Methodologies to calculate the proposed mandatory sustainability indicators required by the EU Markets in Crypto-Assets (MiCA) regulation

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Contents

Introduction and general remarks

The Markets in Crypto-Assets Regulation (MiCA) entered into force in June 2023. Crypto-asset issuers as well as service providers are required to disclose information on the principal adverse impacts on the climate and other environment-related adverse impacts of the consensus mechanism used to issue the respective crypto-asset. The European Securities and Markets Authority (ESMA), which has been mandated to develop draft regulatory standards related to sustainability disclosure, has proposed ten mandatory climate and other environment-related indicators in their 2nd consultation package which was released on 5th October 2023. The ten indicators cover the areas of energy, GHG emissions, waste production, and natural resources. This document provides guidance on how to derive the ten mandatory sustainability indicators proposed by ESMA. The document will be updated as ESMA finalizes the requirements which is expected at the end of June 2024.

Proposed mandatory MiCA sustainability indicators

The following four sections a.-d. shed light on the ten mandatory sustainability indicators proposed by ESMA – clustered by the environmental domain they relate to.

a. Energy

The first three indicators are Energy consumption-related. Indicator 1 captures the total energy used for the validation of transactions and the maintenance of the integrity of the distributed ledger. Indicator 2 quantifies the non-renewable share, and Indicator 3 the per-transaction energy usage. Further details are provided below for each of the indicators.

Indicator 1 – Energy consumption

> "Total amount of energy used, expressed in kilowatt-hours (kWh) per calendar year, for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions"
> *- ESMA, Consultation Package 2, Annex II, Table 1*

For the first indicator, ESMA defines the total energy consumption of the network that is required for the validation of transactions and the maintenance of the integrity of the distributed ledger. It makes the important distinction between transactions and maintenance of the ledger, such that in later metrics we can discern between the two. For a proper assessment of Indicator 1, one needs to also consider the impact of transactions on the overall electricity consumption in the network.

Proof of Work:

There is plenty of research on the energy consumption of a Proof of Work (PoW) blockchain network, and two main approaches can be distinguished: a) Top-down and b) Bottom-up. We briefly describe both, but highly advise using a bottom-up approach, as later metrics also profit from an implementation of a bottom-up approach.

- **The top-down approach** was populated by Alex de Vries' Digiconomist Bitcoin Energy Consumption Index.[1] It assumes that the money earned by miners is directly invested, to a certain degree, into electricity. With data available on the miner's earnings (consisting of block subsidy and transaction fees), the exchange rate for bitcoin, and the assumption that a predefined share of earnings is spent on electricity, it is straightforward to calculate the respective monetary value of electricity. With an assumption on the last variable, the average electricity price we are able to calculate the total network electricity consumption on a daily basis.

- **The bottom-up approach** was initially developed in (Krause & Tolaymat, 2018)[2], refined in (Stoll, Klaaßen, Gallersdörfer, 2019)[3] and is now used in the most-cited Bitcoin Energy Consumption Index by CCAF.[4] Instead of directly looking at miners' earnings, the bottom-up approach considers the hash rate to be the main (direct) driver of the electricity consumption of the network and focuses on it. In PoW, the devices in the network need to solve a hash puzzle, thus requiring a lot of electricity. A bottom-up approach requires a list of available hardware devices and their power demand and hash rate. By taking the average electricity price, one is able to generate a list of profitable devices at any given time in the network, utilizing the current hash rate of the network. The profitable devices can be weighted according to their age and availability in the market, thus creating a list of devices that run at any given point in time, allowing to calculate the daily power demand (and thus the total annualized electricity consumption of the network).

Proof of Stake / Proof of Authority:

For networks that do not rely on a Proof of Work or other computationally heavy algorithms (e.g., Proof of Stake, or Proof of Authority), a uniform approach can be applied to generate the total electricity consumption. The driver of the total electricity consumption in such networks is the node devices in the network, both their count as well as their individual power demand.

"Number of nodes" is a metric that is often readily available. Block explorers or other data providers are able to analyze the P2P network and understand how many entities are connected to the network and provide (depending on the specific algorithm) computational and storage capacity. It is important to discern between full nodes and validating nodes, as only the latter provide "validation of transactions and maintenance of the integrity to the distributed ledger". Therefore, we recommend relying on validator numbers instead of total network nodes.

In contrast to the number of nodes, the power demand of the individual devices is not available. Some research papers estimate the power demand per node based on common hardware requirements of the network. However, such an approach does not allow for nuanced differentiations between different networks, as it is not possible to deviate average power demands from basic performance metrics of the network, such as transaction throughput. This can be addressed through generating the data by setting up nodes and measuring the electricity consumption in real-world scenarios. CCRI has developed a reference hardware set that includes low-tier nodes such as a Raspberry Pi up to server-grade hardware. With this hardware set, one may generate data for an average node of each of these blockchain networks. The individual power demand is enhanced with a marginal electricity consumption per transaction that is calculated based on the power demand and transaction throughput of the node during a measurement period. A detailed description of the methodology applied by CCRI is available.[5]

[1] https://digiconomist.net/bitcoin-energy-consumption.
[2] Krause, Max J., and Thabet Tolaymat. "Quantification of energy and carbon costs for mining cryptocurrencies." Nature Sustainability 1.11 (2018): 711-718.
[3] Stoll, Christian, Lena Klaaßen, and Ulrich Gallersdörfer. "The carbon footprint of bitcoin." Joule 3.7 (2019): 1647-1661.
[4] https://ccaf.io/cbnsi/cbeci
[5] https://carbon-ratings.com/dl/whitepaper-pos-methods-2023.

Proof of Storage / Proof of Spacetime / …

For networks that apply Proof of Storage or similar consensus mechanisms, the electricity consumption calculation becomes two-fold: As these networks also rely on regular P2P messaging between full nodes to process transactions and blocks, this part of the network should be assessed with the identical approach as PoS networks are assessed. In addition, the storage component of the network needs to be assessed, such that computational efforts related to storing and retrieving data are properly considered. To our knowledge, there is no universal approach, as systems and structures differ widely, but research for specific blockchain networks is available.[6]

Tokens

To calculate the total energy consumption of a token that exists on a blockchain, one needs to first understand the energy consumption of the underlying network (see previous section). Once this data is readily available, one can allocate the total energy consumption to an individual token. CCRI uses the well-established hybrid allocation framework[7] developed together with South Pole and under the consultation of PayPal to properly calculate the electricity consumption of the token. A detailed description of this approach can be found in the description of Indicator 3.

Layer 2 networks

Layer 2 networks employ their own consensus mechanisms in addition to being responsible for the activity on the base chain that provides additional security guarantees. For estimating the electricity consumption of layer 2 networks, we combine the PoS approach (for the own network) with the token approach (for the base layer network) and add them up for total electricity consumption.

Indicator 2 – Non-renewable energy consumption

> "Share of energy used generated from non-renewable sources, expressed as a percentage of the total amount of energy used per calendar year, for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions"
> *- ESMA, Consultation Package 2, Annex II, Table 1*

The calculation of the share of non-renewable energy consumption is not dependent on the type of blockchain or consensus mechanism but directly builds on the energy consumption (Indicator 1). Therefore, the same approach fits all different blockchain consensus mechanisms.

The central data point required for the calculation of Indicator 2 is the location and the share of the respective entities that consume electricity. Determining location information is dependent on the network type (and is required for other indicators as well), so we provide a summary of the most-used methodologies to generate location information by network type:

- **PoW networks:** It is not trivial to generate location information for PoW networks, given their secretive nature. Electricity consumption and price are core to the business of any miner and therefore sharing any information might benefit competitors. Therefore, miners often do not

[6] See here: https://github.com/redransil/filecoin-energy-estimation/blob/main/methodology/filecoin-electricity-methodology-paper.pdf.
[7] https://carbon-ratings.com/accounting-framework-2022

proactively share their location, and also obtaining other data that can be used for triangulation (e.g., IP addresses) is difficult, as blocks are propagated through mining pools, so directly connecting and observing miners is rarely possible. Some pools periodically publish aggregated data[8], and Cambridge University publishes its joint work with mining pools in their Bitcoin mining map.[9] Data for other PoW networks are more difficult to obtain, but as they follow very similar incentive structures as Bitcoin and are often mined by the same mining companies, Bitcoin's location data can be used as a proxy for them.

- **Other networks:** For other networks, including Proof of Stake, Proof of Authority, or Byzantine-style consensus mechanisms, location data is often easier to obtain than in PoW networks. Block explorers, specific companies working on identifying locations[10], or other data sources are readily available to be used for geo-footprinting. Sometimes, only locations of full nodes are available, which can be leveraged as a proxy only for the validating nodes.

Indicator 3 – Energy intensity

> "Average amount of energy used, in kWh, per validated transaction"
> *- ESMA, Consultation Package 2, Annex II, Table 1*

The MiCA regulation differentiates between the energy consumption for securing the integrity of the ledger and the energy consumption for validating transactions, as seen in Indicator 1. This distinction is important, as it highlights the need for a methodology to assess the energy consumption of a single transaction not merely by dividing the total consumption by the number of transactions, as this would indicate that the entire energy consumption is attributable to transactions.

For energy allocation, we define two types of activities in blockchain networks, namely transactions (either in the form of transaction count, transaction fees or gas consumption) and holdings (either in the form of the base unit or its monetary value in USD). Overall, there are three ways to allocate electricity consumption to these activities:

- **Holding-based approach**: The holding-based approach mandates us to calculate the electricity consumption per held unit. Therefore, we divide the total electricity consumption of the network by the total supply of the network, resulting in a value of electricity consumption per unit. The timeframe is defined by the timeframe of the electricity consumption, e.g., a day or a year. This approach does not consider transactions to be a driver of electricity consumption. Holding currencies can, especially in the case of PoW networks, be the main driver of electricity consumption: Holders are the entities that pay the mining reward in PoW networks, as the inflation of the currency is paid as a reward to the miners and impact all holders of the currency equally. That indirect payment allows the miners to continue their business and spend their rewards (partially) on electricity. The holding-based approach can be used in times of low or no transaction fees for miners and highlights the importance and cost of securing the ledger in contrast to the execution of transactions.

- **Transaction-based approach**: The transaction-based approach follows the simple approach, as previously described, to divide the total electricity consumption by the number of transactions that occurred during the same period of time. While this metric is easy to calculate, it is often

[8] E.g., Foundry: https://medium.com/foundry-digital/foundry-usa-pool-hashrate-by-state-f9dc92e7bc3b
[9] https://ccaf.io/cbnsi/cbeci/mining_map.
[10] For example, MigaLabs provides a detailed overview of full nodes and validator nodes in the Ethereum network. See https://monitoreth.io/nodes.

misleading, as calculating this metric does not consider the nuances of the network, e.g., as Proof of Work does not only secure the execution of the current transactions, but also protects the integrity of the "non-moving" coins. Other networks that provide file storage would also need to distribute storage-related energy use to transactions without any logical connection whatsoever.

- **Hybrid approach**: The hybrid approach is a methodology developed by South Pole together with CCRI and under the consultation of PayPal[11] and has been further developed since then to cater to new developments and insights in the crypto market, such as layer 2 networks or further consensus mechanisms.[12] The basic idea is to distribute the total electricity consumption between all activities in the network, both holdings and transactions. The respective shares can then be divided by the total amounts of the activities (such as total supply or transaction throughput), resulting in and creating individual metrics for each of the activities.

We recommend using the hybrid approach, as a) it is in line with the MiCA regulation and b) provides fair and comparable metrics between different cryptocurrencies. The core of the hybrid approach is the split-up of the total electricity consumption, and there are, depending on the Consensus Mechanism, different ways to define these shares, depending on the drivers of electricity consumption.

- In **PoW networks**, the main driver of electricity consumption is the monetary incentive of the miner. Miners receive transaction fees and a block subsidy. From a logical point of view, we are able to allocate transaction fees to entities that transact, and block subsidy to the entities that hold. Entities that hold do provide an incentive to the miners, as their monetary holdings get devalued due to inflation by creating new coins. Therefore, the share between transaction fees and block subsidy can be used as a driver for the hybrid allocation.

- In **PoS networks**, transaction fees do not incentivize the validators to spend money on electricity. Instead, transactions are rather a small part of the total electricity consumption of the nodes, as the regular maintenance of the ledger consumes electricity regardless of the transaction throughput. Therefore, we recommend using the marginal electricity consumption per transaction, which we calculated for Indicator 1, as a driver to discern between transactions and holdings, attributing the marginal electricity consumption to transactions and the remainder to the holders.

- In **other networks**, the drivers highly depend on the available activities and their impact on the electricity consumption. An intelligent approach understands all the activities in the networks besides pure holding and transaction execution and finds drivers to separate the total electricity consumption of the network to the respective activities. If a total electricity consumption methodology considers certain elements of the network to be energy intensive, e.g., storing data in a Proof of Storage network, these elements can be considered as activities and respective shares can be calculated. Depending on the specific case, the drivers for transactions can be calculated using the same methodology as for PoS networks.

[11] https://carbon-ratings.com/accounting-framework-2022.
[12] https://arxiv.org/abs/2111.06477.

b. GHG emissions

To derive the GHG emissions for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions, two components are required: (1) the energy consumption and (2) the emission intensity of the energy consumed. The first component has been derived in the previous section and now serves as a direct input for this section. The second component needs to be collected in accordance with established carbon accounting as we outline in the following subsections.

Indicator 4 – Scope 1- Controlled

> "Scope 1 GHG emissions, expressed in tonnes (t) carbon dioxide equivalent (CO2e) per calendar year for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions"
> *- ESMA, Consultation Package 2, Annex II, Table 1*

For the fourth indicator, ESMA asks for scope 1 GHG emissions for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions. The distinction between the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions is analogous to the previous section on energy. However, special attention needs to be paid to the different scopes of the emissions.

The distinction of the emission in different scopes has been introduced by the GHG Protocol which provides guides for carbon accounting at the corporate level.[13] Scope 1 is defined as direct GHG emissions from sources that are owned or controlled by the company. As a crypto-asset is not a company, the distinction in emission scopes may seem somehow misleading in this context. We would argue that a reasonable interpretation would be to think of the GHG emissions that are owned or controlled by the ones who validate transactions and maintain the integrity of the distributed ledger transactions (i.e., miners/validators). As the GHG emissions for the validation of transactions and the maintenance of the integrity of the distributed ledger occur during the production of the electricity that is consumed, the GHG emissions would only be owned or controlled by the miners or validators in case they are producing the electricity themselves. Large mining companies that need vast amounts of energy could run their own power plants. However, this does not belong to the main business areas of miners or validators and hence we would argue that it should be assumed that miners and validators are purchasing the electricity they use (which represents scope 2 – see indicator 5), unless there is clear evidence that a power plant is owned or controlled by the miner or validator itself. The associated emissions would then be calculated by taking the electricity consumed by the owned or controlled power plant and multiplying it by the emission intensity of the respective plant (i.e., largely driven by the type of power plant, for example solar PV vs. wind. vs. gas). As the MiCA regulation foresees sustainability disclosures on the level of a crypto-asset and not on company level, any information on potentially independently operated or controlled power plants must be taken from public reports from miners/validators and might be therefore difficult to gather and/or verify.

[13] https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf.

Indicator 5 – Scope 2- Purchased

> “Scope 2 GHG emissions, expressed in tCO2e per calendar year for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions”
> *- ESMA, Consultation Package 2, Annex II, Table 1*

For the fifth indicator, ESMA asks for scope 2 GHG emissions for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions. Also in this case, the distinction between the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions is analogous to the previous section on energy. Scope 2 is defined as indirect GHG emissions from emissions from the generation of acquired and consumed electricity.[14] In line with indicator 4, we would argue that a reasonable interpretation would be to think of the indirect GHG emissions of the acquired and consumed electricity of miners and validators. Similar to most other industries, we would argue that the majority of the miners and validators purchase the electricity they consume rather than producing it themselves, resulting in higher scope 2 emissions compared to scope 1 emissions for most crypto-assets. The GHG Protocol presents two complementary methods to report scope 2 emissions:

- **Location-based method:** It reflects the average emissions intensity of grids on which energy consumption occurs (using mostly grid-average emission factor data). Therefore, the method requires the amount of electricity consumed at each location (see indicator 2 for an overview) as well as the respective grid-average emission factors which are often published by state authorities (e.g., by the United States Environmental Protection Agency for U.S. states).
- **Market-based method:** It reflects emissions from the electricity that companies have purposefully chosen (or their lack of choice). It derives emission factors from contractual instruments, which include any type of contract between two parties for the sale and purchase of energy bundled with attributes about the energy generation, or for unbundled attribute claims. As such, the market-based method does not only require information on the contractual instrument used (as well as associated credible claims) but also emission factors representing the untracked or unclaimed energy and emissions (termed the “residual mix”) for the share of electricity for which there is no contractual information that meets the Scope 2 Quality Criteria.

The GHG Protocol requires both methods to be reported separately if one decides to start calculating scope 2 emissions with the market-based method (termed “dual reporting”). As the market-based method was introduced as a complementation to the location-based method, we would recommend to initially focusing on the location-based method and extending to the market-based method as data availability improves. However, the location-based method needs to be continuously used also if market-based accounting is conducted in order to satisfy the dual reporting principle of the GHG Protocol.

[14] https://ghgprotocol.org/sites/default/files/2023-03/Scope%202%20Guidance.pdf.

Indicator 6 – GHG intensity

> "Average GHG emissions (scope 1 and scope 2) per validated transaction, expressed in kilogram (kg) CO2e per transaction (Tx)"
> - *ESMA, Consultation Package 2, Annex II, Table 1*

For the sixth indicator, ESMA asks for the average GHG emissions (scope 1 and scope 2) per validated transaction. This metric can be derived in the same way as described for the average energy consumption per validated transaction required for Indicator 3. In case market-based accounting was conducted in addition to location-based accounting for Indicator 5, two metrics should be provided for Indicator 6.

c. Waste production

Similar to the energy-related indicators, the first waste production-related indicator captures the total amount of electrical and electronic equipment waste for the validation of transactions and the maintenance of the integrity of the distributed ledger. Indicator 8 then quantifies the non-recycled share, and Indicator 9 the hazardous waste fraction. Further details are provided below for each of the indicators.

Indicator 7 – Generation of waste electrical and electronic equipment (WEEE)

> "Total amount of WEEE generated for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions, expressed in tonnes per calendar year"
> - *ESMA, Consultation Package 2, Annex II, Table 1*

For the seventh indicator, ESMA asks for the total generation of waste electrical and electronic equipment. The generation of electronic waste is dependent on the hardware usage of the network and how fast devices are replaced – either because of hardware depreciation, performance issues, or implications on the revenue. Depending on the specifics of the hardware replacement, the calculation of the total electronic waste can be conducted in two consecutive steps:

1. **Understand the hardware composition and weight of devices**: The first indicator calculates the total electricity consumption of the respective network; to do so, some assumptions on the hardware composition are to be made, both on device type and distribution between devices. This hardware composition, whether in PoW with the number of ASIC devices or in PoS with the number of validators, provides a solid basis for the calculation of the number of total devices in the network. In any case, hardware weights need to be collected. This collection can be, depending on the hardware device, more or less complex. If specific assumptions are made about the hardware (e.g., a reference set of hardware), it is recommended to uphold respective assumptions and use the same hardware for the waste calculation.
2. **Define the depreciation time frame**: If we know the hardware composition for a given day in the network, we are able to calculate the WEEE generated on that day with a given depreciation time frame.[15] As previously mentioned, deciding on the time frame can be complex and research in the regard of depreciation is sparse.[16]

For depreciation time frames, a recommendation should consider the following aspects:

- **Industry benchmarking to ensure comparability**: What are other players with similar properties assuming in the space? For example, as Cambridge University assumes 5 years for

[15] Example: If a hardware device is deprecated over 5 years, then the generated WEEE of devices is calculated by the devices' weight divided by the total days the devices are in use (5 years = 1,825 days).
[16] Cambridge uses a time frame of 5 years for PoW. Operators of data centers usually replace their hardware once service levels are no longer valid, which is, in case of enterprise hardware, often after 3 years. Anecdotal evidence from interviews with validators within various networks suggests replacement rates between 2 years and +5 years.

PoW devices, it would be a valid approach to assume a similar time range for other PoW-based networks.

- **Hardware usage**: If the network under assessment requires specific properties of the hardware, such as profitability or high throughput, it makes sense to understand how long an average device properly works under given conditions. In a PoW network, it might make sense to look at average profitability thresholds. In a Proof of Storage network, it might make sense to look at Total Bytes Written (TBW) of typical disks used in the network and the average write-access of that network per day. This data can give an indication of how long these devices will last in the network and can be used as an approximation for the depreciation time frame.
- **Consider interplay with the electricity consumption:** The electricity consumption of the network often depends on the age of the hardware in use, as older devices are usually less energy efficient than newer devices. Therefore, it is of importance, to align the waste calculation with the calculation of the electricity consumption, such that the overall picture remains consistent. A high production of WEEE should materialize in a lower electricity consumption (i.e., indicator 1) and vice-versa.

As one aligns on the hardware composition and the depreciation timeline, WEEE generation can be calculated.

Indicator 8 – Non-recycled WEEE ratio

> "Share of the total amount of WEEE generated for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions, not recycled per calendar year, expressed as a percentage."
> *- ESMA, Consultation Package 2, Annex II, Table 1*

For the eighth indicator, ESMA asks for the share of non-recycled WEEE. To calculate this metric, one needs to consider the location of miners and validators (see indicator 2 for an overview) as well as the local recycling rates for WEEE at the respective locations. Similarly, to energy sources and emission factors by country or region, local recycling rates can be obtained from state authorities or research institutions specialized in the field (e.g., United Nations Institute for Training and Research (UNITAR), UNU-ViE Sustainable Cycles (SCYCLE), The International Telecommunication Union (ITU) jointly publishes reports monitoring e-waste production and recycling).

Indicator 9 – Generation of hazardous waste

> "Total amount of hazardous waste generated for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions, expressed in tonnes per calendar year"
> *- ESMA, Consultation Package 2, Annex II, Table 1*

For the ninth indicator, ESMA asks for the hazardous waste generated by the network. As we calculated the waste component of the network already in indicator 7, we are able to build upon that figure and calculate the hazardous waste as a share of the total electronic waste and provide a respective value expressed in tonnes per calendar year.

Hazardous waste is a term that is linked to European Union Guidelines “Waste Electrical and Electronic Equipment Directive (WEEE Directive)” (2012/19/EU) and Restriction of Hazardous Substances Directive (2011/65/EU, RoHS 2) which properly defines contents of electronic devices as hazardous substances, such as lead, mercury, cadmium, and others.

The calculation of the share of the hazardous substances is merely a question of proper data sources and diligence. Ideally, for every device considered in the hardware composition described in Indicator 7, one obtains a “Restriction of Hazardous Substances Directive Report” (RoHS Report), which needs to be published by respective vendors.[17] The contents of these documents need to be summed up for each device. With that information and the hardware depreciation, one is able to calculate the total hazardous waste generated by the network. If the ROHS Report is not available for every type of device in the network, similar device types for which the report is available can be used as a proxy.

[17] For example, Intel produces such reports, e.g., for Intel NUCs: https://cdrdv2-public.intel.com/728760/xnuc11atkc4000x%20%20Declaration%20Form%20Build%20-%2068241.pdf.

d. Natural resources

The last category aims to capture lifecycle impacts on natural resources beyond the aspects captured by the previous indicators. For the tenth indicator, ESMA asks for a description of the impact on natural resources of the production, the use and the disposal of the devices of the DLT network nodes. While ESMA asks for very concrete metrics for the other indicators by defining exact time periods and units, this indicator is only loosely defined as of now. Thus, there is reason to assume that this indicator may be more closely defined as ESMA publishes its final requirements for mandatory indicators (expected by the end of June 2024).

Indicator 10 – Impact of the use of equipment on natural resources

> "Description of the impact on natural resources of the production, the use and the disposal of the devices of the DLT network nodes"
> *- ESMA, Consultation Package 2, Annex II, Table 1*

For the tenth indicator, we provide a description of the general impact of the devices of DLT network nodes on natural resources, such as water, fossil fuels, and critical raw materials during the production, use, and disposal phase. Particularly, water consumption during the use phase has already been discussed in the context of Bitcoin. Water consumption is heavily driven by the amount of energy consumed by the network as well as the regional water intensity of the electricity consumption. Thus, the energy consumption, the location of validators as well as regional electricity water footprint may serve as an input to assess the water consumption of a crypto-asset during the use phase following the approach which is taken by research papers investigating the water consumption of Bitcoin.[18]

[18] de Vries, Alex. "Bitcoin's growing water footprint." Cell Reports Sustainability 1.1 (2024).