Mandatory information on principal adverse impacts on the climate and other environment-related adverse impacts of the consensus mechanism

N	Field	Content
General Information		
S.1	**Name**	Zillion Bits Ltd
S.2	**Relevant legal entity identifier**	254900FESD7AF56FOQ37
S.3	**Name of the crypto-asset**	Bitcoin (BTC)
S.4	**Consensus Mechanism**	Bitcoin operates on a Proof of Work (PoW) consensus mechanism, which forms the foundation of its transaction validation and security model. This mechanism requires network participants called miners to solve complex cryptographic puzzles by performing intensive computational operations. The first miner to solve the puzzle earns the right to add a new block of transactions to the blockchain and receives newly minted bitcoins as a reward. The PoW consensus process begins when transactions are broadcast to the network and collected into a memory pool. Miners select transactions from this pool, typically prioritising those with higher fees, and arrange them into a candidate block. They then repeatedly modify a value in the block header (nonce) while applying the SHA-256 cryptographic hash function twice, attempting to produce a hash value that meets the network's current difficulty target. This target automatically adjusts approximately every two weeks to maintain a consistent average block time of 10 minutes, regardless of changes in total network computational power. When a miner successfully produces a valid block, it is broadcast to the network, where other nodes independently verify its validity by checking that all transactions are properly signed, no double-spending occurs, and the proof of work meets the difficulty requirement. Upon verification, nodes add the block to their copy of the blockchain and begin working on the next block. Bitcoin's security relies on the significant computational resources required to perform this work, making it economically impractical for malicious actors to attempt to

		rewrite transaction history. As the network's hashrate (total computational power) increases, so does the difficulty of the puzzles, creating a self-adjusting security mechanism that scales with network participation. This consensus mechanism requires specialised hardware (ASIC miners), substantial electricity consumption, and cooling infrastructure to operate effectively. The energy profile of Bitcoin mining varies significantly based on the geographical distribution of miners, local energy sources, and hardware efficiency.
S.5	**Incentive Mechanisms and Applicable Fees**	Bitcoin's incentive structure is designed to maintain network security and transaction validation through economic rewards for miners. The primary incentive mechanism consists of two components: the block subsidy and transaction fees. The block subsidy represents newly minted bitcoins awarded to miners who successfully validate a block of transactions. This subsidy undergoes a programmed halving approximately every four years. This systematic reduction in the issuance rate creates a deflationary supply schedule, with a maximum cap of 21 million bitcoins that will ever exist. Transaction fees form the second component of miner rewards and are expected to become increasingly important as the block subsidy diminishes over time. These fees are determined through a market-based mechanism where users bid for block space by attaching optional fees to their transactions. Miners, acting as profit-maximising entities, typically prioritise transactions offering higher fees per byte of data, creating a fee market based on network demand. The fee market exhibits significant volatility, with fees increasing during periods of high network congestion and decreasing during lower demand. Users can choose their fee level based on desired confirmation speed, with higher fees resulting in faster inclusion in the blockchain. This dynamic pricing mechanism serves as a natural method for allocating the scarce resource of block space, which is limited by the protocol's base block size. Unlike traditional financial systems, Bitcoin has no mandatory minimum fees, allowing for theoretically feeless transactions during periods of low network demand. However, such transactions may experience significant delays in confirmation as miners prioritise fee-paying transactions. The network also lacks any maximum fee caps, allowing the market to determine upper limits based on user willingness to pay.

		This dual incentive structure of block subsidy and transaction fees creates alignment between miners' economic interests and network security. As miners compete for rewards by dedicating computational resources to the network, they simultaneously strengthen Bitcoin's security model against potential attacks, creating a self-reinforcing system where economic incentives drive the decentralised maintenance and security of the blockchain.
S.6	**Beginning of the period to which the disclosure relates**	2024-01-01
S.7	**End of the period to which the disclosure relates**	2024-12-31
	Mandatory key indicator on energy consumption	
S.8	**Energy consumption (kWh/year)**	171082483745.37628
	Sources and methodologies	
S.9	**Energy consumption sources and Methodologies**	The primary data foundation consists of blockchain parameters obtained from publicly available explorers and network statistics, including block rewards, transaction fees, and network difficulty. Market price data was sourced from regulated exchanges to determine mining revenue streams. The methodology incorporates electricity price data from the International Energy Agency (IEA) and European Environment Agency (EEA), with geographical distribution patterns of mining operations informed by the Cambridge Bitcoin Electricity Consumption Index historical data patterns. This approach operates on the fundamental economic principle that Bitcoin miners allocate a significant portion of their revenue to electricity costs, with this relationship remaining relatively stable within operational profitability thresholds. The ratios were derived from industry financial reports and academic research published in peer-reviewed journals. The geographical distribution of mining operations significantly impacts both the average electricity price and the carbon intensity of network operations. The analysis incorporates data on regional electricity pricing from national energy authorities and international organisations, weighted according to estimated mining distribution across major regions, including North America, Europe, and Asia. The methodology accounts for the SHA-256 consensus algorithm used by Bitcoin, which depends entirely on

		computational work performed by specialised ASIC mining hardware. Our approach was validated against publicly available blockchain metrics and cross-referenced with published research from academic institutions to ensure consistency with established understanding of Bitcoin network economics while avoiding direct implementation of proprietary methodologies.

Supplementary information on principal adverse impacts on the climate and other environment-related adverse impacts of the consensus mechanism

	Supplementary key indicators on energy and GHG emissions	
N	**Field**	**Content**
S.10	**Renewable energy consumption (percentage of the total amount of energy used per calendar year)**	36.41248
S.11	**Energy intensity (energy used per validated transaction in kWh)**	30.94658
S.12	**Scope 1 DLT GHG emissions – Controlled (in t CO2eq per year)**	0.00000
S.13	**Scope 2 DLT GHG emissions – Purchased (in t CO2eq per year)**	74555456.33009
S.14	**GHG intensity (emissions per validated transaction in kg CO2eq)**	10.93250
	Sources and methodologies	
S.15	**Key energy sources and methodologies**	Our assessment of Bitcoin's energy consumption profile employs a comprehensive framework that combines geographic distribution analysis, regional energy mix evaluation, and transaction data verification. For determining renewable energy consumption percentage, we first mapped the global distribution of Bitcoin mining operations using data from the International Energy Agency (IEA) and the Cambridge Centre for Alternative Finance, which provides authoritative insights into the geographic allocation of the network's hashrate. This distribution was then correlated with regional renewable energy penetration rates obtained from national

		energy authorities and the International Renewable Energy Agency (IRENA). The methodology accounts for both the base grid mix in each region and mining-specific renewable energy initiatives, as miners often strategically locate near renewable energy sources or establish direct power purchase agreements. We considered seasonal variations in renewable energy availability, particularly for hydroelectric power in regions with significant mining presence. Data from the European Environment Agency and national renewable energy reports provided granular insights into regional electricity generation profiles. For energy intensity calculations, we implemented a transaction-based allocation model that distinguishes between the energy used for network security (ledger maintenance) and transaction validation. This hybrid approach acknowledges that Bitcoin's Proof of Work consensus mechanism serves dual purposes: processing new transactions and securing the historical ledger. The transaction component was determined by analysing the proportion of miner revenue derived from transaction fees versus block subsidies, with data sourced from blockchain explorers and the Bitcoin network protocol specifications. Key assumptions include the differentiation between mining hardware efficiency tiers across geographic regions, estimated average electricity prices paid by miners in different jurisdictions, and the attribution of transaction validation energy based on fee incentives. The methodology assumes that miners operate rationally within economic constraints, with electricity costs representing a significant portion of operational expenses.
S.16	**Key GHG sources and methodologies**	For calculating Scope 2 DLT GHG emissions, we employ the location-based method recommended by the Greenhouse Gas Protocol, multiplying the electricity consumption by country-specific grid emission factors from sources including the European Environment Agency, the US Environmental Protection Agency, and Climate Transparency reports for G20 countries. Our analysis accounts for the renewable energy mix in Bitcoin mining, applying appropriate emission factors for both renewable sources and non-renewable sources (weighted by regional factors), resulting in a comprehensive assessment of purchased electricity emissions. The GHG intensity calculation divides the total GHG emissions by the number of validated transactions on the Bitcoin blockchain over the reporting period, providing an accurate per-transaction environmental impact metric. We source transaction data directly from the Bitcoin blockchain,

		analysing the full annual transaction volume using public ledger data, which allows for transparent verification of the transaction count. Regarding the Scope 1 DLT GHG emissions, these are considered negligible because Bitcoin miners typically purchase electricity from external providers rather than generating it themselves through owned or controlled power sources. Direct emissions only occur when miners operate their own power generation facilities, which represents an insignificant portion of the global mining operations, according to the International Energy Agency's cryptocurrency energy consumption reports.