QUANTUM FAMILY OFFICE
INTERNATIONAL TRUST-SERVICES

Sustainability Disclosures for Major Crypto-Assets

(In accordance with Article 66(5) of Regulation (EU) 2023/1114 – MiCA, date 24.08.25)

Date: 01.09.2025

Quantum Family Office LLC provides the following climate and environment–related disclosures for the major crypto-assets we support, based on the most reliable available sources. These indicators reflect energy use, carbon emissions, and supplementary environmental impacts where applicable.

1. Bitcoin (BTC)

Consensus Mechanism: Proof-of-Work (energy-intensive)

Primary Environmental Indicators:

- **Annual Energy Consumption:** ~162–184 TWh/year
  - Cambridge Bitcoin Electricity Consumption Index: 162 TWh
  - Digiconomist estimate: 184 TWh
- **Carbon Emissions:** ~55 Mt CO_2/year
- **Energy per Transaction:** Up to ~1,200 kWh

Supplementary Environmental Indicators:

- **Renewable Energy Share:** 39–74% (varies by region and study)
- **Water Usage:** Tens of millions m^3/year (indirect via electricity generation)
- **Hardware Lifecycle Emissions:** ~5–10 Mt CO_2e/year (manufacture, transport, disposal of mining rigs)

- **E-waste Generation:** Thousands of tons/year from obsolete mining equipment
- **Other Impacts:** Local air pollution and land use associated with large mining facilities

Notes: Bitcoin remains one of the most energy-intensive and environmentally impactful crypto-assets due to its PoW consensus mechanism. Supplementary indicators highlight additional sustainability considerations beyond energy and carbon metrics.

2. Ethereum (ETH) – Post-Merge

Consensus Mechanism: Proof-of-Stake (post-15 Sept 2022 Merge)

Primary Environmental Indicators:

- **Annual Energy Consumption:** ~0.3 TWh (~99.9% reduction post-Merge)
- **Carbon Emissions:** ~0.87 kt CO_2e/year (~99.99% reduction)
- **Energy per Transaction:** Negligible

Supplementary Environmental Indicators:

- **Renewable Energy Share:** High (>99%) post-Merge
- **Water Usage:** Minimal
- **Hardware Lifecycle Emissions:** Minimal
- **E-waste Generation:** Minimal

Notes: Ethereum post-Merge is highly energy-efficient compared to PoW blockchains.

3. USD Coin (USDC)

Consensus Mechanism: Exists on other blockchains (primarily Ethereum PoS); not mined directly

Primary Environmental Indicators:

- **Energy Use:** Negligible for USDC itself; tied to host blockchain (Ethereum PoS)
- **Carbon Emissions:** Closely tracked to Ethereum emissions
- **Energy per Transaction:** Minimal

Supplementary Environmental Indicators:

- **Renewable Energy Share, Water Usage, Hardware Lifecycle Emissions, E-waste:** Minimal (all tied to underlying blockchain)

Notes: Environmental impact of stablecoins is largely indirect and dependent on the energy profile of the host blockchain.

4. Litecoin (LTC)

Consensus Mechanism: Proof-of-Work (similar to Bitcoin)

Primary Environmental Indicators:

- **Annual Energy Consumption:** Estimated at 0.5–1.0 TWh/year
  - Litecoin's energy consumption is comparable to that of Bitcoin, as both utilize the Proof-of-Work consensus mechanism.
- **Carbon Emissions:** Approximately 0.3–0.6 Mt CO_2/year
  - This estimate is based on the energy consumption and carbon intensity of the electricity used for mining operations.
- **Energy per Transaction:** Around 0.7–1.0 kWh
  - Each Litecoin transaction consumes a similar amount of energy to that of Bitcoin transactions.

Supplementary Environmental Indicators:

- **Renewable Energy Share:** Estimated at 50–70%
  - The proportion of electricity consumed by Litecoin mining operations that is sourced from renewable energy varies by region and mining practices.
- **Water Usage:** Estimated at 10–20 million m^3/year
  - This figure represents the indirect water consumption associated with electricity generation for mining operations.
- **Hardware Lifecycle Emissions:** Approximately 0.2–0.5 Mt CO_2e/year

    - Emissions from the manufacturing, transportation, and disposal of mining hardware contribute to Litecoin's environmental footprint.

- **E-waste Generation:** Estimated at 100–200 tons/year
    - The rapid obsolescence of mining equipment leads to significant electronic waste annually.
- **Other Environmental Impacts:** Includes land use and local air pollution
    - Large-scale mining operations can lead to habitat disruption and emissions from fossil fuel-based energy sources.

Notes:

- Litecoin's environmental impact is closely tied to the energy consumption of its mining operations, which depend on the energy mix of the regions where mining occurs.
- Efforts to transition to renewable energy sources and improve mining efficiency are crucial for reducing Litecoin's environmental footprint.
  5. XRP (Ripple)

Consensus Mechanism: XRP Ledger (XRPL) – Federated Byzantine Agreement (RPCA; non-mining, validator-based)

Annual Energy Consumption: Very low (no Proof-of-Work mining)

Carbon Emissions: Very low (driven by validator nodes' electricity mix)

Energy per Transaction: Negligible relative to PoW chains

Supplementary Indicators:

- Renewable Energy Share: Dependent on validator operators and hosting providers
- Water Usage / E-waste / Hardware Lifecycle Emissions: Minimal relative to PoW systems
- Notes: Throughput and finality designed for payments; footprint scales primarily with validator operations rather than hashpower.

6. XLM (Stellar Lumens)

Consensus Mechanism: Stellar Consensus Protocol (SCP; quorum-based, non-mining)

Annual Energy Consumption: Very low

Carbon Emissions: Very low (validator-mix dependent)

Energy per Transaction: Negligible relative to PoW chains

Supplementary Indicators:

- Renewable Energy Share: Validator/host dependent
- Water Usage / E-waste / Hardware Lifecycle Emissions: Minimal
- Notes: Network optimized for cross-border payments and asset issuance; sustainability profile comparable to other non-PoW, validator-based networks.

7. Solana (SOL)

Consensus Mechanism: Proof-of-Stake with Proof-of-History (PoS/PoH; non-mining)

Annual Energy Consumption: Low (staking/validator operations dominate; no PoW)

Carbon Emissions: Low, correlating with validator electricity sources

Energy per Transaction: Very low in steady state

Supplementary Indicators:

- Renewable Energy Share: Varies by validator geography
- Water Usage / E-waste / Hardware Lifecycle Emissions: Low (commodity servers; no ASIC mining turnover)
- Notes: High throughput design; energy profile largely a function of data-center operations rather than mining.

9. Bitcoin Cash (BCH)

Consensus Mechanism: Proof-of-Work (SHA-256; mining)

Annual Energy Consumption: Moderate (significantly below Bitcoin due to lower network hashpower)

Carbon Emissions: Moderate, driven by miners' energy mix

Energy per Transaction: Higher than non-PoW chains; lower than Bitcoin on average

Supplementary Indicators:

- Renewable Energy Share: Region/miner dependent
- Water Usage: Non-trivial where water-linked electricity is used
- Hardware Lifecycle Emissions / E-waste: Present (ASICs), but lower scale than Bitcoin
- Notes: Environmental footprint inherits PoW dynamics; materially influenced by energy sourcing and hardware refresh cycles.

10. Chainlink (LINK)

Consensus Mechanism: Token on host chains (primarily Ethereum PoS; LINK ERC-20/677)

Annual Energy Consumption: Very low for token transfers (inherits Ethereum's PoS profile)

Carbon Emissions: Very low (mirrors host chain validators' mix)

Energy per Transaction: Negligible on Ethereum PoS

Supplementary Indicators:

- Renewable Energy Share: Follows Ethereum validator mix
- Water Usage / E-waste / Hardware Lifecycle Emissions: Minimal relative to PoW systems
- Notes: LINK is a work/utility token used to pay oracle services; sustainability largely equals that of the underlying PoS chain, analogous to your USDC treatment.
  Sustainability Disclosures for …

Methodology & Sources

Figures are drawn from reputable and independent sources including:

- Cambridge Bitcoin Electricity Consumption Index

- Digiconomist
- International Energy Agency (IEA)
- Peer-reviewed studies (e.g., Mora et al. 2018; Krause & Tolaymat 2018)
- Ethereum.org, Polytechnique Insights, and industry analyses

Commitment to Sustainability

We are committed to transparency and environmental accountability. These disclosures are updated as new data becomes available to reflect the most accurate assessment of crypto-asset sustainability.

Sources:

- Cambridge Centre for Alternative Finance
- Digiconomist
- International Energy Agency (IEA)
- Peer-reviewed studies on cryptocurrency mining and environmental impacts

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- Polytechnique Insights
- Investopedia
- Ethereum.org, CCN.com, Cointelegraph
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