Annex- Joint response to the ESMA consultation on MICA RTS on ¨ Content, methodologies and presentation of sustainability indicators on adverse impacts on the climate and the environment¨

1. Annex to Question 2

Consensus Mechanism	**Description**	**Incentive Structure**	**Examples**	**Sustainability Impact Considerations**
Delegated Proof of Stake (DPoS) **Variety of Proof of Stake.**	Token holders vote for delegates to manage the blockchain on their behalf.	Rewards for delegates based on votes and performance.	EOS, Tron, Lisk	Reduces energy usage and increases transaction efficiency. Energy-efficient due to fewer validators. Easier identification of validators, limited geographical decentralisation
Directed Acyclic Graph (DAG)	Multiple chains allow simultaneous transactions.	Rewards are often based on transaction validation participation.	IOTA, Hedera Hashgraph, Nano	High scalability with potentially lower energy consumption per transaction.
Proof of Authority (PoA)	Transactions validated by approved accounts or validators.	Trust-based, with validators typically pre-selected.	VeChain, POA Network, GoChain	Low energy consumption due to trusted, pre-selected validators. Simple identification of validators, who are generally the project's core team

Proof of Burn (PoB)	Miners destroy a portion of tokens to obtain mining rights.	Incentivized by burning token for long-term rewards.	Slimcoin, Counterparty, Factom	Less energy-intensive Reduces energy usage but raises concerns about resource wastage (burning coins).
Proof of Elapsed Time (PoET)	Participants randomly chosen based on the amount of time they have been waiting.	Fair opportunity for all nodes.	Hyperledger Sawtooth	Low energy due to efficient use of resources and fairness in validator selection.
Proof of History (PoH)	A high-frequency verifiable delay function to encode the passing of time into a ledger.	Efficient and fast processing with a focus on transaction speed.	Solana	Low energy consumption due to efficient time-stamping and transaction processing.
Proof of Space (PoSpace)	Validation based on disk space allocation.	Rewards based on the amount of disk space provided.	Chia, Filecoin, Spacemesh	Energy-efficient with significantly lower energy use compared to PoW.
Proof of Stake (PoS)	Validators are chosen based on the number of tokensheld and staked.	Rewards based on token stake.	Ethereum 2.0, Cardano, Polkadot	Much lower energy consumption, reducing carbon footprint.
Proof of Work (PoW)	Miners solve cryptographic puzzles to validate transactions and create new blocks.	Rewards based on solving puzzles first. High competition and computational power required.	Bitcoin, Litecoin, Dogecoin	High energy consumption due to intensive computational work. Significant carbon footprint which is likely to decrease in the energy market (green energy is often cheaper than carbon-based energy)
Tendermint	A Byzantine Fault Tolerant (BFT) variant combining PoS elements.	Incentives based on staking and validator performance.	Cosmos	Efficient in energy use due to BFT mechanism and validator accountability.

After delving into the characteristics of various consensus mechanisms and understanding their similarities and differences, it becomes evident that certain sustainability indicators can be effectively applied across all these mechanisms. This universal application of indicators allows for an equitable and comprehensive assessment of the environmental impact of different blockchain technologies.

The following table presents a comprehensive view of the indicators that can be designed for assessing the sustainability impact across consensus mechanisms. However, it also highlights the inherent challenges in data collection, particularly due to the decentralised and varied nature of blockchain networks.

Indicator	**Data Required**	**Challenges in data collection**
Total Energy Consumption (kWh)	Energy usage data from each node; may need self-reporting or monitoring systems.	Difficulty in obtaining accurate data from all nodes, especially in decentralised networks. Potentially significant variations according to market cycles can still affect the ease with which overall energy consumption can be calculated.
Proportion of Renewable Energy Usage (%)	Energy sourcing details; certifications or proof of renewable energy usage.	Varied reporting standards and verification of energy sources, especially in decentralised networks. The methodology used to calculate this proportion may vary.
Type of Energy Source	Energy supply stability data; backup solutions in place.	Assessing the exact type of energy source for each node is challenging, especially in a decentralised context.
Carbon Footprint	Emission data from energy providers; hardware lifecycle	Challenges in tracking and quantifying emissions across global, decentralised

(CO2e)	emissions.	nodes.
Carbon Compensation Measures	Details of compensation initiatives (e.g., reforestation projects, carbon credits purchased); proof of implementation and effectiveness.	Requires transparent reporting and verification of compensatory measures, which may vary widely.
Community and Ecosystem Impact	Local impact assessments; stakeholder feedback.	Difficult to quantify indirect impacts.
Hardware Efficiency	Specifics of hardware models used; energy efficiency ratings.	Diverse hardware types and configurations across nodes complicate standardisation of efficiency metrics.
Lifecycle Impact of Hardware	Supply chain data; manufacturing and disposal practices.	Requires detailed data on hardware production, usage, and disposal processes, often not readily available.
Network Scalability	Transaction volume data; network capacity and growth metrics.	Requires comprehensive data on network performance under different loads, often not publicly disclosed.
Level of Decentralization	Number and distribution of nodes; network topology.	Decentralisation metrics are often subjective and challenging to quantify uniformly across different networks.
Total Waste Production	E-waste data; recycling and disposal information.	Tracking waste generation across diverse and globally distributed hardware systems is complex.

Water Usage	Water usage data; cooling system details.	Relevant mainly for large-scale data centres; difficult to assess for smaller or decentralised operations.
Geographic Distribution of Nodes	Location data of nodes; regional environmental impact assessments.	Gathering accurate location data of all nodes in a decentralised setup is challenging.

The table presented serves as a foundational guideline, outlining potential indicators that could be uniformly applied across various consensus mechanisms. However, it is crucial to acknowledge that the actual feasibility of implementing these indicators comprehensively and effectively by issuers requires a more detailed analysis. To ensure that the set of criteria and methodologies developed are both applicable and feasible, **a comprehensive feasibility study is needed**. This study should delve into the practical aspects of data collection, technological requirements, cost implications, and regulatory compliance challenges associated with these sustainability indicators.

The importance of such a feasibility study is further underscored by the dynamic and rapidly evolving nature of blockchain technologies and crypto-assets. It will provide critical insights into how these sustainability measures can be integrated seamlessly into the existing operational frameworks of crypto-asset issuers, without imposing undue burdens or hindering innovation within the sector.

Therefore, it is recommended to await the outcomes of the tender on 'Developing a Methodology and Sustainability Standards for Mitigating the Environmental Impact of Crypto-assets.' This initiative is expected to offer a realistic and executable methodology, grounded in thorough research and industry insights. The results from this tender will be instrumental in shaping a set of sustainability indicators and reporting standards that are not only comprehensive and robust but also practical and adaptable to the unique characteristics of the crypto-asset industry. This patient, informed approach will ensure the development of sustainability standards that are truly effective and conducive to the long-term growth and responsible evolution of the blockchain and crypto sector.