

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

N	Field	Content
<b>General Information</b>		
S.1	<b>Name</b>	Zillion Bits Ltd
S.2	<b>Relevant legal entity identifier</b>	254900FESD7AF56FOQ37
S.3	<b>Name of the crypto-asset</b>	Cardano (ADA)
S.4	<b>Consensus mechanism</b>	<p>Cardano employs an energy-efficient Proof of Stake (PoS) consensus protocol called Ouroboros. The protocol organises network operation by dividing time into epochs and slots (1 second), with slot leaders selected to create blocks based on stake proportion.</p> <p>The network is sustained by Stake Pool Operators (SPOs) who validate transactions and maintain the blockchain. Each SPO typically operates a block-producing node and relay nodes that connect to the broader network, creating a robust decentralised infrastructure.</p> <p>ADA holders can participate in consensus without technical expertise through delegation. When delegating their stake to SPOs, users retain full ownership and control of their funds while contributing to network security and earning rewards proportional to their stake. This mechanism encourages broad participation in network governance without requiring direct operation of nodes. From a security perspective, Ouroboros provides mathematical proofs comparable to those of Bitcoin while consuming just a fraction of the energy.</p> <p>Unlike some other PoS protocols, Cardano does not implement slashing penalties, but SPOs face opportunity costs for non-participation as they would miss block rewards.</p> <p>The environmental sustainability of Cardano's consensus mechanism represents a significant improvement over Proof of Work systems, while preserving the decentralisation and security principles fundamental to blockchain technology.</p>

<b>S.5</b>	<b>Incentive mechanisms and applicable fees</b>	<p>Cardano operates on a Proof-of-Stake (PoS) consensus mechanism, specifically the Ouroboros protocol. In this system, network security and validation of transactions are maintained by a decentralised set of validators known as "stake pool operators."</p> <p>Both stake pool operators and ADA holders who delegate their tokens to these pools receive rewards. The rewards are distributed in ADA and are determined by the pool's performance, the total amount staked, and the protocol's monetary policy. This mechanism incentivises honest participation, decentralises block production, and aligns economic interests with network security.</p> <p>ADA holders who do not wish to operate a stake pool can delegate their tokens to an existing pool. Delegators receive a share of the rewards proportional to their stake, encouraging widespread participation and supporting the decentralisation of the network.</p> <p>To ensure honest behaviour, the protocol incorporates mechanisms that reduce or eliminate rewards for pools or operators that act dishonestly or fail to meet performance criteria. While Cardano does not implement "slashing" (the loss of staked tokens) as in some other PoS networks, poor performance or malicious activity leads to reduced or zero rewards, providing a strong economic disincentive against such behaviour.</p> <p>Each transaction on Cardano incurs a fee, paid in ADA. The fee structure is determined by a formula that takes into account a fixed minimum fee and a variable component based on the size (in bytes) of the transaction.</p> <p>Collected transaction fees are pooled and distributed as part of the staking rewards to stake pool operators and delegators. This further incentivises participation in the consensus mechanism and aligns interests between network users and validators.</p> <p>Cardano does not impose additional fees for smart contract deployment or asset creation beyond the transaction fees, although complex transactions or smart contract executions may incur higher fees due to increased computational requirements.</p>
<b>S.6</b>	<b>Beginning of the period to which the disclosure relates</b>	2024-01-01

S.7	End of the period to which the disclosure relates	2024-12-31
<b>Mandatory key indicator on energy consumption</b>		
S.8	Energy consumption (kWh/year)	708349.50434
<b>Sources and methodologies</b>		
S.9	Energy consumption sources and methodologies	<p>The energy consumption calculation for Cardano (ADA) follows a bottom-up approach that measures the electrical power demand of the network infrastructure and converts it to annual energy consumption. The calculation considers both the base power requirements for maintaining the distributed ledger and the additional power requirements for transaction validation.</p> <p>Data Sources</p> <ul style="list-style-type: none"> <li>▪ Node count data: derived from on-chain data available through the Cardano blockchain explorer.</li> <li>▪ Power consumption measurements: based on benchmarks of standard hardware configurations typically used for Cardano node operation, as documented in academic papers on Proof-of-Stake systems and industry reports.</li> <li>▪ Transaction volume: extracted from the Cardano blockchain with a projected annual transaction count.</li> <li>▪ Energy efficiency parameters: derived from technical specifications published by the International Energy Agency (IEA) and European Union Agency for the Cooperation of Energy Regulators (ACER) for server and networking equipment.</li> </ul> <p>Key Assumptions</p> <ul style="list-style-type: none"> <li>▪ Operational Pattern: the calculation assumes nodes operate continuously throughout the reporting period.</li> <li>▪ Hardware Configuration: average power consumption per node is based on typical server configurations used for Cardano validation.</li> <li>▪ No Significant Protocol Changes: the calculation assumes the Cardano consensus mechanism, the node count and distribution, and average power consumption per node remain stable during the reporting period.</li> <li>▪ Storage power consumption is included in the base node power consumption</li> </ul>

## 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)	29.40637
S.11	Energy intensity (energy used per validated transaction in kWh)	0.00782
S.12	Scope 1 DLT GHG emissions – Controlled (in t CO <sub>2</sub> eq per year)	0.00000
S.13	Scope 2 DLT GHG emissions – Purchased (in t CO <sub>2</sub> eq per year)	422.18820
S.14	GHG intensity (emissions per validated transaction in kg CO <sub>2</sub> eq)	0.00322
Sources and methodologies		
S.15	Key energy sources and methodologies	<p>The assessment begins with a comprehensive analysis of the blockchain network architecture, including the type of consensus mechanism, the structure of validator nodes, the hardware profile and operational cycle.</p> <p>The total energy consumption calculation methodology incorporates direct electricity consumption from all network validators, including computing, memory, storage, and networking components, as well as associated cooling requirements.</p> <p>The renewable energy consumption percentage represents the proportion of total energy derived from renewable sources. The validator locations are mapped using on-chain data and validator registries. For each region, renewable energy percentages are applied based on official electricity grid data from the International Energy Agency (IEA) electricity statistics, European Environment Agency (EEA) energy mix reports, and national renewable energy regulatory reports.</p>

		<p>The data is validated through cross-verification with multiple sources, including the EU Energy Statistical Pocketbook, the International Renewable Energy Agency (IRENA) Renewable Energy Statistics and national grid operators' renewable energy penetration reports.</p> <p>Energy intensity is calculated using a hybrid allocation approach that distinguishes between baseline energy consumption (network maintenance) and transaction-specific energy consumption. To determine the total number of transactions, we carry out a validated transaction count from the blockchain for the reporting period. Baseline energy is the energy used for maintaining network consensus regardless of transaction volume. Marginal energy is the additional energy specifically attributable to transaction processing determined by applying a transaction attribution factor.</p> <p><b>Key Data Sources</b></p> <ul style="list-style-type: none"> <li>▪ Validator Network Data: On-chain data from blockchain explorers and validator registries;</li> <li>▪ Energy Consumption Benchmarks: European Commission Joint Research Centre (JRC) technical reports on server energy consumption;</li> <li>▪ Regional Renewable Energy Mix: Eurostat energy statistics, IEA World Energy Outlook and National renewable energy regulatory authorities; and</li> <li>▪ Hardware Energy Profiles: EU Energy Star and EU Ecodesign Directive technical documentation.</li> </ul> <p><b>Key Assumptions</b></p> <ul style="list-style-type: none"> <li>▪ Hardware Homogeneity: Validators use reasonably similar server-grade equipment with standardised power profiles;</li> <li>▪ Continuous Operation: Validators operate continuously throughout the reporting period;</li> <li>▪ Geographic Distribution: Validator distribution remains relatively stable during the reporting period;</li> <li>▪ Transaction Processing Impact: The marginal energy impact of transaction processing is measurable and can be reasonably estimated through controlled testing; and</li> <li>▪ Grid Mix Application: Regional grid mix data accurately represents the actual energy sources used by validators in those regions.</li> </ul>
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<p><b>S.16</b></p>	<p><b>Key GHG sources and methodologies</b></p>	<p>The methodology distinguishes between different types of emissions according to the Greenhouse Gas Protocol and ISO 14064 standards:</p> <p>Scope 1 emissions (direct emissions from owned or controlled sources) are classified as negligible, as the Proof of Stake (PoS) consensus mechanism does not require specialised mining equipment that would generate direct emissions during operation.</p> <p>Scope 2 emissions (indirect emissions from purchased electricity) constitute the primary environmental impact of the network's operations and are the focus of our calculation methodology.</p> <p>The methodology employs a structured data collection system that incorporates validator network assessment, hardware energy profiling, and geographical distribution mapping, including the application of region-specific grid emission factors from the International Energy Agency (IEA).</p> <p>The methodology for calculating Scope 2 emissions follows these key steps: (i) determining the total network electricity consumption, and (ii) applying region-specific emission factors from authoritative sources such as the IEA, European Environment Agency (EEA), and national environmental protection agencies.</p> <p>For the certification and uncertainty assessment, we apply data quality criteria based on the Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance and conduct a sensitivity analysis to address uncertainties in the estimation process.</p> <p>For calculating GHG intensity per transaction, the methodology employs a hybrid allocation approach of (i) determining energy allocation between functions, (ii) assessing the transaction volume by extracting transaction data directly from the blockchain's public ledger, and (iii) carrying out intensity calculation by applying the allocation percentage to total emissions and dividing these emissions by the total number of validated transactions.</p> <p><b>Key Data Sources</b></p> <p>Emission Factors:</p> <ul style="list-style-type: none"> <li>▪ International Energy Agency (IEA) - World Energy Outlook;</li> <li>▪ European Environment Agency (EEA) - European emission factors;</li> </ul>
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