

## OPINION

## Are carbon offsets the key to green cryptocurrencies?

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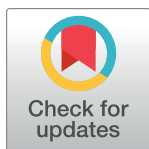
## The rise of cryptocurrencies and their growing environmental costs

Cryptocurrencies have seen a meteoric rise in their adoption and value over the past decade. For instance, the most widely-traded cryptocurrency, Bitcoin, which started at only a few cents per token in 2009 when it was first mined [1], crossed an all-time high price of more than USD68,000 in November 2021 [2]. Largely made possible with the rise of blockchain technology, a cryptocurrency is essentially a digital form of money that allows the transfer of value directly between users, without requiring an intervening financial institution [1]. A blockchain is a system where records of transactions are distributed across multiple users in a network as encrypted 'blocks' [1,3,4]. The users in a blockchain network participate in both the creation of new tokens (equivalent to 'minting' new money), as well as the authentication of these records through complex mathematical operations on their computers, which is referred to as 'mining' [1]. This decentralized 'distributed ledger' prevents the false modification of records [3] and allows for a more secure, trustworthy and scalable way to make financial transactions [1]. These advantages have led to significant growth in this sector.

However, the massive energy consumption of mining cryptocurrencies and consequently their carbon footprint is a significant environmental concern. Studies suggest that the annual carbon emissions from the Bitcoin network alone could potentially exceed 90 MtCO<sub>2</sub>e, which surpasses the total carbon footprint of some of the most populous cities in the world including Beijing, Sao Paulo and New Delhi ([www.citycarbonfootprints.info](http://www.citycarbonfootprints.info)) [5]. In response to these environmental costs, several approaches to make cryptocurrencies more sustainable are being explored. These either attempt to directly decarbonize cryptocurrencies by reducing emissions or try to compensate for their adverse climate impacts through negative emissions from carbon offsets. Naturally, both these pathways are needed in tandem to achieve carbon neutrality [6]. However, due to the significant constraints that limit the future decarbonization of this sector, connecting cryptocurrencies to carbon offsets is arguably the most practical approach for mitigating their climate impact.

## Limits to reducing emissions through enhanced network efficiency

The first approach to creating a 'greener' cryptocurrency is to enhance the energy efficiency of the blockchain networks that form the foundations of cryptocurrencies. Algorithms used to establish consensus in a blockchain can typically consume varying degrees of energy [4]. For example, Bitcoin uses a highly energy-intensive Proof-of-Work (POW) protocol but more efficient algorithms like Proof-of-Stake (POS), which require less than a hundredth of the amount



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of energy required to power POW networks, are a viable approach for reducing the carbon footprint of cryptocurrencies, which is why major cryptocurrencies like Ethereum are planning on moving to the latter in the future [4]. However, Bitcoin, which still dominates the cryptocurrency sector in terms of value and environmental impact, is unlikely to transition completely to POS given the inherent technical challenges and the need for agreement across a majority of users on the network to enable such a transition [7]. Therefore, this approach is useful in making newer tokens more sustainable but pre-existing cryptocurrencies need other greening solutions such as relying on renewable energy sources or linking to carbon offsets as outlined below.

### **Challenges in transitioning to renewable sources of power**

There has recently been significant interest in powering cryptocurrencies through renewable energy. For example, blockchain-based platforms like Ripple have recently announced the decision to go carbon neutral by 2030, which will partly be achieved through renewable sources of power [8]. However, this is easier to do for privately held networks like Ripple's XRP cryptocurrency compared to completely public ledgers like Bitcoin that make the tracing of mining activity and consequently of energy consumption, very challenging [9]. Moreover, despite the availability of renewable energy sources such as hydropower in regions like Sichuan province in China, where over 48% of historical mining capacity was concentrated, seasonal fluctuations in renewable energy yield still need to be balanced out using non-renewable coal power [10]. Although the Chinese government has recently clamped down on mining activity within these regions, this will likely lead to mining capacity getting displaced to other countries, where renewable sources may not be abundant, thereby ruling out the possibility of truly decarbonized cryptocurrencies through reliance on renewable energy alone [11].

### **The promise of connecting carbon offsets to cryptocurrencies**

Given the aforementioned constraints that limit the decarbonization of cryptocurrencies and the voluntary carbon market's recent surge [12], carbon offsets offer an exciting opportunity for greening cryptocurrencies. Using offsets can potentially be a substantial climate mitigation tool for cryptocurrencies since the total volume of carbon credits in tons of CO<sub>2</sub>e transacted in the voluntary market in 2021 (through August 2021) are currently more than twice as high as the estimated annual carbon emissions from the Bitcoin network (239.3 MtCO<sub>2</sub>e vs. 90.1 MtCO<sub>2</sub>e) [5, 12]. Moreover, offsets for cryptocurrencies can potentially drive up the demand and consequently price for carbon credits, thereby opening up new opportunities for investible carbon sequestration projects. A recent example of this approach is the launch of Bitcoin Zero [13]. This novel cryptocurrency builds on the bitcoin network, but for every one unit of Bitcoin Zero that is minted, 10 tons of carbon credits generated through REDD+ projects are retired to offset the carbon footprint of each token [13]. A carbon credit once retired cannot be traded further, thus reducing the total amount of available carbon within circulation in the offsets market.

However, ensuring that carbon credits deliver the climate benefits that they promise is vital for effectively offsetting the environmental impacts of cryptocurrencies. This is especially important because forestry and land-use based projects, which have recently become the most highly transacted offset type in the voluntary market [12], can often overstate their climate impact [14]. Furthermore, guaranteeing that carbon offsetting projects store carbon permanently and ensuring that they do not simply displace the drivers of environmental degradation elsewhere are significant technical challenges and administrative overheads that potentially diminish their adoption [15]. Additionally, limitations in environmental accounting can lead

to ‘double-counting’, where both the buyer and seller of a carbon credit count the emissions reductions of the same action towards their climate targets, which may lead to a net increase in emissions [16]. Addressing these challenges must be a fundamental priority for the future adoption of carbon offsets for greening cryptocurrencies.

### Priorities for the future

Investors are unlikely to move away from tokens like Bitcoin given the immense wealth locked away in this network, as well as the fact that it has continued to be the most dominant and highly valued cryptocurrency [2], despite government crackdowns and widespread coverage about its environmental damage [5,11]. However, developments such as the launch of Bitcoin Zero suggest that investors may be willing to pay a premium to offset this environmental damage. Therefore, offsets are currently the lowest hanging fruit for bringing cryptocurrencies like Bitcoin closer to carbon neutrality and must therefore be more widely publicized to enhance adoption. Next, there is immense scope for developing additional products like Bitcoin Zero that connect other cryptocurrencies to carbon markets. Finally, it is crucial to ensure the quality of carbon offsets by leveraging emerging technologies such as remote-sensing, artificial intelligence and blockchain for more accurate, transparent and timely reporting of their performance [17]. There is still a long way to go in making cryptocurrencies truly ‘green’, but with a total market value of more than two trillion dollars [2], cryptocurrencies are here to stay. Mitigating their environmental cost is vital to a sustainable future and leveraging carbon offsets may be the key to doing so.

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