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Carbon Emissions Report

Hashdex Nasdaq Bitcoin ETF | BITH11



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Preamble

This report is prepared by CCRI for **Hashdex Asset Management Ltd..**

Executive summary

- Bitcoin has followed an unparalleled rise in market cap over the past years
- In light of the imminent climate crisis, there is raised attention towards Bitcoin's electricity consumption and carbon footprint
- Bitcoin's electricity consumption and the corresponding carbon footprint is influenced by a complex interplay of market prices, hardware efficiencies and electricity prices
- To calculate the CO₂e emissions related to specific Bitcoin holdings and transactions, we determine the electricity consumption, translate this to CO₂e emissions and allocate it to the holdings and transactions on the basis of several scientific publications
- We derive the total amount of CO₂e emissions that needs to be allocated to the Bitcoin holdings of **Hashdex Nasdaq Bitcoin ETF (BITH11)** to be at 2,221.04 tones (over the period from June 24th, 2021, to June 29th, 2022)

1. Aim and scope

This report calculates the amount of CO₂e emissions corresponding to the **Hashdex Nasdaq Bitcoin ETF** fund. To do so, we provide comprehensive background information as well as a detailed calculation of the amount of CO₂e emissions estimated to be allocated to the holdings. This report is prepared on the basis of several scientific publications which explored the electricity consumption and corresponding CO₂e emissions. The results of this report provide a solid indication of the amount of CO₂e emissions that **Hashdex Asset Management Ltd.** needs to be mitigated in order to claim their fund carbon neutral.

The report is structured as follows: We outline background information with regard to Bitcoin's market rise and the corresponding electricity consumption and carbon footprint in section 2. Section 3 explains the economics of Bitcoin mining to provide an understanding of the underlying mechanisms. In section 4, we show our methodology to calculate the carbon footprint of the Bitcoin network and how to allocate emissions to specific Bitcoin holdings and transactions. Section 5 presents the results.

2. Background

Bitcoin has followed an unparalleled rise in market cap over the past years. In 2021, the market price has increased more than doubled from just under USD 30,000 to as much as USD 69,000 at its peak. [1] This has increasingly sparked the interest of investors from all over the world. In January 2021, electric car manufacturer Tesla became the first company listed on the S&P500 stock market index to buy the digital currency Bitcoin. [2] As Bitcoin becomes more salient in the global financial system, there is raised attention towards the major concern related to Bitcoin which is the electricity consumption and the associated CO₂e emissions. Previous research has shown that the electricity consumption of the Bitcoin network translates to annual CO₂e emissions in the ballpark of entire countries. [3] In light of the imminent climate crisis, investments in line with portfolio decarbonization efforts are becoming increasingly important. The financial sector has a critical role in achieving net zero by mid-century as huge amounts of capital need to be redirected at decarbonizing the economy. [4] Thus, Bitcoin's and other cryptocurrency's environmental impact is increasingly acknowledged in investment decisions. For instance, Tesla suspended the purchase of vehicles using Bitcoin over environmental concerns just 50 days after first enabling this practice. In accordance with this, carbon-neutral Bitcoin funds are gaining increasing traction. [5]

3. Economics of Bitcoin mining

Bitcoin's blockchain uses a "Proof of Work" consensus mechanism to avoid double spending and manipulation of the underlying ledger. The validation of ownership and transactions is based on a computationally extensive algorithm which needs to be performed by network participants in order to add valid blocks to the chain. This process is called 'mining'. The network participant that succeeds in adding a new block receives the block reward as well as the corresponding transaction fees. On average, every ten minutes a new block is added to the blockchain. To keep these 10-minute intervals constant and account for a rising hash rate, the difficulty for adding a new block to the blockchain is regularly adjusted. In times of rising market prices, miners have an incentive to add new capacity to the network. [6] Growth in the network (i.e. a rising hash rate) can cause higher electricity consumption of the Bitcoin network unless the effect is balanced by improved hardware efficiency. Consequently, the electricity consumption and the corresponding carbon footprint of the network is influenced by a complex interplay of market prices, hardware efficiency and electricity prices.

4. Methodology

To calculate the CO₂e emissions related to specific Bitcoin holdings and transactions, we take three steps. First, we determine the electricity consumption. Second, we translate this amount to CO₂e emissions. Third, we allocate Bitcoin's total carbon footprint to holdings and transactions.

For the electricity consumption, we rely on the Cambridge Bitcoin Electricity Consumption Index (CBECI). [7] The team behind CBECI had reached out to us in the design phase to improve methodology and representation of results. Since then, we have discussed trends and current developments on several occasions. CBECI takes a bottom-up approach by accounting for hardware efficiencies, profitability considerations as well as the current hash rate. It provides a lower-bound, an upper-bound and a best-guess estimate. We consider the best-guess estimate provided by the CBECI the most accurate and up-to-date estimate available for Bitcoin's electricity estimate as it considers a balanced mix of profitable hardware types.

For CO₂e emissions, we apply monthly carbon intensities for the Bitcoin network which we derive based on the methodology published in a recent study in 2022 [8] and additional mining location data published by the CBECI team in spring 2022. The location of mining facilities and local grid emission factors are utilized to derive a carbon intensity of the Bitcoin network.

For the allocation, we apply the hybrid methodology which we co-developed with South Pole in consultation with PayPal to determine the carbon footprint of Bitcoin holdings and transactions. [9]

The respective shares for holdings as well as transactions are weighted depending on the miner's revenue; holdings are allocated in accordance with the block reward, transactions in accordance with transaction fees. This approach allows to account for both holdings as well as transactions without double counting any emissions. We calculate the share of the Bitcoin holdings and transactions on a daily basis to account for changes in the holdings and transactions as well as the growth of the Bitcoin network caused by newly mined bitcoins. Additionally, we factor in that approximately a fifth of all bitcoins may be permanently inaccessible and thus adjust the size of the Bitcoin supply accordingly. [10]

5. Results

Based on the outlined methodology and the data provided by **Hashdex Asset Management Ltd.**, we derive the amount of CO₂e emissions that needs to be allocated to the Bitcoin holdings and transactions of **Hashdex Nasdaq Bitcoin ETF** over the period from June 24th, 2021, to June 29th, 2022 at 2,221.04 tones. The average annual electricity consumption for the respective time period of the Bitcoin network amounts to 112.0 TWh. The applied average carbon intensity of Bitcoin lies at 0.531 Mt CO₂e/TWh and monthly carbon intensities range from 0.472 to 0.557 Mt CO₂e/TWh.

6. References

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About CCRI

CCRI is a research-driven company providing data on sustainability aspects of cryptocurrencies, blockchain and other technologies. The interdisciplinary team has built a multi-year research track record with a specific focus on cryptocurrencies and their sustainability impacts. CCRI uses the most up-to-date data sources as well as methods based on formerly peer-reviewed studies published in renowned scientific journals. CCRI provides insights that help their clients to understand and manage crypto-related ESG exposure. They serve a broad range of clients including institutional investors, exchanges and blockchain networks.