

# Carbon Footprints of Crypto-currency

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**Abstract – Crypto-currency is a form of digital money based on blockchain, the core technology. Its operation is dependent on the process called mining, which necessitates large number of calculations requiring vast computing power.**

**Crypto-currency usage consumes large amount of energy, primarily generated by fossil fuels. At a time when the world is in dire need of reducing its carbon footprint, the last thing anyone needs is another source of money-making at the expense of the planet and its inhabitants.**

**This paper examines negative impact of crypto-currency on our environment. However it is not possible to eliminate the use of crypto-currencies as it has become mainstream with trillions of dollars at stake. Way out is outlined to mitigate its adverse impact.**

*Keywords: Crypto-currency, Sustainability, Carbon footprint, Bit Coin*

## I. INTRODUCTION

Donald Trump's endorsement of crypto-currency, gave Bitcoin a significant boost to cross \$100000 for each unit. However Bitcoin is only one among over 13000 crypto-currencies in operation. Bitcoin is the most widely used crypto-currency. There are estimated to be over 560 million crypto-currency users around the world. In January 2009, bitcoin was created by pseudonymous developer Satoshi Nakamoto who published a paper in 2008 that introduced crypto-currency, initiating its rise to popularity [1]. Subsequently, other digital assets that were not bitcoin became collectively known during the 2010s as alternative crypto-currencies, or, "altcoins"

Awareness and curiosity led Indian citizens to consider parking their funds in cryptos, as they reckoned it as a means for quick wealth creation. In fact India leads the world in crypto-currency adoption, with estimated over 100 million active crypto investors surpassing, China and USA. This figure represents just over 7% in terms of user-penetration. India's growing interest in crypto-currencies is driven by a desire for financial inclusion and growing uneasiness with traditional banking systems.

## II. WHAT IS CRYPTO-CURRENCY?

A crypto-currency is a form of digital money that operates on a secure network, where users can transfer funds directly to one another without intermediaries. It uses cryptography for

security, and is recorded on a decentralized public ledger called a blockchain, the core technology which is a distributed ledger that records all transactions across a network of computers, ensuring transparency and security. Decentralized implies no single entity manages the system. The process of creating new crypto-currency units is called "mining", which needs computers to solve complex mathematical problems. To store and manage crypto-currencies, users need digital wallets that act like virtual bank accounts, allowing them to send and receive crypto. Transactions made using crypto-currencies are codified as blocks. And multiple blocks linking each other forms a blockchain on the distributed ledger. Crypto-currencies are supported by a technology known as blockchain, which maintains a tamper-resistant record of transactions and keeps track of who owns what. Individual units of crypto-currencies can be referred to as coins or tokens

Over the past few years, Crypto has established itself as a notable player in the financial markets contending for a position in several investors' portfolios. Several growth factors are driving its growth including increasing acceptance and adoption of crypto-currencies by individuals and institutions, growing interest in decentralized finance (DeFi) platforms, and the potential for crypto-currencies to serve as a hedge against inflation and political instability. Advancements in blockchain technology and the increasing use of crypto-currencies for cross-border transactions are contributing to market growth.

RBI treats crypto-currency profits similar to speculative gains. Every crypto transaction must reflect in the taxpayer's returns. Non-declaration of crypto earnings constitutes an offence under PMLA. Failure to disclose can lead to prosecution.

El Salvador became the first country to make bitcoin legal tender. In USA AT&T, Microsoft, Starbucks and Whole Foods now accept bitcoin payments.

## III. ENVIRONMENTAL IMPLICATIONS

Crypto-currency requires energy, equipment, internet and a global networking infrastructure. Resultantly, it has a large environmental impact, with some networks using as much energy as small countries to maintain a blockchain. For example, the Cambridge Bitcoin Electricity Consumption (CBEC) Index estimates that Bitcoin, the most widely-mined

Top 10 Cryptos
Bitcoin
Ethereum
Binance Coin
Solana
Ripple
Dogecoin
Polkadot
SHIBa INU
Cardano
Avalanche

crypto-currency network, uses an estimated 151 terawatt-hours (TWh) of electricity annually (0.59% of global electricity use). Moreover, thousands of different crypto-currencies and hundreds of exchanges exist worldwide. None of the crypto-currency energy use reports or calculations account for the energy expended to develop new coins or administer services for them.

The machines performing the “work” are consuming huge amounts of energy while doing so. Moreover, the energy used is primarily sourced from fossil fuels. The ‘Bitcoin Energy Consumption Index’ was created to provide insight into these amounts, and raise awareness on the unsustainability of the proof-of-work algorithm.

Therefore, increasing popularity of crypto-currency has environmentalists on edge, as the digital “mining” creates a massive carbon footprint due to the staggering amount of energy it requires. Unlike paper money, which is regulated through central banks, transactions in cryptos are tracked through a public ledger consisting of a network of computers around the world: the blockchain. “Mining” is a process in which computational puzzles are solved in order to verify transactions between users, which are then added to the blockchain. It allows this validation to take place, which is an energy-intensive process. Crypto-currency mining is the process of adding new transactions to the blockchain, and it is a crucial aspect of the entire crypto-currency ecosystem. The mining process involves solving complex mathematical problems using sophisticated hardware, which then validates the transactions and adds them to the blockchain.

Data scientist, Alex de Vries, doing PhD at Vrije Universiteit Amsterdam, The Netherlands created an online tool, ‘Digiconomist’ to track the carbon-footprint of Bitcoin. He determined that a single Bitcoin transaction releases 563 kg of Carbon dioxide besides using 1009 kWh of electricity, 15900 litres of water and creating an e-waste of 239 grams [2].

According to the study done by United Nations scientists, The greenhouse gas emissions of Bitcoin mining alone could be sufficient to push global warming beyond the Paris Agreement’s goal of holding anthropogenic climate warming below 2 degrees Celsius [5].

**IV. PROOF-OF-WORK VERSUS PROOF-OF-STAKE**  
Proof-of-work and proof-of-stake are consensus mechanisms, or algorithms, that allow blockchains to operate securely. These consensus mechanisms keep blockchains secure by allowing only genuine users to add new transactions.

Proof-of-Work (PoW) is the original consensus mechanism used to validate transactions and open new blocks. A consensus mechanism is a method for validating entries into a distributed database, namely a blockchain. Here, block creators are called miners. Miners work to solve a hashing problem to verify transactions. In return for solving it, they are rewarded with a coin. The miners must invest in processing equipment and incur hefty energy charges to power the machines attempting to solve the computations.

Proof-of-stake (PoS) was created as an alternative to PoW to validate transactions and open new blocks. PoS is seen as less risky regarding the potential for an attack on the network, as it structures compensation in a way that makes an attack less advantageous.

PoS reduces the computational work needed to verify blocks and transactions. It changes the way blocks are verified using the machines of coin owners, so there doesn’t need to be as much computational work done. Here, block creators are called validators who check transactions, verify activity, vote on outcomes, and maintain records.

The equipment and energy costs under PoW mechanisms are expensive to ensure security of the blockchain. PoS blockchains reduce the amount of processing power needed to validate block information and transactions. The mechanism also lowers network congestion and removes the rewards-based incentive PoW blockchains have.

#### V. THE WAY FORWARD

Every urban city has landfills where, methane gas is produced when organic waste breaks down which is a major contributor to climate change. However, researchers have created [8] special equipment that collects the methane emissions from landfills. Instead of letting the gas escape into the air, it is redirected into generators that turn it into electricity. This electricity is then used to run the energy-intensive process of Bitcoin mining. This approach provides a reliable and sustainable energy source for Bitcoin miners, reducing their reliance on fossil fuels and making their operations more environmentally friendly.



Figure 1. Block-chain is the core technology powering a crypto-currency, occurs digitally and has no governing authority[3].

## Global Cryptocurrency Market

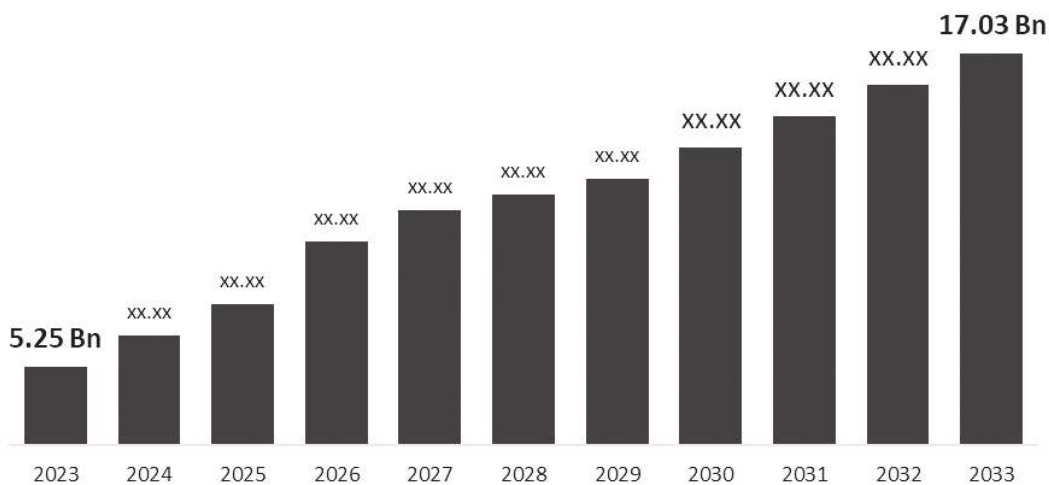


Figure 2. Several growth factors are driving increasing use of crypto-currencies (Courtesy: Spherical Insights).

It is imperative to reduce the hazardous impacts of crypto-currency mining or else it can become a bigger problem in the near future. If we want to reduce these effects, we need to:

*Use Renewable Energy Sources:* The first thing we need to do is shift mining operations to regions that are rich in renewable resources. This will reduce the usage of excess electricity and will also decrease carbon emissions. If these operations are in a developed country like the United States then they can use solar power and geothermal energy to run them. This way we all can move towards cleaner energy alternatives.

*Actions by Government:* The government also plays a crucial role in reducing the negative effects of crypto mining. They can enforce several measures and set up energy-efficient standards. This shift towards environment-friendly mining must be supported by the governments or else it will all go to waste. The government need to provide financial support to organizations that are looking for ways to improve our environmental health.

*Utilize Energy-Efficient Systems:* Energy-efficient technological systems including a “Proof-of-Stake” system must be used instead of Proof-of-Work. It can reduce the energy consumption

significantly. For instance, Ethereum switched from Proof-of-Work to Proof-of-Stake to conserve energy. This has reduced the energy use to over 99.9%.

*Take Legislative Measures:* Various crypto-currencies have not yet implemented the use of energy-efficient systems for mining purposes. For instance: Bitcoin and many other crypto-currencies are not switching to Proof-of-Stake because of lower profit margins. There is a need for proper legislation against these crypto-currencies.

### CONCLUSION

Perceived as a hedge against inflation and political instability, several persons, particularly youngsters are parking their money in crypto-currencies (cryptos) to earn higher returns than available from traditional avenues. Advancements in blockchain technology and the increasing use of cryptos for cross-border transactions are contributing to dizzy market growth. However, the transactions in cryptos consume enormous amount of electrical power and water leading to adverse environment effects. Greenhouse gas emissions of Bitcoin mining alone could be sufficient to push global warming beyond the Paris Agreement's goal of holding anthropogenic climate warming below 2 degrees Celsius.

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**Dr Ranjit Singh**, FIETE (b. 17 Aug 1948) obtained B.Tech, M.Tech. and Ph.D degrees from Indian Institute of Technology, Kanpur in 1969, 1971 and 1975 respectively specializing in the area of Electronic circuits and devices. Has abiding passion for research and innovative approach to teaching. Guided B.Tech, M.Tech and Ph.D scholars.

He is founding Editor-in-Chief of the '*AKGEC International Journal of Technology*', which is running in fifteenth volume. Earlier served IETE as Editor during 1975-1987; Technical Editor at Telematics India during 1987-2001 and Editor of *Industrial Purchase* journal during 2002-2008.

From September 2008 to February 2015, he taught at Ajay Kumar Garg Engineering College, where he was a Professor in the Department of ECE. Thereafter served as Head of the Departments of ECE and EI at IEC Engineering College, Greater Noida from April 2015 - May 2016, where he supervised setting up of e-Yantra lab. Currently assisting IETE in their mission.

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