I.00: Table of content

I.01: Date of notification

2024-06-29

I.02: Statement in accordance with Article 51(3) of Regulation (EU) 2023/1114

This crypto-asset white paper has not been approved by any competent authority in any Member State of the European Union. The issuer of the crypto-asset is solely responsible for the content of this crypto-asset white paper.

I.03: Compliance statement in accordance with Article 51(5) of Regulation (EU) 2023/1114

This crypto-asset white paper complies with Title IV of Regulation (EU) 2023/1114 and to the best of the knowledge of the management body, the information presented in the crypto-asset white paper is fair, clear and not misleading and the crypto-asset white paper makes no omission likely to affect its import.

I.04: Warning in accordance with Article 51(4), points (a) and (b) of Regulation (EU) 2023/1114

This e-money token is not covered by the investor compensation schemes under Directive 97/9/EC. This e-money token is not covered by the deposit guarantee schemes under Directive 2014/49/EU.

Summary	
I.05: Warning in accordance with Article 51(6), second subparagraph of Regulation (EU) 2023/1114s	The summary should be read as an introduction to the crypto-asset white paper.

The prospective holder should base any decision to purchase the asset-refenced token on the content of the crypto-asset white paper as a whole and not on the summary alone.

The offer to the public of the crypto-asset does not constitute an offer or solicitation to purchase financial instruments and that any such offer or solicitation can be made only by means of a prospectus or other offer documents pursuant to the applicable national law.

The crypto-asset white paper does not constitute a prospectus as referred to in Regulation (EU) 2017/1129 of the |

	European Parliament and of the Council (36) or any other offer document pursuant to Union or national law.
I.06: Characteristics of the crypto-asset	eUSD is a stablecoin fully backed by the United States Dollar (USD) that is issued by Membrane Finance Oy, supervised by the Finnish Financial Supervisory Authority. Classified as electronic money and an e-money token, eUSD is crypto-asset that is designed to maintain a stable value equivalent USD. This stability is achieved through a pegging mechanism where each eUSD token is fully backed by equivalent reserves of USD. These reserves are duly managed under an extensive regulatory framework, which ensures that holders of eUSD tokens can redeem their eUSD for USD at a 1:1 ratio at any time without incurring fees.

eUSD is a new EMT that has just recently been issued for the first time on Ethereum using the ERC-20 standard. However, as Membrane Finance Oy is the issuer of a technologically similar EMT with the name of eUSD, that references the value of the USD Dollar, Membrane Finance Oy will begin implementing most, if not all, of the tried-and-tested functionalities and operating platforms of eUSD onto eUSD as well. While the exact time period for this endeavour is yet unknown, this white paper shall be updated accordingly. The following characteristics of eUSD represent the possible development possibilities for eUSD in the future:

"eUSD operates on multiple blockchain platforms, including Ethereum, while leveraging their security and efficiency features.

On Ethereum, eUSD is implemented using the ERC-20 standard, with equivalent standards used on other blockchains, ensuring broad compatibility with various wallets and exchanges. This structure facilitates seamless transactions between on-chain and off-chain environments, providing users with a reliable and stable digital representation of the USD Dollar, which can be used for various financial applications." |
| I.07: Right of redemption | The holders of the e-money token have a right of redemption at any time and at par value.

Holders of eUSD have the right to redeem their tokens at par value, meaning that each eUSD token can always be redeemed for one USD. Holders of eUSD may exercise this right of redemption at any point in time, without any requirements of existing contractual relationships with Membrane Finance Oy prior to redemption. While there is no minimum threshold for redemption, Membrane Finance Oy may review and subsequently prohibit multiple successive redemption requests if they serve no justifiable reason, or where such successive redemptions are clearly used to disrupt Membrane Finance Oy's services or otherwise negatively influence the usage or availability of any e-money token that Membrane Finance Oy issues. Membrane Finance Oy shall always conduct this kind of assessment in good faith, and will additionally provide a fair explanation on the reason of prohibiting successive redemptions to the person that has been prohibited from doing so.

To initiate a redemption, holders need to either have an account with Membrane Finance Oy or, if applicable, fill and submit the "EMT Redemption" -form found on Membrane Finance Oy's website at https://www.membrane.fi. Redemption requests can only be submitted through these designated platforms provided by Membrane Finance Oy, and |

	are either processed within five (5) business days, or if not the person who initiated the redemption shall be notified of any delays and their respective reason(s).
	There will not be any fees associated with the redemption of eUSD under typical day-to-day circumstances, as is required by the Markets in Crypto-Assets Regulation, (EU) 2023/1114 (MiCA) of the European Union, under which eUSD is regulated. However, in the highly exceptional, although still possible, event that Membrane Finance Oy faces critical financial stressors — such as the risk of bankruptcy, insolvency, or loss of regulatory authorization — redemption fees may be have to be enforced as a part of the obligatory Recovery Plan of eUSD, which is also required by MiCA. The purpose of a recovery plan is to ensure that the issuer of an e-money token, such as eUSD, remains compliant with applicable legislation and upholds the required level of financial stability and liquidity. Membrane Finance Oy's strong commitment to regulatory excellence should make the need for implementing recovery measures that would result in levying redemption fees extremely rare and unlikely, in part due to the fact that redemption fees should not be the first method implemented during these kinds of stress-events.
	All redemption requests are subject to compliance reviews, which are used to ensure regulatory adherence, ensuring that the redemption process is secure and compliant with all relevant legislation and other regulatory obligations Membrane Finance Oy is subject to.
	Redemptions must be done directly through Membrane Finance Oy, although some authorized and stringently reviewed third parties may be used to facilitate the process. The right of redemption, including its conditions and processes, shall be clearly stated in the terms and conditions found within the aforementioned website. Any modifications to these rights will be communicated to all holders of eUSD who have an account with Membrane Finance Oy at least 30 days prior to their implementation. On the same date, these modifications shall be published on Membrane Finance Oy's website, with the aim of providing full transparency and empowering all holders — even those without an account — with the ability of responding to any of the changes.
	This structure has been designed with the aim of guaranteeing that holders can always confidently convert their eUSD's back into traditional USD at any point in time without being subjected to any fees in the process.
I.08: Key information about the offer and or admission to trading	eUSD is an e-money token (EMT) that is issued by Membrane Finance Oy. Due to Article 3(1)(12) of MiCA, whenever a natural or legal person, other undertaking, or the issuer of an EMT presents, in any form and by any means, relevant information that results in a prospective holder being enabled to make a decision on whether or not to purchase an EMT that such information refers to, the EMT in question shall be considered as offered to the public. Practically this should mean that every time someone provides the ability to purchase eUSD, be it via issuing a brand new eUSD, or "selling" or otherwise offering transacting it in exchange for other tangible or non-tangible assets, that person is offering eUSD to the public. Membrane Finance Oy, as the issuer of eUSD, is thus always offering eUSD to the public.
	There is no cap on the total amount of eUSD to be offered to the public, which assures flexibility in availability. The issue

price of eUSD shall always remain at a 1:1 ratio with the USD, meaning that each eUSD token is priced at its par value, which is one USD. Membrane Finance Oy may levy fees for the issuance of eUSD, which would be clearly outlined and communicated to users during the acquisition process. However, the redemption of eUSD is completely free of any charges, as was specified above.

Membrane Finance Oy has set no specific minimum or maximum subscription targets so that prospective users may acquire eUSD in any amount they desire. eUSD is fully backed by USD reserves held in regulated financial institutions, providing robust financial security and stability.

eUSD's admission to trading cannot yet be sought on any specific platform, because an admission to trading can only be sought within crypto-asset service providers (CASPs), which are not regulated by MiCA at all prior to the date of 30.6.2024. Once the provisions within MiCA relating to CASPs become applicable, Membrane Finance Oy and/or other authorized parties may seek the admission to trading of eUSD within these CASPs.

Currently, no third parties are authorized to offer eUSD to the public. However, all persons authorized to offer eUSD to the public in the future, as well as any changes authorized persons or future admissions to trading of eUSD, shall be communicated to the public and all relevant stakeholders once confirmed, which shall be done by sending an e-mail to all persons who have an account with Membrane Finance Oy and by simultaneously publishing all changes relating to this subject matter on Membrane Finance Oy's website, specifically at https://www.membrane.fi/offerors. Whenever deemed necessary, this white paper will be updated to reflect any relevant developments.

Before purchasing eUSD from any source, Membrane Finance Oy strongly encourages that all prospective holders of eUSD visit https://www.membrane.fi/offerors in order to confirm that the person offering eUSD has been duly authorized and thus can be endorsed by Membrane Finance Oy. If eUSD is acquired from non-authorized sources, Membrane Finance Oy will not be able to guarantee the legitimacy or reliability of such sources in any way, shape or form.

While currently eUSD is only available on Ethereum, Membrane Finance Oy is intending to extend its operability on multiple blockchain platforms in the future, so that wide compatibility and accessibility for varying styles of users can be established. Additionally, this multi-platform approach will increase eUSD's potential use-cases and enable the facilitation seamless transactions across different blockchain ecosystems.

The comprehensive structure, where eUSD may be offered to the public by some trustworthy and duly authorized persons alongside Membrane Finance oy, will be established so that eUSD is always maximally available to all prospective users, while becoming a reliable and versatile digital representation of the USD, that can be used for various financial applications.

Part A – Information about the issuer of the e-money token	
A.1: Name	Membrane Finance Oy

A.2: Legal form	Limited Liability Company, ELF: DKUW (Osakeyhtiö)
A.3: Registered address	Meritullinkatu 1B, 00170 Helsinki, Finland
A.4: Head office	Meritullinkatu 1B, 00170 Helsinki, Finland
A.5: Registration Date	2021-10-18
A.6: Legal entity identifier	743700KYSSTKZYGEUF50
A.7: Other identifier required pursuant to applicable national law	3236886-2
A.8: Contact telephone number	+358 10 348 7210
A.9: E-mail address	info@membrane.fi
A.10: Response Time (Days)	5
A.11: Management	The management body of Membrane Finance Oy consists of the following individuals: Teemu Päivinen, Chair of the Board of Directors; Meritullinkatu 1B, 00170, Helsinki, Finland Laura Lehtinen, Member of the Board of Directors; Meritullinkatu 1B, 00170, Helsinki, Finland Juha Viitala, Member of the Board of Directors and Managing Director; Meritullinkatu 1B, 00170, Helsinki, Finland Otto Wirkkala, Member of the Board of Directors and Chief Financial Officer; Meritullinkatu 1B, 00170, Helsinki, Finland Max Atallah, Chief Compliance Officer; Erottajankatu 1-3 A 1, 00130 Helsinki Otto Sulin, Chief Strategy Officer; Meritullinkatu 1B, 00170, Helsinki, Finland Jimi Lehtonen, Head of Finance Partnerships; Meritullinkatu 1B, 00170, Helsinki, Finland Juuso Roinevirta, Head of Product Growth; Meritullinkatu 1B, 00170, Helsinki, Finland Patrick Aarikka, Compliance Officer; Meritullinkatu 1B, 00170, Helsinki, Finland
A.12: Business Activity	Membrane Finance Oy, the issuing company of eUSD, is focused on developing and providing secure, efficient, and compliant digital financial solutions primarily related to e-money tokens (EMTs). Therefore, the company's primary business revolves around the issuance and management of these e-money tokens, which are always fully backed by equivalent reserves in the currency of the face-value of the specific EMT. Membrane Finance Oy operates under the regulatory oversight of the Finnish Financial Supervisory Authority, ensuring adherence to stringent financial regulations and industry standards. In addition to issuing e-money tokens, the company may offer a range of related services. The principal markets where Membrane Finance Oy operates include the European Union and other jurisdictions with robust regulatory frameworks for crypto-assets and other digital assets. The company's primary revenue-generating activities are derived from the issuance of EMTs and the subsequent interest generated by the asset-reserves backing these issued EMTs. While the company's success is currently particularly dependent on the adoption and utilization of eUSD, all other

	EMTs, including eUSD, and/or crypto-assets Membrane Finance Oy issues/may issue in the future will always be of great importance to Membrane Finance Oy. Key customers of Membrane Finance Oy include financial institutions, entities operating with crypto-assets and/or other digital/virtual assets, businesses seeking blockchain integration, as well as individual users adopting crypto-assets or digital currencies for their daily transactions. By leveraging advanced blockchain technology and robust security measures, Membrane Finance Oy aims to position itself as a leader in the digital finance sector by being committed to innovation, transparency, and regulatory compliance. This comprehensive approach ensures that Membrane Finance Oy remains a reliable partner in the evolving landscape of digital finance.
A.13: Parent Company Business Activity	Stability Holding Oy functions primarily as a parent company for Membrane Finance Oy. Stability Holding Oy's main business activity is to provide financial support and investment to Membrane Finance Oy, aligning with collective strategic goals. The aim is to facilitate the growth and development of Membrane Finance Oy by ensuring it has adequate financial resources to meet operational and regulatory requirements. Potential future returns from Membrane Finance Oy's activities are Stability Holding Oy's primary revenue-generating activities. By providing equity funding and strategic financial support, Stability Holding Oy ensures that Membrane Finance Oy's operations and strategic objectives are adequately supported. In summary, the primary business activity of Stability Holding Oy revolves around the financial management of and investment in Membrane Finance Oy, supporting its strategic objectives and ensuring it has the necessary capital to operate and grow.
A.14: Parent Company	Stability Holding Oy does not currently have, nor does it need to have, a LEI number under Finnish law.
A.15: Conflicts of Interest Disclosure	Membrane Finance Oy, the issuer of eUSD, is committed to maintaining transparency and integrity in its operations. However, potential conflicts of interest may arise in certain situations. One potential conflict of interest could occur if Membrane Finance Oy engages in transactions or business activities with entities in which its executives or board members have a financial interest. Another potential conflict could arise from the company's dual role as both the issuer of eUSD and the provider of related financial services, such as digital wallets and blockchain integration, which could influence the prioritization of some services over others. Furthermore, Membrane Finance Oy issues another electronic money token, eUSD, which could lead to conflicts of interest in terms of resource allocation, marketing efforts, and strategic focus between the two tokens. Therefore, the company must carefully manage and balance its commitments to both eUSD and eUSD so that the interests of the holders of each token are fairly represented. Additionally, these risks could be further exacerbated by the issuance of other e-money tokens in the future. While the listing of eUSD may be sought on various independent trading platforms in the future to enhance

liquidity and accessibility, Membrane Finance Oy does no control any trading platforms.

Regarding the reserve assets backing eUSD, Membrane Finance Oy does not lend out these assets and maintains strict control over their management. The reserves are held secure, regulated financial institutions, and their investment policy is conservative, ensuring the stability and liquidity of e-money tokens issued by Membrane Finance Oy currently and in the future.

All decisions relating to the operations of eUSD are solely and independently made by Membrane Finance Oy, ensuring that these processes are conducted efficiently and transparently. Neither Membrane Finance Oy, nor any of its affiliates, engage in commercial trading activities related to any e-money tokens issued by Membrane Finance Oy, thereby minimizing any potential conflicts of interest in this area.

Membrane Finance Oy maintains close relations with several businesses and has some partnerships that might influence the operations of eUSD. If these relationships were to have a direct effect on Membrane Finance Oy's activities relating to the crypto-assets it issues, these effects would be identified, disclosed and managed transparently, specifically in accordance with MiCA and all other relevant legislation, so that any undue influence on operations can be avoided. Additionally, Membrane Finance Oy has policies in place to prevent insider trading, which ensure that any principals or employees do not trade based on non-public information related to eUSD, eUSD or any crypto-asset issued by Membrane Finance Oy.

Incentive programs and business arrangements with third-party service providers are always designed to align with the interests of eUSD holders. Any potential conflicts arising from these arrangements shall be disclosed and managed according to Membrane Finance Oy's Conflict of Interest Policy. This Policy includes regular monitoring, disclosure requirements, and procedures that all are aimed at guaranteeing that all business decisions will be made in the best interest of Membrane Finance Oy's stakeholders and everyone who holds any tokens issued by Membrane Finance Oy.

By addressing these areas, Membrane Finance Oy aims to maintain trust and confidence among its users and partners, ensuring ethical business practices and regulatory compliance.

A.16: Issuance of other crypto-assets	Yes
A.17: Activities related to other crypto-assets	Yes
A.18: Connection between the issuer and the entity running the DLT	N/A
A.19: Description of the connection between the issuer and the entity running the DLT	N/A
A.20: Newly Established	N/A
A.21: Financial condition for the past three years	N/A
A.22: Financial condition since registration	Membrane Finance Oy has always governed a strong and regulatory compliant reserve, and all e-money tokens issued by Membrane Finance Oy are always fully backed by equivalent reserves that are held in regulated financial institutions. These reserves are segregated from Membrane Finance Oy's own funds in order to safeguard the assets

belonging to holders of such electronic money tokens, even if Membrane Finance Oy were to become insolvent in any shape, way or form, in the future.

Financial Metrics and Historical Data:

Membrane Finance Oy has maintained healthy capital reserves, which have ensured robust backing for eUSD, and should continue the same for eUSD. Even though Membrane Finance Oy as a company is still in its early stages and inevitably does not currently have a strong positive profit margin, expenses related to operations and regulatory compliance have always been managed effectively, indicating that Membrane Finance Oy should be capable of continued operations even prior to the significant revenue streams that have been prepared during these early stages. Specific revenue figures and profit margins are detailed in the company's annual financial statements, which have been duly reported to all competent authorities without any issues.

Causes of Material Changes:

Significant increases in revenue can be envisioned in the future due to the growing adoption of e-money tokens issued by Membrane Finance Oy, and the expansion of customer bases. On the expense side, the relative costs of development and regulatory compliance have stabilized from initial amounts, leading to improved operational conditions.

Non-Financial KPIs:

Key non-financial performance indicators include user growth and transaction volumes. Membrane Finance Oy has seen an increase in the number of eUSD users, along with a corresponding rise in transaction volumes, reflecting the increasing utilization of eUSD, which could be a promising indicator for eUSD as well.

Cash Flows and Capital Resources:

Membrane Finance Oy has an adequate liquidity position, with sufficient short-term and long-term capital resources to support its operations and growth initiatives. The primary sources of capital include equity investments and retained earnings, which provide a solid foundation for future expansion.

Financial Statements:

The financial statements for the past fiscal years provide a detailed account of Membrane Finance Oy's financial performance. These financial statements have been duly notified to all competent authorities. Notably, there have been no unusual or infrequent events materially affecting Membrane Finance Oy's operations.

Membrane Finance Oy's commitment to transparency, regulatory compliance, and sound financial practices has positioned it well in the competitive landscape of services related to digital finance, and more specifically to e-money tokens. As Membrane Finance Oy continues to innovate and expand its offerings, it remains focused on maintaining its financial health and delivering value to its stakeholders.

A.23: Exemption from authorisation	N/A

A.24: Asset Token Authorisation	Membrane Finance Oy is an electronic money institution supervised by the Finnish Financial Supervisory Authority and authorized across the EU and EEA. Business ID FI32368862, LEI code 743700KYSSTKZYGEUF50.
A.25: Authorisation Authority	Finnish Financial Supervisory Authority (Fin-FSA)
A.26: Persons other than the issuer offering to the public or seeking admission to trading of the e-money token according to Article 51(1), second subparagraph, of Regulation (EU) 2023/1114	eUSD may be offered to the public by certain trustworthy carefully selected third parties that additionally have received a written consent from Membrane Finance Oy to act as offerors of eUSD, and possibly any other EMTs issued by Membrane Finance Oy as well. Currently, no third parties are authorized to offer eUSD to the public, although this situation may be subject to changes. An up-to-date list of all persons that have been authorized to offer all or some e-money tokens issued by Membrane Finance Oy can be found from Membrane Finance Oy's website, specifically at https://www.membrane.fi/offerors. Before purchasing eUSD from any source, Membrane Finance Oy strongly encourages that all prospective holders of eUSD visit the aforementioned website-address in order to confirm that the person offering eUSD has been duly authorized and thus can be endorsed by Membrane Finance Oy. If eUSD is acquired from non-authorized sources, Membrane Finance Oy will not be able to guarantee the legitimacy or reliability of such sources in any way, shape or form.
A.27: Reason for offering to the public or seeking admission to trading of the e-money token by persons referred to in Article 51(1), second subparagraph, of Regulation (EU) 2023/1114	By allowing some trusted third parties to offer eUSD to the public, Membrane Finance Oy would have access for distributing eUSD on various platforms, with the intention of increasing liquidity and accessibility, subsequently making it easier for users to buy, sell, and trade eUSD within regulated and secure environments. Public offering on established platforms helps build trust and credibility among potential users and investors, demonstrating Membrane Finance Oy's commitment to transparency and regulatory compliance. Such offering would also allow for broader market participation and the potential for increased adoption of eUSD. As the market demand for eUSD is projected to be strong, Membrane Finance Oy envisions utilizing these authorized offerors in order to provide faster and more reliable access to liquidity. This efficiency is crucial for both individual users and institutional investors looking for a dependable digital asset. Additionally, listing eUSD on trading platforms can open up new revenue streams for Membrane Finance Oy, while additionally providing valuable insights into customer behavior and preferences, allowing Membrane Finance Oy to develop its services and improve user-experience more efficiently. Membrane Finance Oy aims to create a more robust and user-friendly ecosystem for digital transactions, while reinforcing the reliability and stability of eUSD as a digital representation of the USD, which is why Membrane Finance Oy may opt to allow eUSD to be offered to the public by these kinds of trusted third parties. Currently, no third parties are authorized to offer eUSD to the public, although this situation may be subject to changes.

An up-to-date list of all persons that have been authorized to offer all or some e-money tokens issued by Membrane Finance Oy can be found from Membrane Finance Oy's website, specifically at https://www.membrane.fi/offerors.

Before purchasing eUSD from any source, Membrane Finance Oy strongly encourages that all prospective holders of eUSD visit the aforementioned website-address in order confirm that the person offering eUSD has been duly authorized and thus can be endorsed by Membrane Finance Oy. If eUSD is acquired from non-authorized sources, Membrane Finance Oy will not be able to guarantee the legitimacy or reliability of such sources in any way, shape or form.

Part B – Information about the e-money token	
B.1: Name	eUSD e-money
B.2: Abbreviation	eUSD
B.3: E-money token Characteristics	eUSD is a USD-backed regulated stablecoin supervised by the Finnish Financial Supervisory Authority, that is simultaneously legally considered as electronic money and as an electronic money token. eUSD is fully backed by equivalent reserves in USD. eUSD can be used either as funds or as a crypto-asset in multiple different transactions and use-cases. eUSD is always issued at par value, which practically means that it is always "sold" to prospective holders at a 1:1 ratio of eUSD to USD. Any holders of eUSD (even those who did not get eUSD directly from Membrane Finance Oy) can always redeem eUSD at any point in time and at par value without any fees, which practically means that holders can always "return" eUSD to Membrane Finance Oy, subsequently receiving back an equivalent amount in USD without any cost. eUSD's Functionally Fungible Group Digital Token Identifier (FFG DTI) has been applied, but not yet received. eUSD's Digital Token Identifiers (DTIs), which represent the granular identifying numbers of eUSD on each blockchain it is available on, consists of the following DTIs: Arbitrum One: not available yet on this blockchain Avalance (C-Chain): not available yet on this blockchain Concordium: not available yet on this blockchain Ethereum: pending processing from the DTI Foundation Optimism: not available yet on this blockchain Polygon PoS: not available yet on this blockchain Solana: not available yet on this blockchain The data necessary for the classification of this white paper consists of the following information, some of which shall be updated and/or assigned by the Finnish Financial Supervisory Authority (FinFSA) whenever this white paper is submitted to the ESMA's registry in accordance with Article 109 of MiCA: Record identifier: assigned by the FinFSA Classification: ISO 10962 CFI code; not available to anyone yet, will be updated once available

Type of white paper: EMTW

Name of the issuer: Membrane Finance Oy

Legal form of the issuer: DKUW (Osakeyhtiö)

Legal entity identifier of the issuer: 743700KYSSTKZYGEUF50

Date and time of notification: 2024-06-11T09:00:00.000000UTC, which will be updated by the FinFSA

Country of the registered office of the issuer: FI

The industry sector of the economic activities of the person to which the information relates: K64

Digital Token Identifier: pending processing from the DTI Foundation\
Digital token short name: eUSD

Functionally Fungible Digital Token Identifier: pending processing from the DTI Foundation

The type of submission: NEWT

| B.4: Details of all natural or legal persons involved in the implementation of the crypto-asset project | ```

eUSD has been developed by Membrane Finance Oy. Membrane Finance Oy's management body consists of the following persons:
Teemu Päivinen, Chair of the Board of Directors; Meritullinkatu 1B, 00170, Helsinki, Finland
Laura Lehtinen, Member of the Board of Directors; Meritullinkatu 1B, 00170, Helsinki, Finland
Juha Viitala, Member of the Board of Directors and Managing Director; Meritullinkatu 1B, 00170, Helsinki, Finland
Otto Wirkkala, Member of the Board of Directors and Chief Financial Officer; Meritullinkatu 1B, 00170, Helsinki, Finland
Max Atallah, Chief Compliance Officer; Erottajankatu 1-3 A 1, 00130 Helsinki, Finland
Otto Sulin, Chief Strategy Officer; Meritullinkatu 1B, 00170, Helsinki, Finland
Jimi Lehtonen, Head of Finance Partnerships; Meritullinkatu 1B, 00170, Helsinki, Finland
Juuso Roinevirta, Head of Product Growth; Meritullinkatu 1B, 00170, Helsinki, Finland
Patrick Aarikka, Compliance Officer; Meritullinkatu 1B, 00170, Helsinki, Finland
Additionally, although Membrane Finance Oy has utilized the external expertise of some other sources, these following third parties are the ones that have had a material impact on the continued design and development of eUSD:
Aki Häkkilä, Senior Software Developer; Meritullinkatu 1B, 00170, Helsinki, Finland
Patrik Elias Johansson, Former Chief Compliance Officer; Meritullinkatu 1B, 00170, Helsinki, Finland
Nordic Law Oy Ab, legal advisory and compliance functions; Erottajankatu 1-3 A 1, 00130 Helsinki, Finland
KPMG Oy Ab, internal auditing relating to the compliance of the company's regulatory policies and IT-systems; Töölönlahdenkatu 3 A, 00100 Helsinki, Finland
Grant Thornton Oy, accounting; Tietokuja 4, 00330 Helsinki, Finland
Equilibrium Group Oy, part of the corporate enterprise of |

Membrane Finance Oy; Meritullinkatu 1B, 00170, Helsinki, Finland
Eiger Oy, part of the corporate enterprise of Membrane Finance Oy; Meritullinkatu 1B, 00170, Helsinki, Finland
Finnish Financial Supervisory Authority, regulatory oversight resulting in the current format of the company's internal policies and procedures; Snellmaninkatu 6, 00170 Helsinki, Finland
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| Part C – Information about the offer to the public of the e-money token or its admission to trading | |
|---|---|
| C.1: Public Offering or admission to trading | OTPC |
| C.2: Number of units | Membrane Finance Oy has structured the issuance of eUSD without a predefined cap on the total number of units to be offered to the public or admitted to trading. This open-ended issuance model ensures that eUSD can be provided in quantities that meet market demand without limitations. The number of units in circulation will be directly tied to the amount of USD held in reserve, maintaining a 1:1 backing ratio. This approach allows for flexibility in meeting user needs while ensuring the stability and trustworthiness of eUSD. The exact number of units available at any given time will be transparently reported and can be verified through regular reserve attestations and public disclosures, ensuring full accountability and transparency for eUSD holders. |
| C.3: Trading Platforms | N/A |
| C.4: Applicable law | Law of Finland |
| C.5: Competent court | District Court of Helsinki, Porkkalankatu 13, 00180 Helsinki, Finland, jurisdiction of Finland. |

| Part D – Information on the rights and obligations attached to e-money tokens | |
|---|---|
| D.1: Holder's rights and Obligations | Rights of holders:

Holders of eUSD have the right to redeem their tokens at par value, meaning that each eUSD token can be redeemed for one USD. Holders of eUSD may exercise their right of redemption at any time. While there is no minimum threshold for redemption, Membrane Finance Oy may review and subsequently prohibit multiple successive redemption requests in situations where they serve no justifiable reason, or where such successive redemptions are used to disrupt Membrane Finance Oy's services or otherwise intentionally used to negatively influence the usage or availability of eUSD.

To initiate a redemption, holders need to either have an account with Membrane Finance Oy or, if applicable, fill and submit the "EMT Redemption" -form found on Membrane Finance Oy's website at https://www.membrane.fi. Redemption requests can be submitted through these designated platforms provided by Membrane Finance Oy, which either processes redemption requests within five (5) business days, or notifies the person who initiated the redemption of any delays and the reason(s) for such delays.

There are no fees associated with the redemption of eUSD. All redemption requests are subject to compliance reviews, which are used to ensure regulatory adherence, confirming that the redemption process is secure and compliant with all relevant legislation and  other regulatory obligations Membrane Finance Oy is subject to.

Redemptions must be done directly through Membrane Finance Oy, although some authorized and stringently |

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|---|---|
| | reviewed third parties may be used to facilitate the process. The right of redemption, including its conditions and processes, are clearly stated in the terms and conditions found within the aforementioned website. Any modifications these rights will be communicated to all holders of eUSD who have an account with Membrane Finance Oy at least 30 days prior to their implementation. On the same date, these modifications shall be published on Membrane Finance Oy's website, with the aim of providing full transparency and granting all holders — even those without an account — with the ability of responding to any of the changes. |
| | Obligations of holders: |
| | Holders of eUSD must comply with certain obligations to exercise their rights of redemption. Specifically, holders are required to provide Membrane Finance Oy with all requested information during the redemption process. Such information is necessary to fulfill the obligations placed upon Membrane Finance Oy by applicable legislation, as well as compliance with internal policies, which have been approved by the Finnish Financial Supervisory Authority and as such must be stringently complied with. |
| | Additionally, all holders of eUSD must adhere to any and all legislation applicable to them, which shall include but not be limited to, for example, strictly and absolutely refraining from allowing eUSD to be used for money laundering, terrorism financing, or any other financial crimes. |
| D.2: Rights and obligations modification | The rights and obligations of eUSD holders may be modified under specific conditions to ensure regulatory compliance and the stability of eUSD. Membrane Finance Oy, the issuer of eUSD, reserves the right to update the terms and conditions governing the redemption and use of eUSD. Such modifications may be necessitated by changes in regulatory requirements, operational considerations, or the need to address security and compliance issues. Any proposed changes will be communicated to holders with a 30-day notice period, during which holders can review and prepare for the updates. |
| | Notwithstanding anything to the contrary, if modifications are due to a legally binding request by any competent authority, or if justifiably deemed necessary by Membrane Finance Oy in order to comply with regulatory, legal, or compliance related obligations, such modifications will be effective immediately. Modifications with immediate effect will be communicated similarly to all other modifications without any undue delays. |
| | Additionally, modifications to the rights and obligations may occur in response to compliance reviews/audits, where necessary adjustments are made to maintain adherence to regulatory standards. In cases where compliance issues are detected, redemption requests may be temporarily denied or altered until the issues are resolved, although Membrane Finance Oy will consider this as the absolute last resort. |
| D.3: Description of the rights of the holders | eUSD is fully backed by equivalent reserves in USD, that are held in segregated accounts at regulated financial institutions. These reserves are designated specifically to ensure the redeemability of eUSD at par value. In the event that Membrane Finance Oy, the issuer of eUSD, becomes insolvent or bankrupt, the rights of eUSD holders are primarily focused on the protection and redemption of their funds within the reserve of assets that backs eUSD. In the case of |

insolvency or bankruptcy, this segregated reserve of assets would be utilized to honor redemption requests from holders, ensuring they can redeem their eUSD for USD. This structure is designed to protect the interests of eUSD holders by segregating their assets from the Membrane Finance Oy's operational and own funds.

All of these segregated accounts where the reserves are held in are approved and authorized by the Finnish Financial Supervisory Authority, which in turn results in complete legal segregation from Membrane Finance Oy's own funds. Practically, what this means is that if Membrane Finance Oy were to become insolvent or bankrupt in the future, all of these accounts, to which all holders of eUSD have a legal claim on, will not be used to cover any of Membrane Finance Oy's potential outstanding debts or credits, instead being completely devoted for the redemption of all remaining eUSD in circulation. All agreements/contracts related to these segregated reserve accounts that Membrane Finance Oy uses are construed in a manner where these accounts, which are sometimes referred to as 'trust accounts', are legally segregated from the funds of the financial institution that acts as the custodian for the trust account. Thus, if any of these financial institutions were to become insolvent or bankrupt, the reserve assets, which always ultimately belong to the holders of eUSD and are subject to a legal claim from these holders, will remain free from any claims or liens from the debtors or creditors of the insolvent or bankrupt custodian.

The exact details of the redemption process that shall be deployed in the case of insolvency will be described within the redemption plan that Membrane Finance Oy will create in collaboration with competent authorities. This white paper will be updated to reflect the approved recovery plan, once regulatory authorization has been received. Holders shall always retain the right to seek legal recourse if Membrane Finance Oy fails to adhere to the redemption plan or otherwise violates the rights of holders presented above. Typically, in accordance with Finnish law, holders should have the right to file claims against Membrane Finance Oy and participate in legal proceedings related to potential insolvency or bankruptcy.

Additionally, this white paper shall act as a public attestation from Membrane Finance Oy, that in case of insolvency or bankruptcy, in terms of priority of claims, holders of eUSD are entitled to a proportionate share of the segregated reserve assets, with their claims taking precedence over unsecured creditors, as mentioned above. This prioritization ensures that the funds backing eUSD are primarily used to satisfy the redemption rights of eUSD holders before addressing any other debts and liabilities.

The regulatory framework under which Membrane Finance Oy operates mandates stringent oversight and audit requirements, further safeguarding the reserves. However, the actual process and priority of claims may be subject to the legal proceedings and regulations governing insolvency and bankruptcy in Finland.

Holders shall always have the right to claim their funds from the segregated reserves, but they should be aware that the resolution process could involve legal and administrative procedures.

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| D.4: Rights in implementation of recovery plan | Recovery plan is still under development. This white paper will be updated to reflect the approved recovery plan once regulatory authorization has been received. |
| D.5: Rights in implementation of redemption plan | Redemption plan is still under development. This white paper will be updated to reflect the approved redemption plan once regulatory authorization has been received. |
| D.6: Complaint Submission Contact | complaints@membrane.fi |
| D.7: Complaints Handling Procedures | Membrane Finance Oy has established a comprehensive procedure for handling complaints received from holders of eUSD to ensure timely and effective resolution. When a complaint is received, it is promptly acknowledged and documented. The complaint is then reviewed by an appropriate member of the team who is responsible for investigating the issue. Relevant information is gathered and necessary departments are consulted to understand the nature of the complaint and identify potential resolutions.<br><br>Membrane Finance Oy aims to provide an initial response to the complaint within five business days, outlining the steps being taken to address the issue. If the complaint requires more extensive investigation, the holder is kept informed of the progress and expected timeline for resolution. Membrane Finance Oy strives to resolve all complaints within 30 days from the date of receipt.<br><br>If the holder is not satisfied with the proposed resolution, they have the right to escalate the complaint to senior management for further review. Additionally, holders can seek external resolution through appropriate legal channels if they believe their complaint has not been adequately addressed. Holders can, for example, seek external resolution through the Finnish Financial Ombudsman Bureau or other relevant regulatory bodies if they believe their complaint has not been adequately addressed.<br><br>All complaint handling procedures are designed to ensure transparency, fairness, and efficiency in resolving any grievances or other issues holders of eUSD may encounter. Detailed records of each complaint and its resolution are maintained so that Membrane Finance Oy can continuously improve its services and address any systemic issues. |
| D.8: Dispute Resolution Mechanism | Membrane Finance Oy has established a comprehensive procedure for handling complaints received from holders of eUSD to ensure timely and effective resolution. When a complaint is received, it is promptly acknowledged and documented. The complaint is then reviewed by an appropriate member of the team who is responsible for investigating the issue. Relevant information is gathered and necessary departments are consulted to understand the nature of the complaint and identify potential resolutions.<br><br>Membrane Finance Oy aims to provide an initial response to the complaint within five business days, outlining the steps being taken to address the issue. If the complaint requires more extensive investigation, the holder is kept informed of the progress and expected timeline for resolution. Membrane Finance Oy strives to resolve all complaints within 30 days from the date of receipt.<br><br>If the holder is not satisfied with the proposed resolution, they have the right to escalate the complaint to senior management for further review. Additionally, holders can seek external resolution through appropriate legal channels if they believe their complaint has not been adequately addressed. Holders can, for example, seek external resolution through |

the Finnish Financial Ombudsman Bureau or other relevant regulatory bodies if they believe their complaint has not been adequately addressed.

All complaint handling procedures are designed to ensure transparency, fairness, and efficiency in resolving any grievances or other issues holders of eUSD may encounter. Detailed records of each complaint and its resolution are maintained so that Membrane Finance Oy can continuously improve its services and address any systemic issues.

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| D.9: Token Value Protection Schemes | eUSD token value protection shall be ensured through full backing by equivalent reserves in USD held in segregated accounts at regulated financial institutions. This segregation ensures that the funds are kept separate from any and all operational accounts or personal accounts of Membrane Finance Oy, providing a secure basis for redeemability of eUSD.<br><br>In the event of insolvency or financial instability of Membrane Finance Oy, these reserves are designated specifically to meet the redemption requests of eUSD holders at par value, protecting the token's value. Regular  attestations verify the adequacy of these reserves, enhancing transparency and trust.<br><br>It is important to note that eUSD itself as an electronic money token is not covered by investor compensation schemes under Directive 97/9/EC or deposit guarantee schemes under Directive 2014/49/EU. However, the segregated accounts, where the funds or other assets will be held for the benefit of holders of eUSD, are covered by these compensation schemes, which further protects the holders of eUSD from potential insolvency or bankruptcy of the financial institutions that act as the custodians of these segregated accounts.<br><br>While there is no specific compensation scheme for eUSD, the robust regulatory oversight by the Finnish Financial Supervisory Authority and Membrane Finance Oy's continued compliance with stringent financial standards serve as indirect protection mechanisms for eUSD holders. Should any disputes arise, holders have the right to seek legal recourse and participate in claims processes as outlined in Membrane Finance Oy's dispute resolution mechanisms, ensuring that their rights and the value of their holdings are safeguarded. |
| D.10: Applicable law | Law of Finland |
| D.11: Competent court | District Court of Helsinki, Porkkalankatu 13, 00180 Helsinki, Finland, jurisdiction of Finland. |

| Part E – Information on the underlying technology | |
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| E.1: Distributed ledger technology | The only supported blockchain that eUSD is currently available on is Ethereum. In the future, planned support might include, but not be limited to, Arbitrum One, Avalanche (C-Chain), Concordium, Optimism, Polygon PoS and Solana. The underlying technologies, basic functionalities and technical standards relating to eUSD currently and in the possible future, if implemented in each of these blockchains in the envisaged manner, are clarified in the following sections of this white paper. |
| E.2: Protocols and technical standards | eUSD utilizes industry-standard protocols and technical standards to ensure secure holding, storing, and transferring of the token, which is currently available only on Ethereum as an ERC-20 token. As eUSD will likely be implemented into other blockchains as well, the following direct quotation from within eUSD's white paper may be used as reference for |

likely future developments:

eUSD operates on multiple blockchains, including Ethereum, leveraging the robust and secure infrastructures of these platforms. The token is implemented as an ERC-20 token with extensions on Ethereum and follows similar standards and practices on other supported blockchains, ensuring compatibility with a wide range of wallets, exchanges, and decentralized applications.

For holding and storing eUSD, users can utilize any wallet that supports ERC-20 tokens or the corresponding standards on other blockchains. Wallet technology relies on cryptographic algorithms for the custody of crypto assets, involving the generation and management of public and private keys. Public keys allow users to receive tokens, while private keys are used to authorize transactions and access the tokens. Secure storage solutions include software wallets, hardware wallets, multisignature accounts, and accounts managed by multi-party computing.

The transfer of eUSD tokens is facilitated through the underlying blockchain protocols, which employ cryptographic techniques to secure transactions, which are used so that integrity and immutability can be ensured. Transactions are validated and recorded directly on the blockchain, providing a transparent and tamper-proof ledger of all token transfers. To enhance security, Membrane Finance Oy implements multi-signature policies and other advanced security controls, requiring multiple approvals for transactions to prevent unauthorized access.

Additionally, Membrane Finance Oy ensures compliance with relevant technical and security standards to protect against unauthorized access and cyber threats, enhancing the overall security and reliability of eUSD. This adherence to high technical standards and robust protocols ensures that eUSD holders can confidently hold, store, and transfer their tokens within a secure and efficient ecosystem.

Provide any other information on the protocols and technical standards used, allowing for the holding, storing and transfer of e-money token.

The protocols and technical standards used for holding, storing, and transferring any electronic money tokens issued by Membrane Finance Oy, such as eUSD, will always include a combination of industry-standard cryptographic techniques, stringently reviewed blockchain technologies, and secure digital wallets. eUSD operates on multiple blockchain platforms. These blockchains utilize consensus mechanisms such as Proof of Stake (PoS) and Proof of History (PoH) to validate transactions securely and efficiently.

The eUSD token is implemented using the ERC-20 standard on Ethereum and equivalent standards on other blockchains. These standards define a common set of rules for tokens, ensuring they can be integrated seamlessly with various wallets and trading venues or other use-cases. Secure digital wallets are used to store eUSD, employing advanced encryption to protect private keys and ensure that only authorized users can access their funds. The wallets and platforms also support multi-signature policies, enhancing security by requiring multiple approvals for significant transactions.

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| | eUSD utilizes industry-standard protocols and technical standards to ensure secure holding, storing, and transferring of the token. eUSD currently operates on only Ethereum, where the token is implemented as an ERC-20 token. As eUSD will likely be implemented into other blockchains as well, the following direct quotation from within eUSD's white paper may be used as reference for likely future developments:<br><br>eUSD utilizes industry-standard protocols and technical standards to ensure secure holding, storing, and transferring of the token. eUSD operates on multiple blockchains, including Ethereum, leveraging the robust and secure infrastructures of these platforms. The token is implemented as an ERC-20 token with extensions on Ethereum and follows similar standards and practices on other supported blockchains, ensuring compatibility with a wide range of wallets, exchanges, and decentralized applications.<br><br>For holding and storing eUSD, users can utilize any wallet that supports ERC-20 tokens or the corresponding standards on other blockchains. Wallet technology relies on cryptographic algorithms for the custody of crypto assets, involving the generation and management of public and private keys. Public keys allow users to receive tokens, while private keys are used to authorize transactions and access the tokens. Secure storage solutions include software wallets, hardware wallets, multisignature accounts, and accounts managed by multi-party computing.<br><br>The transfer of eUSD tokens is facilitated through the underlying blockchain protocols, which employ cryptographic techniques to secure transactions, which are used so that integrity and immutability can be ensured. Transactions are validated and recorded directly on the blockchain, providing a transparent and tamper-proof ledger of all token transfers. To enhance security, Membrane Finance Oy implements multi-signature policies and other advanced security controls, requiring multiple approvals for transactions to prevent unauthorized access.<br><br>Additionally, Membrane Finance Oy ensures compliance with relevant technical and security standards to protect against unauthorized access and cyber threats, enhancing the overall security and reliability of eUSD. This adherence to high technical standards and robust protocols ensures that eUSD |
| E.3: Technology Used | holders can confidently hold, store, and transfer their tokens within a secure and efficient ecosystem. |
| E.4: Purchaser's technical requirements | To gain control over eUSD tokens, purchasers must fulfill several technical requirements. Firstly, they need a compatible digital wallet or similar technology that supports the blockchain standards on which eUSD operates, which is ERC-20 for Ethereum.<br><br>The purchaser must also have a secure means of generating and storing public and private keys. The public key is used to receive eUSD tokens, while the private key is required to access and authorize transactions involving the tokens. It is crucial that the private key is stored securely, as possession of the private key equates to control over the associated tokens.<br><br>Additionally, the wallet must be properly set up and connected to the relevant blockchain network. For traditional software wallets, this involves installing the wallet software, creating a |

new wallet or importing an existing one, and securely backing up the wallet's seed phrase, which is necessary for wallet recovery.

Purchasers must ensure they have a sufficient amount of the respective blockchain's native cryptocurrency (e.g., Ether (ETH) for Ethereum) to cover transaction fees. This requirement ensures that transactions can be processed and validated on the blockchain network.

Furthermore, purchasers may need to open an account with Membrane Finance Oy or another entity that is authorized to offer eUSD tokens, so that the prospective purchaser can acquire eUSD tokens. This process typically includes completing a Know-Your-Customer (KYC) procedure to comply with regulatory requirements. The KYC process involves providing personal identification information and verifying identity, which helps prevent fraud and ensure compliance with anti-money laundering (AML) regulations.

As eUSD is stored and transferred using public blockchains, purchasers may be able to acquire eUSD using some form of decentralized financial (De-Fi) technologies. If eUSD is acquired from, or with the use of, De-Fi, prospective purchasers should be aware that Membrane Finance Oy cannot guarantee the legitimacy of any such services. Additionally, it is important to note that if the De-Fi service that is used to acquire eUSD is in any way connected to money laundering, terrorism financing, sanctioned persons, or any other illegal activities, Membrane Finance Oy may be required to  freeze the eUSD that has been acquired through such means. This action is mandated by Membrane Finance Oy's Access Denial Policy, which has been established in order to ensure compliance with applicable legislation and can be found at https://www.membrane.fi/legal/access-denial-policy.

Therefore, purchasers should exercise caution and conduct thorough due diligence whenever thinking about acquiring eUSD via De-Fi services to ensure compliance with all legal requirements and to avoid potential disruptions or loss of access to their tokens. Nonetheless, it is important to highlight that Membrane Finance Oy expresses trust and confidence in the distributed and transparent nature of public blockchains and does not consider De-Fi protocols or platforms inherently malicious. However, they will require the user to have significantly more technical prowess and understanding, which is why they might not be suitable for all users; misguided use of De-Fi might lead to complete and unrecoverable loss of assets, or even worse, accidental funding of terrorism or enabling criminally acquired money to be laundered by illicit actors.

Finally, purchasers should employ best practices for security to protect against vulnerabilities and cyber threats. For clarity, these best practices can be defined in simple terms as follows:

Two-Factor Authentication (2FA): This adds an extra layer of security to your account. Instead of just entering a password, you'll also need to enter a code sent to your phone or email. It's like having two locks on your door instead of one.

Secure Storing of Private Keys: Your private key is like a secret password that lets you access your digital tokens. It's important to keep it safe, just like you would with a physical

key. You can write it down and store it in a safe place, or use a secure digital wallet.

Salting Private Keys: This means adding extra random data to your private key before it's stored or used. It's like writing your key in a secret code that only you understand, so even if someone finds it, they can't use it without knowing the code.

Regular Software Updates: Keeping your wallet software up-to-date helps protect you against new vulnerabilities and cyber threats. It's like regularly changing the locks on your door to the newest model in case the older one is not as secure any longer.

Strong Passwords: Use a combination of letters, numbers, and special characters for your passwords. Avoid using easily guessed information like birthdays or simple sequences.

Backup Your Wallet: Regularly back up your wallet to ensure you can recover your funds if your device is lost or damaged. Store these backups in multiple secure locations.

Use a Hardware Wallet: Consider using a hardware wallet, which is a physical device that securely stores your private keys offline, making it less vulnerable to hacking.

Be Cautious of Phishing Scams: Always be cautious of emails, messages, or websites that ask for your private key or personal information. Legitimate organizations will never ask for your private key.

Use Secure Networks: Avoid accessing your wallet or making transactions over public Wi-Fi networks. Use a secure and private internet connection instead.

Enable Email Alerts: Set up email alerts for your wallet to receive notifications of any account activity. This can help you quickly detect and respond to unauthorized access.

By meeting these technical requirements and compliance procedures, purchasers can effectively gain control over and securely manage their eUSD tokens.

| E.5: Consensus Mechanism | eUSD utilizes industry-standard protocols and technical standards to ensure secure holding, storing, and transferring of the token, which is currently available only on Ethereum as an ERC-20 token. As eUSD will likely be implemented into other blockchains as well, the following direct quotation from within eUSD's white paper may be used as reference for likely future developments:<br><br>eUSD operates on multiple blockchain platforms, each utilizing different consensus mechanisms to ensure secure and reliable transactions. The primary blockchains supporting eUSD include Ethereum.<br><br>Ethereum and Polygon PoS use the Proof of Stake (PoS) consensus mechanism. PoS is energy-efficient and promotes network security and decentralization by selecting validators based on the amount of cryptocurrency they hold and are willing to "stake" as collateral. The advantage of PoS is its reduced energy consumption compared to Proof of Work (PoW). However, it may lead to centralization if a small number of validators control a large portion of the stake.<br><br>Avalanche (C-Chain) employs the Avalanche consensus |

protocol, which combines aspects of classical consensus protocols with Nakamoto consensus. It uses repeated sub-sampled voting to achieve consensus, offering high throughput, low latency, and strong security guarantees. The advantage of this protocol is its ability to handle a high volume of transactions quickly. The main disadvantage is the complexity of its implementation compared to simpler protocols.

Concordium utilizes a unique two-layer consensus mechanism. The first layer is a Nakamoto-style consensus to ensure liveness, while the second layer uses finalization to guarantee transaction finality. This hybrid approach balances security and efficiency, providing strong guarantees of transaction finality while maintaining robust performance. The disadvantage is the added complexity in maintaining two layers of consensus.

Solana uses a Proof of History (PoH) consensus mechanism that is combined with a Proof of Stake (PoS) consensus mechanism. PoH serves as a cryptographic clock, providing a historical record that proves events occurred in a specific sequence, which enhances throughput and efficiency. PoS is used for selecting validators and securing the network. The advantages of this mechanism include high transaction speed and low costs, making Solana suitable for high-frequency applications. However, it requires significant technical expertise to implement and maintain.

Arbitrum One and Optimism leverage Ethereum's security while using their own Optimistic Rollup (ORU) technology to achieve consensus. They process transactions off-chain and post only proofs to the Ethereum blockchain, significantly increasing scalability and reducing costs while maintaining security. The advantage of this approach is the scalability and cost-effectiveness it provides. The disadvantages are their reliance on a centralized sequencer. Additionally, Arbitrum One relies on fraud proof submission only by whitelisted actors.

The reasoning behind choosing these specific consensus mechanisms for eUSD includes considerations of scalability, security, energy efficiency, and the ability to handle high transaction volumes. By leveraging the strengths of each blockchain, eUSD ensures a robust, secure, and efficient ecosystem for its users.

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| E.6: Incentive Mechanisms and Applicable Fees | eUSD utilizes industry-standard protocols and technical standards to ensure secure holding, storing, and transferring of the token, which is currently available only on Ethereum as an ERC-20 token. As eUSD will likely be implemented into other blockchains as well, the following direct quotation from within eUSD's white paper may be used as reference for likely future developments: |

The incentive mechanisms to secure transactions for eUSD vary depending on the underlying blockchain used. On Ethereum and Polygon PoS, validators secure the network through the Proof of Stake (PoS) consensus mechanism. Validators are incentivized to act honestly by earning transaction fees and staking rewards, which are distributed based on their staked amount and participation in the consensus process. Transaction fees, often referred to as 'gas fees', are assessed based on the complexity of the transaction and the current network demand. These fees are paid by users to prioritize their transactions and compensate

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| | validators for processing them.<br><br>Similarly, on Solana, validators are incentivized through a combination of transaction fees and staking rewards under the Proof of History (PoH) and PoS mechanisms. The transaction fees on Solana are typically lower compared to Ethereum, due to its high throughput and efficient consensus process. Fees are assessed based on the size and complexity of the transaction and are used to reward validators.<br><br>Avalanche (C-Chain) uses its unique consensus protocol where validators are rewarded with transaction fees and staking rewards. The repeated sub-sampled voting mechanism ensures high security, and validators are motivated to participate actively in the network. Transaction fees on Avalanche (C-Chain) are assessed similarly, based on transaction complexity and network conditions, and are paid to validators who secure the network.<br><br>Concordium's two-layer consensus mechanism includes a Nakamoto-style consensus for liveness and a finalization layer for transaction finality. Validators in Concordium earn transaction fees and staking rewards, which incentivize them to maintain network integrity and security. Fees are assessed according to transaction size and network activity and are distributed to validators.<br><br>Arbitrum One and Optimism leverage Ethereum's security in combination with their own Optimistic Rollup (ORU) technologies. Validators, or sequencers, secure transactions off-chain and post proofs to Ethereum. They are incentivized through transaction fees, which are typically lower than direct Ethereum transaction fees due to the efficiencies gained by transaction batching in the ORU process. These fees are assessed based on transaction complexity and network demand and are paid to the sequencers.<br><br>In summary, transaction fees on these networks are assessed based on transaction complexity, size, and current network demand. These fees are paid by users and serve as compensation for validators or sequencers who maintain the security and integrity of the blockchain. The combination of transaction fees and staking rewards ensures a robust incentive mechanism to support the secure operation of the networks supporting eUSD. |
| E.7: Use of Distributed Ledger Technology | No, DLT not operated by the issuer or a third-party acting on the issuer's behalf |
| E.8: DLT Functionality Description | N/A |
| E.9: Audit | N/A |
| E.10: Audit outcome | Membrane Finance Oy ensures the reliability and security of eUSDe by subjecting its underlying technology to rigorous audits. The audits will focus on evaluating the security, functionality, and compliance of the smart contracts deployed on various blockchains, including Ethereum. |

| Part F – Information on the risks | |
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| F.1: Issuer-Related Risks | Membrane Finance Oy, the issuer of eUSD, is subject to several risks that could impact the stability and reliability of the eUSD token. Key issuer-related risks include regulatory risks, operational risks, technological risks, financial risks, reputational risks, compliance risks, and environmental, social, and governance (ESG) risks. |

Regulatory Risks: Changes in regulatory frameworks or the introduction of new regulations could affect the operations of Membrane Finance Oy. Compliance with varying regulatory requirements across different jurisdictions can be complex and may lead to operational challenges or legal liabilities if not properly managed. Mitigation: Continuous monitoring of regulatory changes and maintaining a robust legal team to ensure compliance across all jurisdictions.

Operational Risks: The efficient functioning of Membrane Finance Oy relies on robust internal processes and systems. Any failures or disruptions in these processes, including human errors, system failures, or inadequate internal controls, could adversely affect the issuance and redemption of eUSD tokens. Mitigation: Regular audits, comprehensive training programs for employees, and the implementation of advanced internal control systems.

Technological Risks: The technology underlying eUSD, including smart contracts and blockchain networks, is subject to vulnerabilities and cyber threats. Although independent audits have confirmed the security of these technologies, there is always a risk of unforeseen vulnerabilities or cyber-attacks that could compromise the integrity of eUSD tokens. Mitigation: Regular security audits, continuous monitoring for vulnerabilities, and employing state-of-the-art cybersecurity measures.

Financial Risks: Membrane Finance Oy's financial health is crucial for maintaining the 1:1 backing of eUSD tokens. Any financial instability, such as liquidity issues or insolvency, could jeopardize the redemption process. The company's ability to manage its reserves and ensure adequate backing is essential to mitigating this risk. Mitigation: Maintaining a robust reserve management strategy and regularly audited financial statements to ensure transparency and stability.

Reputational Risks: Trust in Membrane Finance Oy and the eUSD token is vital. Any negative publicity, whether due to regulatory actions, security breaches, or operational failures, could harm the company's reputation and reduce confidence among token holders and the broader market. Mitigation: Proactive public relations strategies and effective communication channels to manage and mitigate any negative publicity.

Compliance Risks: Ensuring ongoing compliance with any and all applicable legislation is essential for legal and operational integrity. Failure to effectively implement and monitor compliance procedures could result in legal penalties and damage to Membrane Finance Oy's reputation. Mitigation: Regular compliance audits and stringent internal compliance protocols.

Environmental, Social, and Governance (ESG) Risks: As global emphasis on ESG factors increases, any failure to adhere to sustainable and ethical practices could impact the reputation and operations of Membrane Finance Oy. This includes the environmental impact of blockchain operations, social responsibility, and governance practices. Mitigation: Implementing sustainable business practices, ensuring transparency in governance, and actively participating in social responsibility initiatives.

By recognizing and proactively managing these risks, Membrane Finance Oy aims to maintain the stability, security,

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| | and trustworthiness of eUSD, ensuring that it remains a reliable digital asset for its holders. |
| F.2: Token-Related Risks | eUSD, as an electronic money token, is subject to various risks that could impact its stability, usability, and value. Key token-related risks include technological risks, market risks, liquidity risks, regulatory risks, security risks, user-related risks, and reputational risks.

Technological Risks: As eUSD relies on multiple blockchain networks, any technical issues, vulnerabilities, or failures in these blockchain networks could affect the functionality and transferability of eUSD tokens. Additionally, smart contract vulnerabilities could lead to security breaches or malfunctioning of token-related operations. Mitigation: Regular audits and security reviews of the smart contracts and continuous monitoring of the blockchain networks.

Market Risks: The value and demand for eUSD can be influenced by broader market conditions, including fluctuations in the cryptocurrency market, changes in investor sentiment, and macroeconomic factors. These market dynamics could impact the liquidity and stability of eUSD. Mitigation: Maintaining robust reserves and ensuring transparency to foster trust among holders and investors.

Liquidity Risks: Although eUSD is backed 1:1 by USD reserves, there could be situations where the liquidity of the token is compromised, such as during market stress, bank insolvencies, or if Membrane Finance Oy faces financial difficulties. This could hinder the ability of holders to redeem their tokens promptly. Mitigation: Ensuring adequate liquidity management and maintaining reserves in easily accessible, high-quality assets. Additionally, in the future Membrane Finance Oy will establish and implement a recovery plan in cooperation with competent authorities.

Regulatory Risks: Changes in regulatory frameworks or enforcement actions against Membrane Finance Oy could impact the legality and operations of eUSD. Compliance with evolving regulations across different jurisdictions can present challenges. Mitigation: Proactively engaging with regulators, maintaining compliance with current regulations, and adapting to new regulatory requirements.

Security Risks: eUSD holders are exposed to risks related to the security of their digital wallets and the overall security of the blockchain networks. Cyberattacks, phishing attempts, and other security threats could lead to the loss of tokens or unauthorized transactions. Mitigation: Encouraging best security practices among users, such as using hardware wallets and enabling two-factor authentication, along with continuous security improvements conducted by Membrane Finance Oy.

User-Related Risks: Users of eUSD might face risks related to the loss of private keys, user errors, or lack of understanding of how to securely manage crypto-assets. Mismanagement of private keys can result in the irreversible loss of tokens. Mitigation: Providing educational resources and support to users on best practices for managing and securing their eUSD tokens.

Reputational Risks: Trust in eUSD and its issuer, Membrane Finance Oy, is vital for the token's stability. Any negative publicity, whether due to regulatory actions, security |

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| | breaches, or operational failures, could harm the reputation of both the token and the issuer. This could lead to a loss of confidence among holders and the broader market, adversely affecting the token's value and demand. Mitigation: Proactive public relations strategies, effective communication channels, and robust crisis management plans to address and mitigate any reputational damage.<br><br>By understanding and proactively managing these token-related risks, Membrane Finance Oy aims to ensure the stability, security, and reliability of eUSD, safeguarding the interests of token holders. |
| F.3: Technology-Related Risks | eUSD utilizes advanced blockchain technology, which, while offering numerous benefits, also presents several risks. Key technology-related risks include smart contract vulnerabilities, blockchain network security, interoperability issues, scalability challenges, reliance on third-party infrastructure, network consensus and validation risks, internet dependence, network governance, attack risks, and hard fork risks.<br><br>Smart Contract Vulnerabilities: The smart contracts used for eUSD are critical for its functionality. However, any bugs or vulnerabilities in these smart contracts could lead to security breaches, unauthorized transactions, or loss of tokens. Mitigation: Regular audits and security reviews of smart contracts, along with continuous monitoring for potential vulnerabilities and prompt implementation of patches or updates.<br><br>Blockchain Network Security: The security of eUSD depends on the underlying blockchain networks. These networks can be vulnerable to attacks such as 51% attacks, where a malicious actor gains control over the majority of the network's mining or staking power, potentially compromising the integrity of the blockchain. Mitigation: Choosing robust and widely-used blockchain networks with strong security protocols and a large, decentralized validator or miner base.<br><br>Interoperability Issues: eUSD operates on multiple blockchain networks, and ensuring seamless interoperability between these networks can be challenging. Any issues in compatibility or communication between different blockchains could disrupt the transfer or use of eUSD tokens. Mitigation: Implementing standardized protocols for interoperability and conducting thorough testing to ensure smooth cross-chain operations.<br><br>Scalability Challenges: As the usage of eUSD grows, the ability of the underlying blockchain networks to handle a high volume of transactions can be strained. Scalability issues can lead to slower transaction times and higher fees, impacting the user experience. Mitigation: Leveraging layer-2 solutions and other scalability technologies, such as emerging high throughput blockchains, to enhance transaction throughput and efficiency.<br><br>Reliance on Third-Party Infrastructure: eUSD relies on third-party blockchain networks and wallet providers for its operation. Any disruptions, failures, or security breaches within these third-party services can affect the functionality and security of eUSD tokens. Mitigation: Establishing strong partnerships with reputable third-party providers and implementing contingency plans to address potential disruptions. |

Network Consensus and Validation Risks: in the future, eUSD likely relies on various blockchain consensus mechanisms, such as Proof of Stake (PoS) on Ethereum and Polygon, and Proof of History (PoH) on Solana. These consensus mechanisms depend on the active participation of validators or miners to maintain network integrity and security. Any decrease in participation or consensus failures could compromise the network. Mitigation: Ensuring that eUSD is always available within blockchains that have a robust validator community and that incentivize active and non-malicious participation through sufficient validation rewards.

Internet Dependence: The functioning of eUSD is dependent on internet connectivity, as all blockchain transactions require internet access to broadcast and validate transactions. Any disruption in internet services can temporarily halt the ability to transact with eUSD tokens. Mitigation: Encouraging the use of redundant internet connections and planning for alternative communication channels during internet outages.

Network Governance: The governance of the blockchain networks on which eUSD operates affects its stability and development. Poor governance decisions or centralization of control can lead to disputes and instability. Mitigation: Supporting decentralized governance models and participating in governance processes to ensure fair and transparent decision-making.

Attack Risks: In addition to 51% attacks, other potential attacks such as Sybil attacks, where an attacker creates multiple fake identities to gain influence, can threaten the network. Mitigation: Implementing robust identity verification mechanisms and ensuring network protocols can detect and mitigate such attacks.

Hard Fork Risks: Blockchain networks may undergo hard forks, creating divergent versions of the blockchain. This can lead to confusion and potential loss of value if the community splits or if there is uncertainty about which fork represents the "true" version of the token. Mitigation: Monitoring developments in the blockchain communities and planning responses to potential hard forks, including clear communication with token holders.

By recognizing and proactively managing these technology-related risks, Membrane Finance Oy aims to ensure the secure and reliable operation of eUSD, maintaining trust and confidence among token holders.

| | |
|---|---|
| F.4: Mitigation measures | Membrane Finance Oy employs a comprehensive set of measures to mitigate the risks associated with the technology used for eUSD. To address smart contract vulnerabilities, regular independent security audits are conducted to identify and rectify any potential issues. Continuous monitoring and prompt updates ensure that smart contracts remain secure and functional. For blockchain network security, eUSD leverages robust and widely-used blockchain networks with strong security protocols and a decentralized validator or miner base, reducing the risk of attacks such as 51% attacks.

Interoperability issues are mitigated by implementing standardized interfaces for cross-chain operations and conducting thorough testing to ensure seamless integration between different blockchain networks.

To overcome scalability challenges, Membrane Finance Oy |

employs layer-2 solutions and high throughput blockchains such as Solana, enhancing transaction throughput and efficiency.

Reliance on third-party infrastructure is managed by establishing strong partnerships with reputable providers and developing contingency plans to address potential disruptions.

To address internet dependence, Membrane Finance Oy encourages the use of redundant internet connections and plans for alternative communication channels during internet outages. For network governance, the company supports decentralized governance models and may actively participate in governance processes to ensure fair and transparent decision-making.

Attack risks, including 51% and Sybil attacks, are mitigated through robust identity verification mechanisms and advanced network protocols that can detect and prevent such threats.

Lastly, hard fork risks are managed by closely monitoring developments within blockchain communities and planning responses to potential forks, including clear communication strategies with token holders.

These comprehensive measures ensure that eUSD operates securely and reliably, maintaining trust and confidence among its users.

| Part G – Information on the sustainability indicators in relation to adverse impact on the climate and other environment-related adverse impacts | |
| --- | --- |
| G.1: Adverse impacts on climate and other environment-related adverse impacts | Provide information on the sustainability indicators in relation to adverse impact on the climate and other environment-related adverse impacts.<br><br>While Membrane Finance Oy, the issuer of eUSDe, is committed to providing transparent and comprehensive information regarding the environmental impact of its operations, as eUSD has just recently been issued for the first time, its environmental impacts are practically non-existent. Thus, as a "placeholder", the indicators and their respective calculations are borrowed from Membrane Finance Oy's other e-money token, eUSD:<br><br>**Membrane Finance Oy Climate Indicators and Calculations**<br><br>Membrane Finance Oy is committed to providing transparent and comprehensive information regarding the environmental impact of its operations. Therefore, it should be highlighted that the Delegated Regulation regarding these sustainability indicators, that is mandated inter alia under Article 51 of the Markets in Crypto-Assets Regulation (EU) 2023/1114, has not yet been approved nor published. Thus, this white paper currently shall only reference the draft version of said regulation. The following information contains Membrane Finance Oy's approach regarding the identification and disclosure of adverse impacts on the climate and the environment linked to the use of consensus mechanisms to validate transactions in crypto-assets, notably in relation to the use of energy, renewable energy and natural resources, as well as the production of waste and greenhouse gas (GHG) emissions. Additionally, the creation and amount of waste electrical and electronic equipment (WEEE) shall be |

assessed.

The somewhat unconventional format of the information presented hereinafter has been used intentionally so that readers may identify and understand relevant information more quickly. This format presents the conclusions and deductions first, followed by detailed explanations, with supportive argumentation and sources of information being detailed at the end, reversing the typical presentation of this kind of data. Additionally, while some crucial direct quotes, labelled as Fundamental Excerpts, from relevant sources have been included at the end of this white paper, readers should note that those have been included solely to enhance readability, and that they are not the only sources utilized in the preparation of this document.

## General information and key indicators

Membrane Finance Oy, 743700KYSSTKZYGEUF50, acting as the issuer of e-money tokens, is providing information on the principal adverse impacts on the climate and other environment-related adverse impacts of the consensus mechanism used to validate transactions in eUSD, and to maintain the integrity of the distributed ledger of transactions.

The information covers the period from 1.1.2023 to 31.12.2023 with estimates used for the period from 1.1.2024 to 31.12.2024.

The validation of transactions in eUSD and the maintenance of the integrity of the distributed ledger of transactions have led to a total energy consumption of 5 850 000 kWh regarding the entire ecosystem where eUSD operates on, with approximately 4876 kWh (0.08 %) of this total amount being connected to eUSD during 2023.

The validation of one transaction in eUSD has led to a total energy consumption of approximately 0.0158 kWh on average during 2023.

The validation of transactions in eUSD and the maintenance of the integrity of the distributed ledger of transactions has resulted in 570.6363 tonnes of GHG emissions, which represents the total amount of GHG emissions for the blockchain ecosystem eUSD operates on and is comprised of 3.1863 tonnes of Scope 1 emissions and 567.45 tonnes of Scope 2 emissions, of which 0.4526 tonnes (0.0026 tonnes of Scope 1 emissions and 0.45 tonnes of Scope 2 emissions) are attributed to eUSD, while the average amount of GHG Emissions per transaction was approximately 0.00154 kgCO2e, calculated based on sources owned or controlled by the DLT network nodes (scope 1), and indirect emissions from energy purchased by the DLT network nodes (scope 2), during 2023.

## Features of the consensus mechanism\[s] relevant for principal adverse impacts on the climate and other environment-related adverse impacts

The features of the consensus mechanism relevant for principal adverse impacts on the climate and other environment-related adverse impacts have been presented within Part E \[remember to hyperlink to part E] of this white paper.

The consensus mechanisms used for the validation of

transactions in, and the issuance/redemption of, eUSD and for the maintenance of the integrity of the distributed ledger of transactions are primarily based on Proof of Stake (PoS). This mechanism is employed on several blockchain platforms, including Ethereum. While these platforms were primarily selected for their high security and efficiency features, the same features are also crucial for minimizing adverse environmental impacts. The three key-aspects presented below have had a significant impact on Membrane Finance Oy's continued support of these blockchains.

*Incentive Structure*:

The incentive structure of PoS mechanisms encourages validators to participate in the network by staking their tokens. Validators are selected to create new blocks based on the number of tokens they hold and are willing to "stake" as collateral. This process consumes significantly less energy compared to Proof of Work (PoW) mechanisms because it avoids the need for excessively energy-intensive computations. Validators receive rewards in the form of transaction fees and/or newly minted tokens, promoting active participation in maintaining network security and integrity, while simultaneously producing significantly lower emissions due to the fact that transactions are validated on the basis of a financial incentive/risk, instead of the substantial computational workloads that consequently would lead to vast amounts of lost energy in the process.

*Number and Location of DLT Network Nodes*:

The DLT network nodes are distributed globally to ensure decentralization and resilience of the network. The exact number of nodes and their locations vary across the different blockchains but are nonetheless designed to provide robust geographical dispersion. This helps in reducing the risk of localized failures and improves the overall security and performance of the network, while simultaneously distributing and diluting their adverse effects on the climate, instead of creating localized environmental stressors.

*Production, Use, and Disposal of Devices*:

The devices used by the DLT network nodes of these kinds of blockchains typically include standard server hardware and/or specialized staking hardware. The production of these devices involves the use of various natural resources, including metals and semiconductors. During their operational life, these devices consume electricity, which contributes to energy consumption and GHG emissions. At the end of their lifecycle, responsible disposal and recycling practices are crucial so that environmental impacts can be minimized. Membrane Finance Oy is committed to encouraging the use of energy-efficient hardware while promoting recycling and proper disposal methods to reduce the environmental footprint of its operations.

By promoting the use PoS mechanisms instead of PoW mechanisms whenever possible, and by promoting sustainable practices in the production, use, and disposal of hardware, Membrane Finance Oy aims to minimize the adverse environmental impacts associated with the operation of eUSD.

By providing transparent and comprehensive information on these sustainability indicators, Membrane Finance Oy aims to

foster investor awareness and contribute to environmentally responsible crypto-asset operations. These disclosures are reviewed and updated regularly to ensure accuracy and relevance, in support of Membrane Finance Oy's dedicated commitment to sustainability.

**Climate and other environment-related indicators**

*Energy consumption*: The 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. These are calculated in accordance with the European Sustainability Reporting Standard E1, Appendix A, AR 32.

*Non-renewable energy consumption*: The 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. These are calculated in accordance with the European Sustainability Reporting Standard E1, Appendix A, AR 32.

*Energy intensity*: The average amount of energy used, in kWh, per validated transaction. These are calculated in accordance with the European Sustainability Reporting Standard E1, Appendix A, AR 32.

*Scope 1 GHG emissions*: Scope 1 GHG emissions, expressed in tonnes $CO_2e$ per calendar year for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions. These are calculated in accordance with the European Sustainability Reporting Standard E1, Appendix A, AR 39.

*Scope 2 GHG emissions*: Scope 2 GHG emissions, expressed in tonnes $CO_2e$ per calendar year for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions. These are calculated in accordance with the European Sustainability Reporting Standard E1, Appendix A, AR 45.

**Additional climate and other environment-related indicators**

*Energy mix*: The share of energy from non-renewable sources used for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions, broken down by each non-renewable energy source, expressed as a percentage. These are calculated in accordance with the European Sustainability Reporting Standard E1, Appendix A, AR 32.

*Carbon intensity*: The carbon intensity of the energy used for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions, expressed in $kgCO_2e$ per kWh. These are calculated in accordance with the European Sustainability Reporting Standard E1, Appendix A, AR 45.

*Energy use reduction*: Energy use reduction targets or commitments, expressed in absolute or relative reduction of energy use over one calendar year. These are calculated in accordance with the European Sustainability Reporting Standard E1, Appendix A, AR 32.

**Membrane Finance Oy's systematic approach relating to the indicators**

**Methodology and assumptions:**

The methodologies used for these calculations follow the guidance outlined in the European Sustainability Reporting Standard E1. The main assumptions include standardized emission factors for different types of fuels and energy sources, the average lifespan of electronic equipment for WEEE calculations, and typical water usage rates for DLT network operations.

Due to the limited availability of data related to the information on the principal adverse impacts on the climate and other environment-related adverse impacts of the consensus mechanism used to validate transactions, Membrane Finance Oy has had to rely on data specifically pertaining to only Ethereum. This choice is made because no reliable data is currently available for the other blockchains on which eUSD operates. However, it should be noted that this reliance on data relating to Ethereum likely represents a conservative estimation. Other blockchains, such as Avalanche (C-Chain), Concordium, Polygon PoS, Solana, and Arbitrum One, might be even more resource-efficient and thus more environmentally friendly, potentially resulting in a lower overall environmental impact. Therefore, the figures presented herein should be considered as a high-end estimate of the actual adverse impacts, ensuring that the reported data does not underestimate the environmental footprint of Membrane Finance Oy's operations.

**External verification:**

Membrane Finance Oy would support external auditing of the indicators set out in the calculations, so that they could be independently verified and audited by a transparent and trustworthy third party, which would enhance the accuracy and reliability of the reported data. However, unfortunately such auditing is currently not feasible.

**Best efforts for missing data:**

In instances where direct data is not available, estimates are made using reasonable assumptions and external data sets. The methodology for these estimates may involve:

(a) Extrapolating from similar known data points;

(b) Consulting with industry experts and data providers; and

(c) Applying precautionary principles to ensure conservative estimates.

For instance, energy consumption figures are extrapolated from known data points of similar blockchain operations, and GHG emission factors are applied based on the most recent data available from recognized sources.

**Additional information:**

Currently used sources of information include only data that is publicly available. However, as Membrane Finance Oy is committed to enhancing the quality of the data used for these calculations, if suitable methods for this goal become reasonably attainable, they should be used. These methods

may include, but are not limited to, direct operational metrics, utilizing third-party auditors or external data providers, and further observing the crypto-asset ecosystem. These methodologies used for calculating the indicators have the aim of adhering to the European Sustainability Reporting Standard E1 and the GHG Protocol Corporate Standard. Where deviations from standard methodologies occur, detailed explanations and justifications are attempted to be provided. For clarity, unless otherwise expressedly indicated, all total amounts and their respective values found within the 'Detailed calculations of eUSD related emissions' -chapter below shall refer to annual numbers regarding the year 2023, which can and will also be used as reasonable pre-emptive estimations for the year 2024. The following formulas, which are underlined to improve their identification, for the detailed calculations outlined below have been carefully drafted and established by Membrane Finance Oy, taking into account all of the aforementioned considerations.

**Detailed calculations of eUSD related emissions**

**Combined energy consumption and intensity of the DLTs where eUSD is available on:**

Total Energy Consumption (kWh) = Σ (Energy Consumption of Each DLT Network Node)

Average Energy Consumption per Transaction (kWh) = Total Energy Consumption (kWh) / Number of Transactions

Total Energy Consumption (kWh): 5 850 000

Number of Transactions: 370 000 000

Average Energy Consumption per Transaction (kWh): approx. 0.0158

**Formulas for eUSD-specific energy consumption and intensity:**

Energy Consumption of eUSD Transactions (kWh) = Average Energy Consumption per Transaction (kWh) \* Number of eUSD Transactions

eUSD's Share of Total Energy Consumption (%) = (Energy Consumption of eUSD Transactions / Total Energy Consumption) \* 100

Average Energy Consumption per Transaction of eUSD (kWh) = eUSD Energy Consumption (kWh) / Number of eUSD Transactions

**eUSD energy consumption and intensity values:**

Number of eUSD Transactions: 308 595

Energy Consumption of eUSD Transactions (kWh): approx. 4876

eUSD's share of total energy consumption (%): approx. 0.08

eUSD Average Energy Consumption per Transaction (kWh): approx. 0.0158

**Combined GHG emissions of the DLTs where eUSD is available on:**

Scope 1 Emissions (tCO2e) = Σ (Fuel Consumption \* Emission Factor)

Scope 2 Emissions (Location-Based, tCO2e) = Σ (Energy Consumption \* Location-Based Emission Factor)

Scope 2 Emissions (Market-Based, tCO2e) = Σ (Energy Consumption \* Market-Based Emission Factor)

Total GHG Emissions (tCO2e) = Scope 1 Emissions + Scope 2 Emissions

Average GHG Emissions per Transaction (kgCO2e/Tx) = (Total GHG Emissions (tCO2e) \* 1,000) / Number of Transactions (Tx)

Scope 1 Emissions (tCO2e): 3.1863

Scope 2 Emissions (Location-Based, tCO2e): 567.45

Scope 2 Emissions (Market-Based, tCO2e): N/A

Total GHG Emissions (tCO2e): 570.6363

Average GHG Emissions per Transaction (kgCO2e/Tx): approx. 0.00154

**Formulas for eUSD-specific GHG emissions:**

eUSD Scope 1 Emissions (tCO2e) = Scope 1 Emissions \* (eUSD's share of total energy consumption)

eUSD Scope 2 Emissions (Location-Based, tCO2e) = Scope 2 Emissions (Location-Based, tCO2e) \* (eUSD's share of total energy consumption)

eUSD Scope 2 Emissions (Market-Based, tCO2e) = Scope 2 Emissions (Market-Based, tCO2e) \* (eUSD's share of total energy consumption)

eUSD Total GHG Emissions (tCO2e) = eUSD Scope 1 Emissions + eUSD Scope 2 Emissions (Location-Based) + eUSD Scope 2 Emissions (Market-Based)

eUSD Average GHG Emissions per Transaction (kgCO2e/Tx) = (eUSD Total GHG Emissions (tCO2e) \* 1,000) / Number of eUSD Transactions (Tx)

**eUSD GHG emissions values:**

eUSD Scope 1 Emissions (tCO2e): approx. 0.0026

eUSD Scope 2 Emissions (Location-Based, tCO2e): approx. 0.45

eUSD Scope 2 Emissions (Market-Based, tCO2e): N/A

eUSD Total GHG Emissions (tCO2e): 0.4526

eUSD Average GHG Emissions per Transaction (kgCO2e/Tx): approx. 0.00154

**Combined waste production of the DLTs where eUSD is available on:**

Total WEEE (tonnes) = Σ (WEEE)

Non-Recycled WEEE Ratio (%) = (Non-Recycled WEEE (tonnes) / Total WEEE (tonnes)) \* 100

Hazardous Waste (tonnes) = Σ (Hazardous Waste)

Total WEEE (tonnes): 5000

Non-Recycled WEEE (tonnes): 3900

Non-Recycled WEEE Ratio (%): 78

Hazardous Waste (tonnes): 3900

**Formulas for eUSD-specific waste production:**

eUSD Total WEEE (tonnes) = Total WEEE \* (eUSD's share of total energy consumption)

eUSD Non-Recycled WEEE (tonnes) = Non-Recycled WEEE \* (eUSD's share of total energy consumption)

eUSD Non-Recycled WEEE Ratio (%) = (eUSD Non-Recycled WEEE (tonnes) / eUSD Total WEEE (tonnes)) \* 100

eUSD Hazardous Waste (tonnes) = Hazardous Waste \* (eUSD's share of total energy consumption)

**eUSD waste production values:**

eUSD Total WEEE (tonnes): 4

eUSD Non-Recycled WEEE (tonnes): 3.12

eUSD Non-Recycled WEEE Ratio (%): 78

eUSD Hazardous Waste (tonnes): 3.12

**Combined impact on natural resources of the DLTs where eUSD is available on:**

Total Water Consumption (m³) = Total Energy Consumption (kWh) \* Water Intensity (L/kWh) / 1000

Non-Recycled Water (m³) = Total Water Consumption (m³) \* 0.50

Non-Recycled Water Ratio (%) = (Non-Recycled Water (m³) / Total Water Consumption (m³) \* 100

Water Intensity (L/kWh): 15

Total Water Consumption (m³): 87 750

Non-Recycled Water (m³): 43 875

Non-Recycled Water Ratio (%): 50

**Formulas for eUSD-specific impact on natural resources:**

eUSD Total Water Consumption (m³) = Total Water Consumption (m³) \* (eUSD's share of total energy consumption)

eUSD Non-Recycled Water (m³) = Non-Recycled Water (m³) \* (eUSD's share of total energy consumption)

eUSD Non-Recycled Water Ratio (%) = (eUSD Non-Recycled Water (m³) / eUSD-specific Total Water Consumption (m³) \* 100

**eUSD impact on natural resources values:**

eUSD Total Water Consumption (m³): 70.2

eUSD Non-Recycled Water (m³): 35.1

eUSD Non-Recycled Water Ratio (%): 50

**References, sources of data, and rationale of assumptions**

**eUSD transaction amounts:**

Number of eUSD Transactions: 308 595

Details: Due to the fact that currently the total amount of energy used for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions cannot be accurately quantified, Membrane Finance Oy has opted for the assumption, as further explained later, that the energy used for transactions shall be considered equal to the combined energy used for the validation of transactions and the maintenance of the integrity of the distributed ledger of transactions. In light of the aforementioned considerations, Membrane Finance Oy has calculated the approximate number of all mints/burns (issuance/redemption) and all other transactions of eUSD within all blockchains that eUSD is available in. The Number of eUSD Transactions refers to this approximate combined amount, which has been duly calculated in good faith. While the Number of eUSD Transactions is comprised of all eUSD-related transaction-data from all blockchains eUSD operates on, the environmental effects are calculated in a fashion where the Number of eUSD Transactions has been viewed as if all transactions were done on Ethereum, as per the 'Methodology and assumptions' -chapter above. Membrane Finance Oy does not guarantee perfect accuracy regarding the Number of eUSD Transactions, and this number shall only be endorsed for these calculations of eUSD's climate effects.

**Energy consumption data:**

Energy Consumption of Each DLT Network Node (kWh): 943.2

Total Energy Consumption (kWh): 5 850 000

Number of Transactions: 370 000 000

Energy Consumption of Each DLT Network Node (kWh): (105w \ $24h$ \ 365 =) 919.8

Details: Energy Consumption Data used within these calculations is an estimation, with Membrane Finance Oy opting for intentionally high numbers to ensure conservative results. Technically, the Energy Consumption Data should refer to the annual individual energy consumption readings or

measurements taken from each DLT network node or other relevant sources, and these readings should be collected over a specific period (e.g., daily, monthly), serving as the input data for calculating the total energy consumption. However, currently it is not possible to access reliable measurement or readings of these nodes, which is why reasonable, although very conservative, generalized estimations have been used. Conversely to what the referenced sources would suggest, due to the lack of currently available data, Membrane Finance Oy has chosen to ignore the marginal differences between full nodes and validating nodes, even though only the latter provides "validation of transactions and maintenance of the integrity to the distributed ledger". Accordingly, the energy used for transactions on Ethereum has been assumed equal to the energy used for the validation of transactions and maintenance of the integrity to the distributed ledger. This assumption may be subject to changes in the future, as additional data may be gathered and/or published.

**Emission factors and GHG Data:**

GHG Emission Factor for Scope 1: 3186.30 kg of CO2e per tonne

GHG Emission Factor for Scope 2 (Location-Based): 97 gCO2/kWh

GHG Emission Factor for Scope 2 (Market-Based): N/A

Calculations: (3186.30 kgCO2e = 3.1863 tCO2e); (5850000 kWh \ *97 gCO2/kWh = 567.45 tCO2e); (3.1863 tCO2e + 567.45 tCO2e = 570.6363 tCO2e); (570.6363 tCO2e* \ 1000 / 370000000 Tx = 0.00154226027 kgCO2e/Tx)

Details: Emission Factor of Finland for 2023 was an average of 55 gCO2/kWh, with maximum and minimum numbers of 97 and 36 respectively. A conservative approach justifies the use of the maximum number of 97. Membrane Finance Oy does not use fuel in its commercial activities. However, some personnel might sometimes travel with vehicles that use fuel. Thus, as an intentionally exaggerated amount, 1000kg of 'Gas/Diesel oil' with an Emission Factor of 3186.30 kg of CO2e per tonne was selected as the Fuel Consumption. Energy Consumption was kept at the annual level of 5850000 kWh. Membrane Finance Oy does not have any Market-Based contractual instruments and thus will result to only using the location-based factor for Scope 2. Due to the fact that Membrane Finance Oy does not have access to any sort of reasonable methods for obtaining data pertaining to the operational metrics of all nodes within Ethereum, the same Emission Factors are used for the entire blockchain ecosystem as is used for eUSD specific calculations. This assumption can be justified, as the factors that are used to represent Membrane Finance Oy's environmental effects are vastly exaggerated so that a conservative "worst-case scenario" could be presented herein.

**Waste production data:**

Total WEEE (tonnes): 5000

Non-Recycled WEEE (tonnes): 3900

Non-Recycled WEEE Ratio (%): 78

Hazardous Waste (tonnes): 3900

Details: Bitcoin as a PoW system allegedly generates 26.89 kilotonnes of annual total e-waste, with average e-waste per transaction hovering around 122,5 grams per transaction. Ethereum has been described as a much more environmentally friendly alternative during recent years. Additionally, Ethereum has much less intensive system requirements. According to researchers, it seems relatively likely that no reliable data relating to Ethereum's WEEE amount is available. Thus, a reasonable estimate has been presented by Membrane Finance Oy. While eUSD is utilized mostly within Europe, it should be noted that validators and nodes within Ethereum or any other blockchain can be situated anywhere on the globe. Again, as a reliable estimation cannot be made due to the lack of information, Membrane Finance Oy presents a reasonable estimation. In accordance with the Waste Framework Directive (2008/98/EC), 'Hazardous Waste' refers to any waste that is in any way explosive, oxidizing, highly flammable, flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, toxic for reproduction, mutagenic, sensitizing, or ecotoxic. According to the World Health Organization (WHO), most of e-waste would be considered Hazardous Waste, indicating that it is reasonable to assume all Non-Recycled WEEE as Hazardous Waste.

**Water consumption data:**

Total Water Consumption (m³): 87 750

Non-Recycled Water (m³): 43 875

Details: Determining an exact water consumption value for Ethereum is practically impossible due to limited specific data on water usage associated with its operation. However, based on available industry reports and methodologies applied to other blockchain networks, some estimations can be made. According to the report "Bitcoin's growing water footprint", water consumption is heavily influenced by the energy consumption of the network and the regional water intensity of electricity consumption. Although that report focuses on Bitcoin, similar principles can be applied to Ethereum. As a rough estimation, the water consumption for Ethereum's operations can be inferred from studies on Bitcoin's water footprint. For instance, Bitcoin's water consumption was found to be 15.0 liters per kWh in 2021. Assuming a similar water intensity for Ethereum, the estimated water consumption for Ethereum could be approximated using the total energy consumption data as follows:

Total Water Consumption (m³) = Total Energy Consumption (kWh) $*$ Water Intensity (L/kWh) / 1000

Total Water Consumption (m³) = 5 850 000 kWh $*$ 15.0 L/kWh / 1000

Total Water Consumption (m³) = 87 750

Non-Recycled Water (m³) would depend on the proportion of water that becomes unavailable for reuse after withdrawal, primarily due to evaporation in cooling systems and other indirect uses. Given the lack of specific data, a very conservative estimate of non-recycled water could be around 50% of the total water consumption.

Non-Recycled Water (m³) = Total Water Consumption (m³) \* 0.50

Non-Recycled Water (m³) = 87 750 \* 0.50

Non-Recycled Water (m³) = 43 875

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*World Health Organization (WHO), "Electronic Waste (e-waste)", October 2023, available at:* https://www.who.int/news-room/fact-sheets/detail/electronic-waste-(e-waste).

*World Resources Institute, "GHG Protocol Tool for Stationary Combustion", Version 4, 2015, available at:* https://ghgprotocol.org/calculation-tools-and-guidance.

**Fundamental Excerpts from the list of references:**

Page 4 of "Methodologies to calculate the proposed mandatory sustainability indicators required by the EU Markets in Crypto-Assets (MiCA) regulation": *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.*

Page 7 of "White Paper: Determining the Electricity Consumption and Carbon Footprint of Proof of Stake Networks": *Furthermore, previous research suggests that participating in the PoS consensus mechanism has only a negligible effect on the device's electricity consumption – –*

*With the measurements of the electricity consumption for each hardware configuration when running a full node in a respective PoS network, we can provide an upper bound (the highest electricity that a node consumes), a lower bound (the least electricity a node consumes), and a best guess that captures the consumption of the average node best for the network. – – The electricity consumption of an average node in a network is challenging to estimate. Typically, there is no empirical data on the concrete hardware that nodes are running on or indicating users' preferences. For node owners, several factors are relevant for their decision on which hardware to run their node on.*

Page 59 of "GHG Protocol Scope 2 Guidance An amendment to the GHG Protocol Corporate Standard": *For companies with any operations in markets providing product or supplier-specific data in the form of contractual instruments, companies shall report scope 2 according to a location-based method and a market-based method.*

Pages 8, 9 and 10 of "Methodologies to calculate the proposed mandatory sustainability indicators required by the EU Markets in Crypto-Assets (MiCA) regulation": *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. – – Scope 2 is defined as indirect GHG emissions from emissions from the generation of acquired and consumed electricity. 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. – – 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.

Pages 9, 10 and 30 of "The Merge Implications on the Electricity Consumption and Carbon Footprint of the Ethereum Network": *In comparison to the use-phase of the hardware, the production and disposal of cryptocurrency mining devices play a subordinate role of carbon emissions in PoW networks (De Vries Stoll, 2021; Köhler Pizzol, 2019). Especially for ASIC-resistant PoW algorithms, general purpose hardware can be repurposed afterward and is available for secondary markets. Therefore, the carbon footprint of a PoW network largely depends on the utilized electricity sources during the mining process and their respective carbon intensities. To properly identify the carbon intensity of the respective cryptocurrency network, one needs to determine the locations and, ideally, the electricity sources of miners. This is an inherently difficult endeavor due to the nature of mining – – For Bitcoin as the largest PoW network, various estimates on the locations and carbon intensity exist (CBECI, 2022; de Vries et al., 2022; Stoll et al., 2019). In these cases, mining pools have provided data on the location of the connected miners or other information such as IoT search engines have been leveraged for location determination. Nonetheless, these data points face the same issues as previously mentioned, allowing only for a rough estimate of the carbon intensity of the network. To the best of our knowledge, only one estimate on the carbon intensity of the Ethereum network exists. In his paper, Kyle McDonald also analyzed the miner location of Ethereum miners to determine an overall carbon intensity (and thus carbon footprint) of the network (McDonald, 2021). He thereby uses data partly relying on self-reported location by miners as well as further information about mining pools, blog posts, and other sources such as Reddit. In his article, he comes up with a carbon intensity of 320 gCO2/kWh. In comparison, the world average carbon intensity lies at 459 gCO2/kWh (International Energy Agency, 2021), which is significantly higher than McDonald's estimate. Furthermore, estimates for the Bitcoin network are significantly higher ranging from 480 gCO2/kWh to 560 gCO2/kWh (de Vries et al., 2022; Stoll et al., 2019). – – In recent years, Ethereum has faced harsh criticism for its electricity demand and carbon emissions. The Merge and its reduction of electricity consumption and carbon footprint by over 99.98 % marks a significant milestone in both the Ethereum network as well as for the entirety of the cryptocurrency space. After the Merge has taken place, a major step towards environmental sustainability has been done.*

Pages e905 and e917 of "Health consequences of exposure to e-waste: an updated systematic review": *Electronic waste (e-waste) contains numerous chemicals harmful to human and ecological health. To update a 2013 review assessing adverse human health consequences of exposure to e-waste, we systematically reviewed studies reporting effects on humans related to e-waste exposure. We searched EMBASE, PsycNET, Web of Science, CINAHL, and PubMed for articles published between Dec 18, 2012, and Jan 28, 2020, restricting our search to publications in English. Of the 5645 records identified, we included 70 studies that met the preset criteria. People living in e-waste exposed regions had significantly elevated levels of heavy metals and persistent*

*organic pollutants. Children and pregnant women were especially susceptible during the critical periods of exposure that detrimentally affect diverse biological systems and organs. Elevated toxic chemicals negatively impact on neonatal growth indices and hormone level alterations in e-waste exposed populations. We recorded possible connections between chronic exposure to e-waste and DNA lesions, telomere attrition, inhibited vaccine responsiveness, elevated oxidative stress, and altered immune function. The existence of various toxic chemicals in e-waste recycling areas impose plausible adverse health outcomes. Novel cost-effective methods for safe recycling operations need to be employed in e-waste sites to ensure the health and safety of vulnerable populations. – – E-waste contains numerous toxic chemicals including metals such as lead, cadmium, mercury, and nickel, and organic compounds such as flame retardants, chlorofluorocarbons, polycyclic aromatic hydrocarbons (PAHs), polybrominated diphenyl ethers (PBDEs), and polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs). E-waste recycling also recovers valuable materials including iron, aluminium, copper, silver, and rare earth metals but excessive exposure can be noxious. These environmental contaminants pose severe threats to both the health of human beings and the environment. – – Although 78 countries have identified policies, legislation, or regulation governing e-waste, these are not usually legally binding, and —where they are legally binding—enforcement is often a challenge. Ultimately, creating and enforcing policies to prevent the proliferation of e-waste is not nearly enough. In LMICs countries, policies and intervention focusing on curative strategies are imperative for tackling the proliferation of e-waste, both domestic and imported. Further initiatives need to explore cost-effective methods and appropriate technologies based on chemical toxicity for safe recycling operations, including metal recovery and improvement of disposal systems. Such approach should consider the economic benefits of value recovery processes while ensuring the health and safety of populations that depend on informal e-waste recycling for their livelihoods and survival.*

Page 14 of "Methodologies to calculate the proposed mandatory sustainability indicators required by the EU Markets in Crypto-Assets (MiCA) regulation": *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). – – 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.*

*Pages 1 and 2 of "Bitcoin's growing water footprint": In addition to electricity, Bitcoin miners also require water, which is utilized in two main ways. The first involves onsite (direct) water use for cooling systems and air humidification. Water usage de- pends on cooling system types and local climate conditions. It is important to differentiate between water withdrawal and water consumption in terms of this usage. Water withdrawal pertains to the water taken from surface water or groundwater sources, while water consumption refers to the portion of water that becomes unavailable for reuse after withdrawal, primarily due to evaporation in cooling systems. Water consumption is not extensively studied in Bitcoin mining or generic data center research, as reliable data on water consumption factors are challenging to obtain. The second way in which miners use water relates to the (indirect) water consumption associated with generating the electricity necessary to power their devices. Thermoelectric power generation plays a major role in water consumption, as a portion of the withdrawn water for cooling purposes evaporates (unless dry cooling technologies utilizing air are employed). These systems can utilize both freshwater and non-freshwater sources. This commentary, however, exclusively focuses on freshwater consumption. Hydropower generation generally consumes even more water per kilowatt-hour (kWh) generated, as water evaporates from the hydropower reservoirs. However, these reservoirs may serve purposes beyond electricity generation; thus, this commentary considers only the portion of water loss attributable to power generation. The total water footprint of Bitcoin examined in this commentary encompasses the freshwater consumed due to both direct and indirect water consumption during the operational stage of Bitcoin mining devices. The water consumption relating to construction and manufacturing is not considered, as it likely contributes little to the full life-cycle footprint. – – Because the CCAF has provided data on the spatial distribution of Bitcoin miners since late 2019, we can determine that the water footprint of Bitcoin in 2021 significantly increased by 166% compared with 2020. In 2020, the network consumed 591.2 GL of water. Furthermore, the water intensity of electricity consumed rose sharply, from 8.63 L per kWh in 2020 to 15.0 in 2021, signifying a 74% increase. Notably, the majority of this growth can be attributed to increased mining activities in Kazakhstan since late 2020 following China's ban on cryptocurrency mining in spring 2021, which led to miners relocating. The water consumption by Bitcoin miners in Kazakhstan alone amounted to 260.6 GL in 2020 and rose to 997.9 GL in 2021, a 283% increase. Consequently, Kazakhstan accounted for 63% of the net- work's estimated water footprint in 2021. Despite representing a limited share of the total computational power in the Bit- coin network (around 14% by the end of 2021) and having hydropower only play a minor role in electricity generation, Kazakhstan's high water intensity in electricity generation amplifies its impact on the network's water footprint. Notably, the spatial distribution of Bitcoin miners provided by the CCAF has some uncertainty as the underlying sample represents only 44% of the global total computational power in the Bitcoin network. However, an internet outage in Kazakhstan in January 2022 served to confirm the nation's share of the network.*