more people just forget about possible consequences to the environment, moreover investors do not really care about what they invest into and what they encourage to happen.

Since the number of miners increase progressively with the price of Bitcoin, energy costs are on rise, bringing up more and more energy consumption issues, (Alex de Vries 2020). Secondly, mining is a constant process, even though some companies trying to invent ways to use Bitcoin mining utilising wasted low-demand off-peak energy, for instance, Coindesk research in 2021 provides an example how Bitcoin can serve as a load-balancing value battery, however It is poorly established and faces lots of criticism. Thus, the thesis paper can set the following objectives and hypotheses.

Objectives

- Understand how SRI and demographic factors influence investment decisions of particular individuals, when choosing the potential of crypto investments.
- To find out to which extent the participants are aware of environmental issues when investing into cryptocurrency and Bitcoin

Following the objectives, current hypotheses will be set for conducting the survey and collecting the information.

As for 2021 the problem of e-waste for bitcoin has been growing, there is a concern that investors are aware of the current state. (Alex de Vries 2021), states that miners go through a cycle in which short-lived hardware could cause a growth in global electronic waste. According to an S&P Global Market Intelligence article, smaller investors care less about environmental issues nowadays, however larger investors do care about ESG goals. Moreover, many of the investors are aware of the current situation and try to implement greener ways to mine bitcoin, but there is still a concern with renewable energy sources since they are already in use by someone else, as Digieconomist states that there is no future for mining and PoW mechanism

will “die out”, another researcher expects mining to undergo a professional development, (Larisa Govender 2019). With the following facts, the author can suggest futher hypotheses.

Hypothesis:

H: There is a significant relationship between demographic characteristics and investors awareness regarding the environmental issue of cryptocurrency and mining.

H: There is a significant relationship between demographic factors and future of green mining.

H: There is a significant relationship between people

The paper will be started with a theoretical overview, to get a decent understanding of what cryptocurrency and Bitcoin are, also focusing on major parts of the mining process, for instance, consensus protocol and proof of work. The first part to be discussed is mining and energy consumption, revealing to what extent it is good or bad and whether it should be decreased. After that, existing alternatives will be presented and how the government tries to regulate the current situation. Following with the analysis part of investors and their SRI to understand what should be focused in the methodology part. The methodology part will discuss the theoretical framework of this particular study and justification of using it. This paper will utilise the descriptive way of presenting the result by finding out the relationship between demographic variables and their correlation with awareness about mining and cryptocurrency. Sampling will be based on the approximate number of 166 participants collected via working chat. Data collection method will be through the survey or questionnaire. The data collected will be analysed using descriptive, statistical and inferential statistical methods and interpreted through logit binary regression

Nowadays the whole financial system is constantly changing, the need for improvements and new implementations has existed for a long time. Personal experience starting as a beginner in knowledge of cryptocurrency and digital assets, after acquiring a certain working time in a company that prefers using cryptocurrency to fiat, I have enough confidence that it is a completely sensible decision. However, due to the large number of users and lack of certain regulation, it has been a while for cryptocurrency to “shine” from a negative side. Apart from legal and political science, there have been many topics that were approached with various questions from other fields of education. In this paper, I feel it is crucial to connect economic

and social fields together to provide the confirmation that we can change and improve the current situation with cryptocurrency, thus starting to use it as a common payment method everywhere,without too much heavy impact on the environment.

# 1. THEORETICAL BACKGROUND

The development of modern technologies has accelerated drastically for the past decades as the The Organisation for Economic Co-operation and Development states (1998), allowing different entities and organisations to change their traditional approach towards the balances of economic and social organisation utilising the advantage of sophisticated technology. With the change of processes comes the change of resources that are being applied and used. Increased usage of utilities and lack of certain regulations, led the world to the environmental choking and economic imbalance of industrial progress (2011). The cryptocurrency itself has been approached and analysed from different perspectives, ranging from economics, politics, social network and others. O'Dwyer and Malone (2014) say that one of the potential topics to discuss among those existing is electricity consumption required in Bitcoin mining. In recent years, there has been a huge dispute, which made the government such as China to ban power plants, (Frebowitz 2018), to reduce a colossal energy consumption. Since mining requires a significant amount of electrical energy, this paper will be focusing on carbon footprint from electricity burning during Bitcoin mining.

The main part of the mining operation is PoW, according to Aste 2016 the system of proof of work was developed to avoid having false duplications, using Satoshi words: “ One CPU one vote”. But this operation is very costly for most of the people who mine, but in the end the incentive they receive is higher than the cost of electricity. In May 2021, at least 13 years of typical household electricity was consumed per coin, Jon (Huang 2021).Today on average there are 191.073 m/s of terahashes daily, according the daily statistics for Bitcoin transactions, with each transaction e-waste of approximately 355.08 grams, equivalent to to the weight of 2.17 Iphones 12, Digiconomist (2021). The main reason is that most miners do not do it at home with their personal computer, they use a specialised hardware, with an obsolete period of roughly 1.29 years, which makes it so environmentally unfriendly. he main issues with bitcoin mining and the energy usage is basically concerned with its availability. According to FinCEN 2018 Testimony (Treasury’s Financial Crimes Enforcement Network), it is a free business to enter requiring no licence or any official document, but as a miner you are still obliged to make reports on your

earnings to prevent money-laundering and other suspicious activity. However, there were many attempts to lower the miners' activity, the government includes taxing over different states of the US as well as in the EU, (Yereli, Ahmet & Sahin 2018). So far by 2022 EU parlamient has come up with different solutions, which will be shown in below sections.

This part of the thesis paper will contain all the necessary information needed to get an understanding of the main concepts of cryptocurrency. First, the definition of bitcoin will be described. After that, the main process on which the whole system is based will be presented - the blockchain and proof of work concept will be discussed. Moving onto the next important part about hardware, that is utilised in the mining process.

## 1.1 Bitcoin features

Bitcoin is the digital decentralised version of money that you can buy, sell and trade without an intermediary (2008). Bitcoin's creator, Satoshi Nakamoto, originally described it in the bitcoin whitepaper as the need for "an electronic payment system based on cryptographic proof instead of trust. Every coin of digital currency is recorded on a public ledger, which makes it hard to fake and difficult to reverse, (*et al*. Nofer 2017). Bitcoin is not controlled by any entity, the whole system is based on the community that uses it (2008). Since its public launch in 2009, Bitcoin has risen dramatically in value. The current price of Bitcoin at the time of writing this paper, according to coindesk, is 39058,64 USD, however it is not the limit. Since the number of BTC that can be mined is limited to 21 million coins (Meynkhard 2019), the price of the main cryptocurrency in the world is expected to rise in time, based on the main economy rule.

Referring to the main definitions, blockchain can be described as a peer-to-peer system that is operated through computer systems, which maintain and record the financial transactions (Tasatanattakool et al., 2018). After the transaction is done, it is recorded in blockchain, it cannot be edited by any of the participants of an exchange. Blockchain can be used in different sectors apart from financial, for example, in service sector or industrial, (Hughes and Kim 2020). Blockchain serves as a security weapon against fraud that can occur from third party participants. Blockchain is highly adopted by today's companies because of its advantages (Wang et al., 2019). It provides safe and secure online transactions, decreasing the risk of fraudulent actions.

Under the Bitcoin protocol, cryptographic hash functions are used to hash the Bitcoin transactions. Hashing is the process of mapping digital data of any arbitrary size to data of a fixed size. In other words, hash is the digital signature of any data, (Schinckus 2022). It is the process of taking some readable information and converting to something that makes no sense at all. There are some requirements that a good hashing algorithm should contain: the output of the hashing algorithm is fixed, where even the smallest change in the input must provide an entirely different result, (Schinckus 2022). The same input provides the same output. Calculation of input value from the output value (reverse way) should not be possible. The calculation of the hash value must be fast.

Under hashing in the digital world is always thought of as the process of taking diverse sizes of information and converting it into one fixed size. It is always used to hash Bitcoin transactions, (Schinckus 2022).

## 1.2 Proof of work (PoW) and Proof of stake (PoS)

Aste (2016), describes it as the mechanism that allows users in the Bitcoin network to come to consensus, or agree on things like account balances and the order of transactions. It is also called a consensus protocol, as it helps the numerous user systems to reach agreement or consensus. At the basis of this mechanism, lies a cryptographic sealing that is used to verify that multi-agent systems ensure everyone agrees on what information to keep or discard, (et al Mezquita 2021). In mining PoW confirms every transaction that has been made within the network. The system itself is implemented to prevent control from a single person, entity or organisation, (et al Mezquita 2021). According to Gemeliarana, I.G.A.K., (2018) as soon as all the nodes agree on the state of the blockchain, the data will be recorded and the blockchain is able to function with more and more data added to transactions.

Protocol, this system that is based on its holders and the amount of coins they have, can be called stake. Holders lock fixed sums of money in stake pools, offering a specific ROI (Return on investment) over time, (Nguyen 2019). The author of comparative analysis (Akbar 2021) states that: ”PoS works based on stake and emphasises on number of cryptocurrencies in the blockchain to create new blocks rather than spending too many resources, energy or computational power as in PoW " - it can be understood that this way is “greener” than PoW.

The concept of staking works more or less the same way as with deposits in banks for a fixed percentage, but distributing the rewards indirectly proportionally within the participants. Moreover, the International Journal for Research in Applied Science and Engineering Technology (IJRASET) provides evidence in which the more people take part in staking the less is the reward (concept of PoW and mining about power capacity) with the main disadvantage of this concept is Monopoly for staking.

## 1.3 Hardware

Back in the days, “mining” did not require a lot of energy and power capacity of the device, however through the years the situation changed and difficulty has increased for the “miners”. Most of the computational working process is done to solve a complex mathematical problem. According to Bhaskar (2015) there exist different types of mining equipment ranging from CPU’s up to FPGA and ASIC.

Central Processing Units (CPUs) -were the first ones to be used in the early mining. The code was solved using a linear function then computing so-called SHA-256 in software and checking if the result is the valid block (Arvind Narayanan 2016). According to Cryptopedia, the computation of the problem on the CPU mining system is about 20 million hashes per second (MH/s), which would take a couple of years to find a valid block.

Graphic processing unit (GPU)is the next level for CPU miners with higher performance and high speed, but the hardware itself was to become obsolete over a short period of time. Taking a look at EBAY price chart for RTX 3080 graphic card during a certain period in the bitcoin mining history, the price for this particular GPU has risen drastically due to the interest of people to start mining. In the chart we can see that the average price for the NVIDIA GPU has increased up to almost 2500 per one GPU with an MSRP of 700 dollars, in March of 2021, as shown at the PC magazine digital.

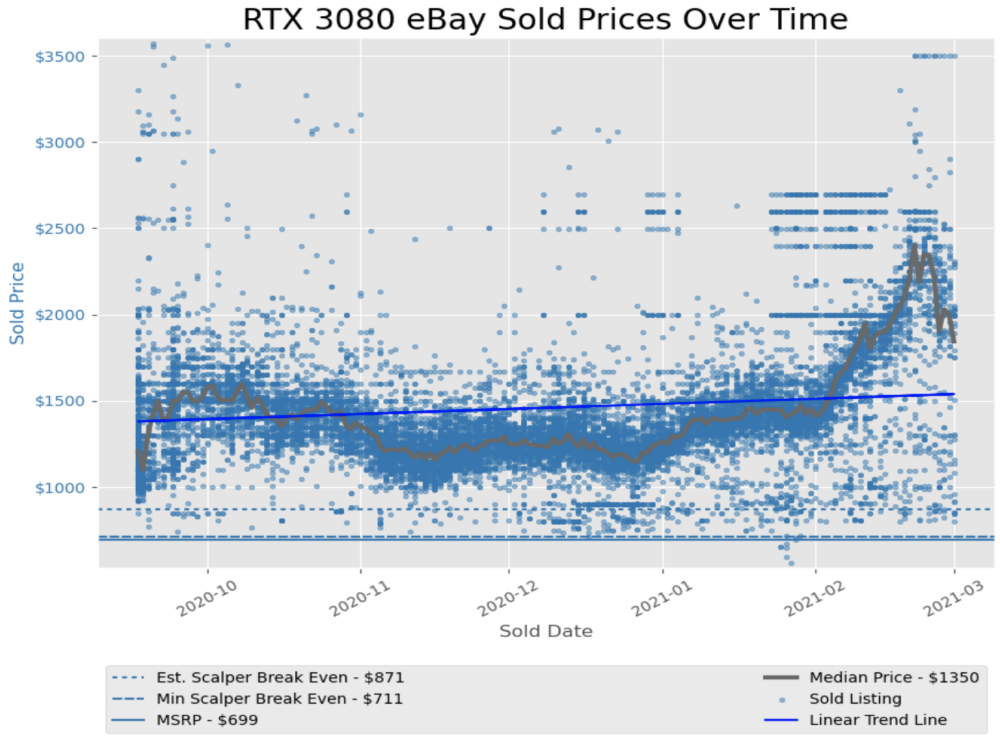


Chart 1, according to PC digital (2021)

This chart observes social attitudes towards mining, meaning that society saw a potential about this process, increasing demand in GPU's, the most affordable way of mining for common people.

FBGA mining - The next in line as a mining hardware comes FPGA (Field Programmable Gate Array) mining machines. The difference between the usual GPU miners and FPGA is that computation power was better, (Taylor 2017), however with the increase of users, but after the difficulty for computation has increased dissatisfaction from the users arose, who had other expectations.

ASIC mining - Continuing the generation, ASIC is currently dominating the mining sector for Bitcoin and other cryptocurrencies. The whole system of ASIC was designed with the sole purpose of mining. Some of the most famous ones that are sold to the customers are Antminer S9, Dragonmint T1 and others. These types of mining systems require a lot of energy and produce excess amounts of heat, so nowadays you can rent a place in the cloud of a mining "farm" without worrying about extra costs. Still, many people prefer this process to be skipped and do everything by themselves, due to a certain chance of fraud, perhaps, lowered profits and lack of access. The cost for the simplest type of this machine is approximately 2860$, with

profitability of 12$ a day and electricity cost of 0.1/ kilowatt. At this cost of power, you expect this device to consume just $7.80 per day while generating a revenue of $37.23. daily. Making this process quite profitable, people start forgetting about the consequences that it brings, for instance Miners of the cryptocurrency each year produce 30,700 tonnes of e-waste, Alex de Vries and Christian Stoll (2021) estimate. That averages 272g (9.5oz) per transaction, they say. By comparison, an iPhone 13 weighs 173g (6.1oz), according to BBC research in 2021.

The major differences between different types and why the transition from one to another happened. As for today, GPUs turned out to be at least 6 times more efficient than CPU mining devices, the cost of GPU thus grew up twice, based on an article from Coindesk. The power that is used by different types is protionally relative to the size of its chip, (Kelly 2015), ASIC hardware has the largest chip component, which makes it the most profitable and the most efficient in energy consuming systems. Since 2015 the size of the chip has not changed, that means that miners are currently in the same incentive reward system as they used to be before.

With the increased power consumption, the alternative methods and solutions were implemented, which represent themselves  as a renewable energy source or a governmental restriction.

# 2. ALTERNATIVES AND SOLUTIONS AVAILABLE NOWADAYS

As the price of bitcoin continues to climb, it draws more attention and more criticism for its environmental impact. However, alternative ways of mining exist and a good percentage of miners have been using different methods and sources of renewable resources energy and clean energy, without causing damage to the ecology. According to a Harvard survey the amount of renewable energy used in mining is around 75%, however CCAF can hardly estimate friendly environment energy resources 39%. Every year the amount of bitcoin emissions can leave a carbon footprint as the size of the London metropolitan area, (Alex de Vries 2021).

Nonetheless, researchers claim that in the future, miners will search for renewable energy sources, as opposed to traditional fossil fuels usage (*et al* Imran 2018 p.11). In the article, it is described how miners could have potentially used different sources of renewable energy, such as hydropower, nuclear and wind powers. Due to the rise of environmental problems nowadays, most investors will search for ESG directed companies for investing, these actions will possibly lower the costs for mining and bring a more efficient way to utilise energy consumption in the POW system (*et al* Imran 2018 p.11).

## 2.1 Mining vs Staking, PoW vs PoS

Cryptocurrency is one of ways to receive coins in a greener way, rather than mining. As described above, mining is based on the POW protocol, which implies solving complex mathematical problems in order to receive incentive. Mass amounts of GPU's are used to mine coins, but this also requires a lot of energy. Staking is based on POS protocol, which implies users to lock their coins in a specific network, without a chance to withdraw for a certain period of time. The network will then choose the validators in the process based on how long the coins are being locked in the network (Nguyen 2019).

The major difference between these both methods is that the energy amount used in staking is a lot less than in mining, which allows a cut down on negative impact to the environment. For example, Ethereum mining currently uses 45,000 gigawatt yearly, staking will help this number

fall to 1/10000 of that amount, according to Bloomberg research by Matthew Leising in 2021. Staking though is being seen as a suspicious way to receive coins, as miners claim it to ruin the whole point of cryptocurrency as it will basically democratise the financial system that runs parallel to fiat currency (Attici 2018) with another concern that staking can lead to create oligapolies, since the more coins you hold in the pool the more chance you get a reward for that, (Kwon 2018). Brining the conclusion that, miners are not ready yet to transfer to alternative way of receiving coins, since the POS protocol was introduced 10 years ago with Tezos and Solana appearance in the market, it is still nowhere near the dominant POW based ledgers according to James Royal for Bankrate article (2022).

## 2.2 Clean energy for mining and challenges of implementation

The reason why mining brings up the topic of ecological issues on the agenda is that it uses fossil fuels such as: heavy oil, coal,  to its mining operations. In the future, mining could be using various sources of clean energy, for instance renewable energy sources, (Tsisilile 2020). In the recent years, many mining companies have transferred to renewable energy sources implementation. From 2008 42 MW of annual installation in 2008 to 3,397 MW of annual installations in 2019, (Tsisilile 2020), it can be seen in the table below (BNEF 2019).

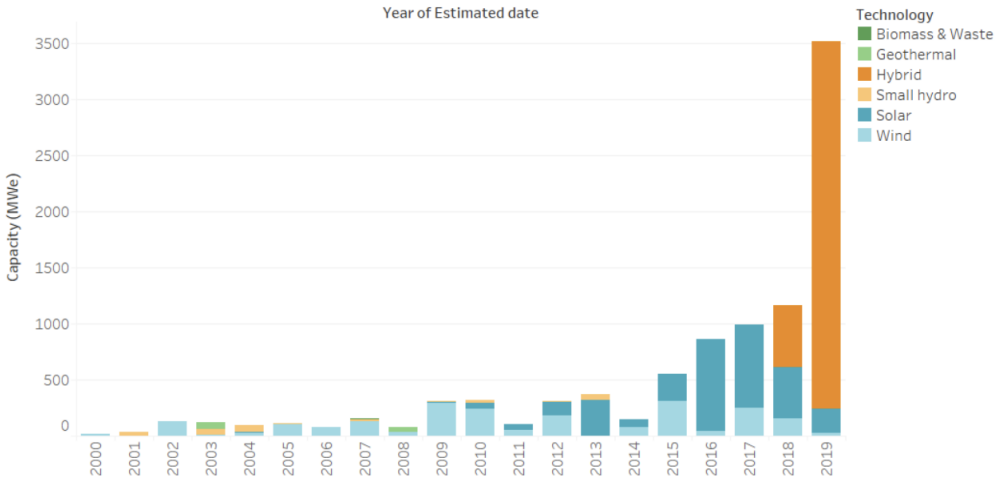


Chart 2, coindesk research (2021)

For the time being, the number of miners using as a clean energy source has reached 39%, primarily in the hydroelectric sector, according to "3rd Global Cryptoasset benchmarking study" by the University of Cambridge, (Apolline 2020). The main points for miners is to get rewards

that exceed the costs of mining, so for instance the use of hydroelectric power in mining is profitable in different seasons for different countries, for instance, in China during wet seasons mining is 3 times more profitable than during the dry season, (Alex de Vries 2022) , but the situation changed after mining in China was banned. Due to these reasons, most of the miners migrated to the US and Kazakhstan causing natural gas to double in the electricity mix from 15% to 30%, (Alex de Vries 2022).

Another example of alternative for mining is the usage of abundant energy or a hybrid mining, as for example in Texas the solar and wind power. This method implies that miners can buy the energy that exceeds the amount needed and it otherwise would be "thrown away", based on Nic Carter for Coindesk research (2021). But yet another claims from the critics that excess of renewables does not exist, simply meaning that if one uses a specific renewable, the other one does not, (Nikita Amir 2021). Right now, the situation is that it is hard for miners to use the excesses of energy, since it makes up only 20% of the whole electricity supply in the US, where most of the miners are based, (Nikita Amir 2021). Experienced miners claim that it would need 20-30 years from now for mining to become "green" and use renewable energy, if nobody else will need this energy to charge a car or a house (Nikita Amir 2021).

## 2.3 Governmental decisions and solutions

Bitcoin is a completely new technology for digital money transactions. Functions and yields that it imposes, make it attractive for many investors as well as for miners. Miners use special hardware to mine bitcoin, however this process requires a large amount of energy to be exploited, which causes significant environmental issues already. This fact has drawn attention from the government side, who tries to ban noy only mining of cryptocurrency but the whole digital currency world.

Some of the first major steps were taken in one of biggest mining spots in the world in China, domestic crypto mining was banned in June and cryptocurrencies completely outlawed in September of 2021, Marco Quiroz-Gutierrez (2022) for Fortune magazine, following with a huge selloff in cryptocurrency and the price dip in the market. According to the summary of Law Library Congress (2021), cryptocurrency in any of its existing states was banned in 8 more countries, restricting actions for banks to deal with crypto transactions and exchanges. During the process of writing this paper EU Parliament members on 31 of March voted to outlaw any

anonymous transaction within the bitcoin network, Jack Schickler for Coindesk research (2022). Bank of England claims that cryptocurrency poses a potential threat to the financial system, BOE Deputy Governor Jon Cunliffe says that it would take time to develop proper regulatory standards (2021).

The problem of the environment should be paid more attention in the coming years, as the damage to the environment is increasing and various international agreements may not be accomplished, especially the The United Nations Paris Agreement, which implies that countries should make everything possible to ensure that temperature does not exceed the prescribed maximum of 2°C above global temperature. According to the mitigation of greenhouse gas emissions and carbon footprint the EU presented an Ecodesign Directive (2009), where the goal for environmental priority should be followed, also revealing and stating the standards for usage of energy-efficient products. The Treaty of the Functioning of the European Union (TFEU) claims that a high level of environmental protection should be applied by each member state, also stating that member states in the EU must protect and take preventive measures that would help establish a united environmental policy . Moreover, the principle where the one who caused substantantial pollution should pay the compensation, was implemented by the Organisation for Economic Cooperation and Development (OECD).

Given the facts above, we can conclude that currently in the world, different committees and governments are trying to mitigate the environmental problem considered with mining and cryptocurrency, through implementing rather sensible regulations.

# 3.WHAT TYPE OF INVESTORS CARE ABOUT ENVIRONMENTAL ISSUES WHEN MAKING DECISION

## 3.1 Social Responsible investment decisions for investors.

For the recent years, individuals have been choosing various sources of investment opportunities, while some of those decisions were based on diverse reasons and having a lot of determinants in the decision making process. In relation to environmental issues, many studies have shown that different factors that affect socially responsible investing come from the background of investors. Particularly, it comes from the demographic, gender, education, family income and other motives, so for instance Williams (2005) and Rosen (1991) tries to describe SRI of investors based on their demographic and social backgrounds. Williams described his findings with Likert scale, where the negative numbers showed that those who believe CSR is unprofitable are less likely to lean toward SRI. Williams (2005) studied investor choice in the context of socially responsible investing by collecting characteristics describing investors in five different countries through a survey. The questions focused on demographic characteristics, attitudes toward firms' social and financial aims, but also their behaviour as consumers. His results suggested that when viewed across countries, demographic characteristics did not generally seem to be statistically significant in describing the probability that an investor would have a preference toward socially responsible investments. In addition, Williams (2005) found that those investors that placed greater importance on social issues personally were also more likely to engage in socially responsible investing, and those investors that have, as consumers, punished companies for bad corporate social responsibility were also more likely to invest in socially responsible ways."

Owen and Qian (2008) studying a US population found that demographic determinants were indeed important in describing consideration of social responsibility in investment decisions. Their results indicated that men, white people, married people are all less likely to take social responsibility into account. In contrast to findings by Williams(2005) some of Owen and Qian's estimations also indicate that people with lower education are more likely to invest in socially responsible ways, while those with higher incomes seem less likely.

Nagy (1994) in their study showed that people while making a decision were more likely to invest in assets that would provide them with safety of their principal and high returns as an investment factor. An interesting fact, that most of the respondents were salaried employees and their focus for investment was for children's further education and marriage expenses. Real-estate was considered only for 13% of all the participants between the salaried people. In the end the study proved that young people were not affected by age or gender in the investment perspectives, it was based on their objectives, denying the traditional belief of age and gender difference.

In contrast to Nagy (1994), Khawaja (2021) in assessment of individual investment choice in Saudi Arabia showed that women were more likely to avoid high risk investments, rather than men, as well as high education people were more likely to participate in investment procedure. The highest frequency age group of 31-40 and most of the investors were currently employed. Proving that in different regions culture can play a significant role in creating investment decisions.

It is hard to imagine how a business analyst of a large company would risk his own career in making good profits for the company for ESG issues. However, according to Harvard survey conducted in May-June 2019, that the top directory of the investment firms such as BlackRock, Vanguard, and State Street and government pension funds of Sweden, Japan and Netherlands paid high attention to ESG issues.Another example comes from the survey conducted in 2018 by FTSE Rusell, showing that more than a half of the global asset owners implement sustainability strategies . Overally, SRI is a strategy that also helps investors align their choices with their personal values. SRI presents a framework for investing in companies that agree with your social

and environmental values. For example, as an investor you might not choose tobacco companies if you go against smoking in the world. In order to create hypotheses for further research, investment decisions based on different characteristics will be provided, to understand what plays a key role.

It has been hypothesised by many practitioners that companies implementing ESG strategies and go along with them, serves as a criteria for good financial and operational performance, their fast adaptivity to the market change and using green technology to lower production costs, while growing their social status within the community. This approach is commented on in scientific research by Cai and He (2014), where there is a relative correlation between stock performance and ESG approach in the business. Moreover, green and sustainability bonds research by HSBC suggests that investors increasingly see ESG issues as a differentiating factor in the long-term performance of the companies they invest in causing outperformance in emerging markets. Another example comes from MSCI executive summary, where MSCI ESG research shows that companies in the MSCI World Index with strong female leadership generated a Return on Equity (ROE) of 10.1% per year versus 7.4% for those without.

The study of Attig (2013) provides evidence that companies have a relationship between corporate social responsibility (CSR) and firms' credit ratings. It shows that the relationship between credit ratings of the company and CSR is a robust indicator of low financial costs, by strengthening relationships with stakeholders and avoiding violations from environmental regulations and litigation, thus reducing the probability of financial distress for the company.
Robert G. Eccles (2015) describes the comparison of two groups and their market performance, they tracked financial performance for 18 years and found out that group that adopted a substantial number of strategic environmental and social policies, outperformed the other one by approximately 4.8%.

Some academic researchers claim that the correlation between sustainable companies and their stock is not positive or even negative in the long-term, Eccles and Serafeim (2013) suggest that market will not reward such actions and will cause a negative impact, due to the fact that, that other companies which have the main focus on ESG material factor will outperform them with their innovative approach to address them.

To focus more on a personal perspective, a number of studies have provided research of relationships to different characteristics. In order to propose the hypothesis for future research, this paper will discuss what factors affect the investment decision.

## 3.2 Characteristics of investors's financial decisions

In the scientific article created by Nagpal and Bodla (2009), they discuss how the characteristics of the respondents can influence their investment choice and found out that the lifestyle of those who answered the survey impacts the final decision and corresponds to the risk capacity of investors. The study came up with the result that investors tend to take less risky investments like fixed deposits.

The study reveals how demographics and personal traits influence the investment choice, Verma (2008) conducted that females were less aggressive in their investment decisions rather than men. It also shows that investors tend to consult with family members about their potential investment choice, as well as how income difference decides which financial asset to take. The survey presented the result that age, gender, education play no role in the period of investment.

Gilliam and Grable (2010) analysed the correspondents between married and unmarried couples within their investment choice. The study concludes that a single person is more likely to select a risk averse asset and have more bias towards financial risk. The study also shows that respondents in an older group age tend to pick less risky investments based on their previous experience.

For instance, Abhijeet and Dinesh (2010) help to analyse how the psychological mindset of a person can affect their investment choice. The study was based on analysation of overconfidence, delicacy towards gossip, and invetaracy attitude in the investment decision. It also concludes that information gained from different sources will help get the clearance in the decision making process.

Another study that provided the evidence on how personality traits affect the investment decision was conducted by Chitra and Sreedevi (2011), this study uses BFF ( Big five factor) model that describes personality traits: extraversion, agreeableness, conscientiousness, openness to experiences and neuroticism or emotional stability, according to Weller and Thulin (2012).

Extroverts are more open-minded and easy going who make their decision more risky and more impulsive than introverts (Sadi *et al.*, 2011). The study provides evidence that overly positive approach can bring to overestimation of market run and can cause negative effects on portfolio. On the other hand, a negative approach can bring an underestimated attitude towards the current market state and pose a risk of losing good potential investments (Lo *et al*., 2005). From Mayfield (2008) We learn that conscientious investors tend to make less impulsive decisions rather than individuals who accept an open approach more.

By applying further empirical analysis, this paper will describe the data collected from a tech savvy company and people's attitudes towards cryptocurrency, mining and environmental issues.

# 4. DATA AND METHODOLOGY

## 4.1 Method and Sample

The paper will be a descriptive research and based on analysation of different variables. The main goal of a descriptive approach is to describe a certain phenomenon or characteristics , therefore a survey or questionnaire can be used, according to (Gall 2007). The data was collected through the survey, which implies the usage of descriptive methods, however the collected data will be analysed via quantitative approach. Quantitative approach was used through systematic reviews of previously published articles. According to Gerrish and Lacey (2010): "Quantitative research will enable researchers to present the results of previously conducted studies.

It allows a researcher to study demographic description according to characteristics that are suitable for a quantitative approach (Snedecor and Cochran 1989), via a survey or a questionnaire. Questionnaire is a quite popular tool for data gathering affording modern format for respondents that allow them equal access and anonymity (Jackson & Furnham 2000). The survey that was used for collecting data was using exactly the same feautures. Another advantage of the quantitative approach through questionnaires is that it provides a possibility for data

analysing using Excel and SPSS, Ronden,  and Nieuwenhuysen (1996), however this particular research involved using Gretl software which allowed to make logit binary regression models. The survey consisted of open questions as well as multiple choice questions using Likert scaling (Joshi 2015), but in the end the decision was made to transfer it to binary system, with the following approach: “Strongly agree and agree” was to be meant “1” and all other options were meant to “0”. The sampling was composed in a non-random approach, with no specific criteria for respondents to qualify with the possibility for everyone with no exception to answer. As mentioned, logit binary regression made most sense in the analysis stage for the paper. Considering the number of respondents would not exceed 200, the regression model could have shown real attitude and current state with hypotheses proposed.

The data was collected in a company of approximate number of 800 employees. The company’s operations include cryptocurrency and investments through the investment fund. A questionnaire was distributed to 168 investors and respondents via Google Survey. At first it was hard to obtain data as most people are not willing to participate as they do not tend to provide information that much. Most of the respondents found it interesting to complete the questionnaire since the company wants to develop further into technology and looks for further possibilities in the market

The survey included questions about main demographic factors: age, gender, occupation, income WIth the main results shown, that mainly respondents were from 16-34 age group, which already makes a statement that young people are more attractive than those from an older group. Males and Females did not have any obvious pattern and consisted equally in the answer sheet. Occupation belonged to the employed group rather than students and retired. Income range was before 2000 thousand euros and showed the most answers there.

## 4.2 Empirical analysis

With the number of 166 participants the author was able to come with the following result about mining issues and cryptocurrency with inferential statistics: The logi binary regression gives the following results according to the survey, Model 1 shows the demographic correlation between gender and age with cryptocurrency awareness.

H0: There is no significant relationship between the demographic variables and awareness of cryptocurrencies environmental issues.

| | Model 1 | | |
|---|---|---|---|
| Variable | Coefficient | Standard error | |
| Gender | 0.541 | 0.408 | |
| Age 1 | 0.389 | 1.390 | |
| Age 2 | 0.996 | 1.352 | |
| Age 3 | 2.679 | 1.709 | |
| Age 4 | 0.629 | 1.404 | |
| Age 5 | 0.338 | 1.436 | |
| Education university graduation | -0.507 | 0.434 | |
| School education | -0.378 | 1.158 | |
| Student | -1.124 | 1.050 | |
| Full-time employed | -0.107 | 1.019 | |
| Retired | -0.038 | 0.707 | |
| Income 1 (less than 1500) | 0.203 | 0.707 | |
| Income 2 ( 1500-3000) | 0.312 | 0.681 | |
| Income 3 (3000+) | 0.436 | 0.781 | |
| N of respondents | 166 | 166 | |
| Adjusted R squared | -8.29% | | |

Model 1

Model 1 represernts the usage of the split variables version, hoping to find some decent result on research of demographic characteristics towards the current perception of investors.

As we can see in the model none of the variables, ranging from Age to Income, which at the first stages was split into 3 categories, showed hardly any relationship and with the dependent with R squared value too low to consider this table valueble. In the end, this table is included in the results section to provide a comparison between other models and the development of the research. For the split variables version we can see no relationship between demographic factors and investors choice. So that we can say that there is no relationship between variables and

cryptocurrency awareness. However, it might have been caused because of too little results for splitting the variables, so the next table was conducted in another manner.

Models 2 and Model 3 showed good results in terms of awareness and provided real data about the current investor's state of mind.

H0: There is a significant relationship between environmental issues and investor choice considerations about governmental approach and its future.

| | Model 2 | | |
|---|---|---|---|
| Variable | Coefficient | Standard error | |
| Knowledge | 0.597 | 0..431 | |
| Work | 0.52 | 0.404 | |
| Daily | 0.043 | 0.398 | |
| Main | -0.388 | 0.238 | |
| Mining awareness | 0.881 | 0.5 | * |
| Energy consumption awareness | | | |
| Green energy | | | |
| Regulation | | | |
| Future of mining | | | |
| N of respondents | 166 | | |
| Adjusted R squared | 2.29% | | |

Model 2

In the second model, the author seeks whether environmental issues that are caused by the cryptocurrency and mining of investors can affect the governemental approach in the future regulations. We can see that those investors that are more or less aware of cryptocurrency are more likely to believe that governmental approach is going to change and improve. Other variables did not show the expected result, proving the fact that demographic variables do not play any role in investors choice regarding cryptocurrency.

Hypothesis 0: There is no significant relationship between demographic factors and whether the mining causes a significant environmental damage.

| | Model 3 | | |
|---|---|---|---|
| Variable | Coefficient | Standard error | |
| Knowledge | 0.276 | 0.48 | |
| Work | 0.702 | 0.451 | |
| Daily | 0.129 | 0.436 | |
| Main | -0.555 | 0.265 | ** |
| Mining awareness | 0.857 | 0.542 | |
| Energy consumption awareness | 1.365 | 0.464 | *** |
| Green energy | 0.055 | 0.432 | |
| Regulation | 0.262 | 0.444 | |
| Future of mining | 1.028 | 0.441 | ** |
| N of respondents | 166 | | |
| Adjusted R squared | 8.29% | | |

Model 3

In the Model 3 we can see that the respondents who tend to work with cryptocurrency and use it as assets for investment have more relationship towards the current environmental situation rather than the future of mining and potential switch to green energy from miners. However, the future of mining and cryptocurrency showed more relevance than the current regulation for investors, making an assumption that regulation does not really have to be changed at this point of a time. R squared values are bigger than in the previous table showing that the scope of demographic variables should be combined, however it does not still give a certain answer for the research question.

Model 4 was designed considering all the previous mistakes and gave the most of the result needed. Following hypothesis was set for this particular model:

H0: There is no significant relationship between demographic variables and whether miners should switch to green energy in future for responsible investing.

| Logit observation | Coefficient | standard error | z | p value | |
|---|---|---|---|---|---|
| Const | -3.621 | 1.82465 | -1.984 | 0.0472 | ** |
| Male | 0.218 | 0.409002 | 0.533 | 0.594 | |
| Higheducation | -0.676289 | 0.401577 | -1.684 | 0.0922 | * |
| Employed | 0.676053 | 0.379606 | 1.781 | 0.0749 | * |
| Knowledge | -0.43972 | 0.428028 | -9,600 | 0.3377 | |
| work | 0.786297 | 0.382917 | 2.053 | 0.04 | ** |
| everyday | 0.901097 | 0.37379 | 2.411 | 0.0159 | ** |
| age | 0.88905 | 0.574001 | 1.549 | 0.1214 | |

Model 4

In the following model we can see that the actual perception has changed for the investors. Approach for the model was changed as well, applying logarithmic values for “age” since the numbers were having a large variance. Another variable that was changed was “people who heard about mining” everyone who never heard of it was excluded, in total 20 respondents, which resulted in a good way. Those people who are employed are less likely to believe that miners will switch to renewable energy in future, rather than those working with crypto on a daily basis. We can also see that everyday users have a good feeling that there will be a switch to renewable energy from miners, but  those who have a high education are less likely to believe in that.

## 4.3 Limitations and Future research

Possible limitations can be caused by the lack of more detailed data where the author could have deepen into the analysation of PoW and PoS mechanisms, also using a sample where the participants would be only be included as “miners" or as “investors”, which would definitely

make the size of data smaller but more accurate. The data observed was focused on demographic factors of participants mainly to perform a decent analysis on investors behaviour. Logit binary regression did not receive enough answers for the survey, however it was assumed that 150+ respondents would be sufficient to provide good data, unfortunately the R squared value was too low in Model 1 and Model 2 which made little or no sense, possible solution is to rename the variables or take more answers in future. Another reason can be lack of comparison in the data analysis, one of the possible solutions was to compare a start-up in the technology and blockchain sector with the company that was already observed, but since the survey was presented in one group it was still hard to find enough data to provide a more detailed research. But the overall result shows that right now the investors are not really interested in environmental issues that are caused by cryptocurrency and mining. One of the possible reasons is that most of the respondents belong to the 16-34 age group, which describes them as more money focused and less environmentally tolerant.

Future research can be conducted on a specific requirement from the participants, providing only the precise questions about mining, hardware and investor's attitude. Moreover, in coming years, the focus will be based on payment and implementation of various other methods for cryptocurrency, so it would be sensible to observe the data concerned with governmental solutions in the survey and participant's attitude towards it.

Mining hardware could have been examined and tried in real life to provide precise data for energy consumption and possible threat to nature. Also it would require a lot of time consumed during the research, about 1 month of mining, which would give enough information to proceed with results.

# CONCLUSION

In the end of the research, it would be crucial to say that cryptocurrency is becoming more and more popular among various users and investors, some countries like Slavador have already implemented it, others like Mexico are currently passing the legislation side for it. Everyday more and more people join a decentralised payment system. Nevertheless, with its popularity comes a significant impact to nature and the environment, which causes a significant energy consumption and carbon footprint. The paper tried to analyse the perception of investors towards current situation with cryptocurrecny regarding its environmental un friendliness.

Main aim was to collect the data from the users of cryptocurrecny and those who mine it. With the proposed hypotheses, whether the demographci factors affect the invetors choice, the author tried to find out whether the perception of different investors and their demographic characteristics like gender, age, occupation, etc., are biassed towards the problems of the environment. To test the hypothesis and whether Social Responsibility Index plays a major role for investors, based on data obtained and literature review, logit binary regression provided the result that there is no significant relationship between the investors and their attitude towards the environmental issues that exist in the world. Age, Gender and other demographic characteristics were not found to be significantly correlated with the investment decision, it can be said that most of the respondents tend to make a choice towards money increase rather than environmental conservation of nature.

In the first model and testing the logit binary regression did not provide with good results regarding the stated hypothesis, whether there is no significant relationship between demographci factors and invertors choice based on the understanding of current environmental situation. Based on the results, we could not deny the hypothesis thus proving that there was no no relationship whatsoever. In the following models it could be seen that the results were improved and showed some decen statistics. Most of the models used binary numbers in age

section, whether Model 4 used logarithmic values to improve the disandvantage of large variance.

After receiving the results the author could make a conclusion, that in cryptocurrency world as well as in many other assets and investment choices, people do tend to focus on profits on money and their yield rather than ESG goals. The demographic factors showed no correllation between the choice, proving that in most of the cases current situation should be somehow improved from the governmental side as well. At the time of writing this paper, the major cryptocurrency in world - Bitcoin, has fallen under 30 thousand dollars, according to Coindesk. While showing the systematic dump in the market, the miners however see no big problems here as Cointelegraph states.

The paper faced many challenges in terms of data collection. Since most of the respondents were just employess of the company rather than common users of cryptoccurency, the table might have given not the whole overview of the current situation. While the approach was correct, most of the people still do not react anyhow to cryptocurrency and showing lack of interest, thus making a belief that all cryptocurrency world is just a bubble. In the future investigation, the author would propose having a sepcific group of people who operate with cryptocurrency, rather than just common employees. Mining hardware playes a great role in the whole process as well, but since the time was limitted it would be hard to establish a farm and provide with estimated results.

The novelty of this particular topic should be brought up more and more nowadays, while some people suggest that cryptocurrecncy will die out, many others believe that it is going to repace fiat money. The author believes that the number of people who take the side of the cryptocurrecny as a decentralised system of finance will increase, thus making it a good prospect for the future careers and implications at work.

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12/05/2022(date)