Our carbon accounting methodology for bitcoin

Who is responsible for BTC emissions?

The underlying logic of Bitcoin as a cryptocurrency differentiates it from other asset classes. Gold can be taken as an analogy for the approach that may normally be taken in emissions allocation for asset managers. The ongoing energy impact of a digital currency is a key differentiator, and it is this that forms the unique nature of proof-of-work cryptocurrencies and informs the recommended approach by Carbon Responsible.

Under the Greenhouse Gas (GHG) Protocol, Scope 3 reporting of carbon emissions includes all indirect impacts that are not included in the combustion of fuels and the use of electricity, heat, and steam by a reporting entity. The range of inclusions in Scope 3 includes lifecycle analysis for a product or service, purchased goods and services and investments. For an exchange-traded fund, the emissions due to maintaining a blockchain fall under scope 3, while mining operations would report their emissions under scope 2 direct electricity consumption.

Scope 3 is currently an optional reporting item within existing UK compliance reporting for emissions. This optionality has already been highlighted as an area for attention by the UK Government and current best practice supports the disclosure of Scope 3 emissions by reporting entities.

Global BTC emissions

The electricity consumption of the entire blockchain is estimated based on 10 model parameters by the Cambridge Bitcoin Electricity Consumption Index (CBECI), which is updated daily. A separate analysis by the CBECI can be used as a source for the geographic distribution of energy consumption. Since different national grids have unique energy mixes, data on the locations of mining operations is needed to calculate the resultant CO2e emissions. This location data is based on a representative sample of IP addresses of mining facility operators and is updated biannually.

Taking the central estimated value for the annualized energy consumption E_{Global} in

kWh, the global emissions are then $\mathrm{G_{Global}} = \mathrm{E_{Global}}\,\vec{R} \cdot \vec{F}$, where $\vec{R}$ is a vector of ratios of IP traffic from each country, and $\vec{F}$ is a vector of emissions intensity from each national grid, in CO2 and equivalent greenhouse gases per kWh.

Apportionment methodologies

There are three principal methodologies for apportioning the indirect impact of maintaining a cryptocurrency blockchain between investors and traders (Crypto Carbon Ratings Institute, 2021).

Holdings-based

The first method is based on the amount of the currency held by an investor as a fraction of the total circulation. The idea is that by investing in a cryptocurrency, the value of that currency in fiat equivalent is driven up by supply and demand. This lowers the profitability threshold for miners who must invest up front in electricity costs and hardware, thereby incentivizing increased energy consumption. Under this methodology an ETF's emissions $G_{Hold} = G_{Global}\frac{H}{C_{Global}}$, Where H is the average holdings value for the given period, and $\mathrm{C_{Global}}$ is the average total circulating value of BTC in that time period. For improved accuracy we calculate this in monthly increments before summing for the financial year.

This approach is unique to proof-of-work based cryptocurrencies emissions and derives from the impact of ongoing energy use. Comparatively an ETF that traded in gold as an underlying asset may have some responsibility or assume responsibility in Scope 3 for the lifecycle production of gold, including mining. It would not however take responsibility for companies' emissions from failed exploration, any more than the derivatives sold on other asset classes would be a part of lifecycle emissions which would derive from underlying assets and their creation. The key difference arises from that fact that the mining impact for Bitcoin is directly related to the limited quantity of units, its digital nature and the very clear relationship between mining and the expansion of the currency base.

Transactions-based

The second method is based on the transactions carried out, either as a fraction of the total volume, or of the transaction fees paid as a fraction of total transaction fees paid across the network. The fees paid are considered more appropriate since a single bitcoin transaction may contain bundles of hundreds of smaller transactions, or the settlement of thousands of transactions, which occurred off-chain on a second-layer

solution. This is more closely aligned with typical scope 3 reporting as a 'purchased service', where miners are directly financially incentivized by the fees offered. It should be noted that bitcoin's energy consumption is linked to block production rather than transaction processing – the number of transactions within a block has no impact on the energy required. The formula to calculate transactions-based indirect emissions is thus $G_{Trans} = G_{Global} \times \frac{F}{T_{Global}}$, where F represents the total transaction fees paid by an ETF in BTC, and $\mathrm{T_{Global}}$ the total BTC value of global transactions within a given period.

Hybrid

Taking both approaches into account, a hybrid method combining the previous two methodologies is the remaining option. Since the financial reward for a miner is twofold in the form of the block reward and the combined transaction fees, these figures can be used as a fraction of the total financial incentive to weight the holdings-based and transactions-based allocations. While transactions will become a more significant driver of Bitcoin mining as the block reward diminishes in the future, they currently typically range between 1-10% of the total reward for a BTC block, hence holdings are still the more significant contributing factor to total emissions value. For a given average ratio of block reward to transaction fees R_{Hold}, the hybrid value $G_{Hybrid} = R_{Hold} \times G_{Hold} + (1 - R_{Hold}) \times G_{Trans}$. The datasets to evaluate R_{Hold} are updated daily, which is incorporated into the model due to the rapidly fluctuating value.

Our suggested approach

To ensure a like-for-like comparison with other asset classes that an ETF may trade in, we recommend a transaction-based approach. This equates BTC transactions with equivalent purchased services and reduces the risk of the same asset being accounted for in multiple years' worth of emissions reports and is thus the industry standard.