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CopperBTC: A Proof-of-Metal Tokenization Experiment Through a MiCA Lens

Introduction

CopperBTC is an experimental crypto token project that represents an **asset-linked token** backed by physical copper. It is described as a "proof-of-metal" tokenization experiment, meaning it emphasizes cryptographic proof of a metal reserve (copper) on-chain rather than promises of redemption or monetary stability. This whitepaper examines CopperBTC through the lens of the European Union's **Markets in Crypto-Assets Regulation (MiCA)** classification framework, using MiCA's concepts of token categories, disclosure, and issuer obligations as a guide. By analyzing CopperBTC's design principles against MiCA's taxonomy, we can illustrate a responsible approach to real-world asset (RWA) tokenization that focuses on transparency and risk representation without making any legal or compliance claims.

Scope: While MiCA is an EU regulation, the insights here are written for a global audience of blockchain builders, regulators, and researchers. MiCA's classification system provides a useful mental model for understanding asset-linked crypto projects anywhere in the world. We do **not** assert that CopperBTC is MiCA-compliant or regulated; instead, we use MiCA's terminology and principles to clarify how CopperBTC is structured and what risks or obligations would be considered if it were under that framework. Importantly, this document is **not** legal advice and does not encourage any investment or token purchase. CopperBTC is a purely **experimental** project and is presented here in a neutral, technical manner.

Why Asset-Linked Crypto Assets Struggle with Trust

Asset-linked crypto tokens – often called stablecoins or commodity-backed tokens – face a fundamental **trust challenge**: how can users be sure the off-chain asset is really there and remains there? Blockchains excel at tracking digital token balances but **cannot natively verify the existence or sufficiency of physical reserves** [1]. This creates a *trust gap*: token holders must rely on off-chain information (such as audits, attestations, or custodial reports) to believe that each token is truly backed by the promised asset [1]. Traditional stablecoins have highlighted this problem:

- **Reserves Opacity:** If an issuer does not provide transparent proof of reserves, users are essentially trusting the issuer's word. In the worst cases, this has led to scandals where tokens were not fully backed, resulting in loss of confidence and "bank runs" as users rush to redeem tokens for underlying assets.
- **Point-in-Time Audits:** Even when issuers publish audits or attestations, these are typically **point-in-time snapshots** – e.g., confirming the reserve at the end of a month [1]. Between such audits, conditions may change. Assets could be moved or encumbered, or new tokens could be issued, and the public wouldn't know until the next report. **Attestations provide no cryptographic guarantees; they are only as good as their frequency and the auditor's credibility** [1].
- **Redemption Risk:** Many asset-backed tokens promise redeemability (e.g. a stablecoin can be redeemed 1:1 for fiat). However, in practice redemption can be delayed or halted under stress. If a

custodian holding reserves fails or a regulator freezes funds, even a fully backed token can break its peg. Users saw this with real-world examples like a major USD stablecoin temporarily de-pegging when a portion of its reserve was stuck in a failed bank – despite being "fully backed" on paper.

- **Perpetual Trust Assumption:** Ultimately, a conventional asset-backed token model requires continuous trust in the issuer or custodian. Every token in circulation assumes that off-chain reserves at least equal the token supply at all times [2]. This assumption cannot be *proven* on-chain; it's an external truth that users must accept on faith or through third-party assurances [3]. If that trust erodes (even due to rumors), a run on the token can occur, collapsing its market value long before any audit confirms a shortfall [4].

These challenges have made it clear that **technical design alone is insufficient** for asset-linked tokens – robust transparency and governance mechanisms are needed to bolster trust. Many projects have attempted to bridge the on-chain/off-chain gap with approaches like **Proof-of-Reserve (PoR)** schemes. In a PoR, an independent party periodically compares on-chain token supply to off-chain reserve balances and publishes a signed report or on-chain attestation [5]. Such measures can **narrow the trust gap** by making hidden risks more observable [6]. However, they do not eliminate it completely: they are still periodic and rely on off-chain verifiers. The fundamental issue remains: the further a crypto token strays from purely on-chain collateral, the more trust in people or institutions is required.

CopperBTC's Motivation: CopperBTC tackles this trust problem head-on. It does so not by offering a perfect solution (indeed, as an experiment, it has clear limitations), but by adopting a *"proof-first" design philosophy*. The project emphasizes **on-chain evidence of reserves from day one** (the "proof-of-metal") and makes all trust assumptions explicit to users. Rather than asking users to trust a vague claim that "each token is backed by X units of copper," CopperBTC provides cryptographic proofs and records of exactly what evidence has been provided, by whom, and when. It treats the reserve backing not as an article of faith, but as something that must be continually demonstrated or else clearly marked as unverified if stale. This approach aims to transform asset tokens from opaque IOUs into transparently **evidenced reference tokens**.

In the following sections, we delve into MiCA's crypto-asset classification regime to see how such an experiment fits. MiCA's framework was chosen as our lens because it compels a focus on **what a token represents (and the risks therein)** rather than how it is marketed. This aligns well with CopperBTC's ethos: cutting through narratives and ensuring the token's design and disclosures plainly reflect its real characteristics.

Why Classification Matters More Than Narratives

In the unregulated wilds of crypto, projects often craft their own **narratives** for tokens – calling something a "utility token," a "stablecoin," an "NFT," etc. – sometimes with the hope of fitting or avoiding certain regulations. MiCA offers a reality check: it classifies crypto-assets based on **objective features and economic purpose** rather than marketing labels. This classification matters more than any storyline a project tells.

MiCA's Token Taxonomy: Under MiCA, there are three primary categories of crypto-assets (excluding those already regulated elsewhere or explicitly exempted):

1. **E-Money Tokens (EMTs):** Crypto-assets that **purport to maintain a stable value by referencing a single official fiat currency** [7]. In essence, these are fiat-pegged stablecoins (e.g., a token aiming to stay equal to 1 EUR or 1 USD). By law, only licensed banks or electronic money institutions can issue EMTs [8], and holders have a right to redeem at face value (like traditional e-money) [9]. EMTs are tightly regulated because they mimic money – if widely adopted, they could impact monetary stability.

2. **Asset-Referenced Tokens (ARTs):** Crypto-assets that **aim to maintain a stable value by referencing any other asset, combination of assets, or non-fiat value or right** [10]. This is a broad bucket covering *all other "stablecoins"* that are not single-fiat. An ART might reference a basket of currencies, a commodity (e.g., gold), or even another crypto-asset or index. Importantly, MiCA's definition of ART is very expansive: if a token is designed such that its value is pegged or tied to some external reference asset (other than one fiat currency), it likely qualifies as an ART [11] [12]. For example, a token fixed at 1 ounce of gold, or one tracking the price of 1 BTC (like wrapped BTC), or a token soft-pegged to a commodity index – all would be ARTs in MiCA's view. *Whether the reference asset's own price is volatile is irrelevant*; the key is the token's **peg or reference mechanism** [13]. If 1 token represents 1 unit of some asset, the token "purports to maintain" equal value to that unit, even if that unit's market price fluctuates [14].

3. **Other Crypto-Assets:** Any crypto-assets that are **neither EMTs nor ARTs**, and not otherwise excluded from MiCA [15]. This category includes things like Bitcoin, Ether, utility tokens for DApps, governance tokens, memecoins, etc. Essentially, these tokens have a **free-floating value** driven by market supply/demand, not by an explicit peg to something. MiCA treats this as a residual category – if a token doesn't fit EMT or ART (and isn't a security or unique NFT etc.), it's an "other" crypto-asset by default [16].

Exclusions: MiCA explicitly excludes certain assets from its scope. Notably, fully **unique, non-fungible tokens** (NFTs) are out of scope, as are crypto assets that are so **decentralized** that they have no identifiable issuer or person offering them [17]. Also excluded are crypto-assets that qualify as traditional financial instruments (securities, deposits, funds, derivatives, etc.) which are regulated under other laws [18] [19]. The intent is that MiCA fills the regulatory gap for crypto-assets that don't fall neatly under existing financial regulations. (It's worth noting that determining whether something is truly an NFT or truly decentralized can be nuanced – regulators will look at the substance, not just form).

Why getting the classification right matters: Each category above comes with **different regulatory requirements** and reflects different risk profiles:

- If a project claims to issue a "stablecoin," under MiCA it *must* determine if that means an EMT or ART. This isn't just semantics – an **EMT (single currency stablecoin)** is only lawful in the EU if issued by a licensed entity like a bank [20]. Many crypto startups discovered that a USD-pegged token would effectively require them to become an e-money institution – a high bar. Some have tried to avoid this by calling their token "algorithmic" or "decentralized" stablecoin. MiCA looks past those labels: if the token's value is **effectively referencing 1 USD**, it's an EMT regardless of how it's collateralized [21]. *For example, the early version of DAI (a so-called decentralized stablecoin) was collateralized by ETH, but it*

was designed to maintain a USD peg; MiCA would class that as an EMT because the value reference was $1.00, not ETH [22] . Misunderstanding this could lead to non-compliance and significant legal risk.

- Projects often prefer the term "utility token" to imply the token is just for access or not a regulated asset. MiCA does define **utility tokens** narrowly – their *sole purpose is to provide access to a good or service by the issuer* [23] . If a token's value comes from anything else (like secondary trading, or it's pegged to an asset, etc.), it's not a pure utility token under MiCA's definition [24] . Thus, calling a gold-backed token a "utility coin" won't fly; regulators will treat it as an ART stablecoin, because that's what it functionally is.

- Some projects believed that if they do not explicitly promise redemption, they might avoid being seen as "asset-referenced." However, MiCA's definition of an ART doesn't strictly require a legal redemption promise; it looks at the *intent to maintain stable value by reference*. Many tokens that are fully collateralized or wrapped (like wrapped BTC or staked ETH tokens) **are ARTs by design, even if they are just technical wrappers** [25] [26] . This has been a surprising realization: even **wrapped tokens and liquid staking tokens likely fall under ART** classification because their value is derived from another asset's value on a 1:1 basis [11] . In other words, MiCA cares about economic reality: if Token A is always supposed to be worth 1 unit of Asset B, then Token A references Asset B's value (hence an ART), regardless of the technology or if arbitrage bots (not the issuer) maintain the peg.

In summary, MiCA forces builders to **know thy token**. It emphasizes **risk representation**: what risk does holding this token entail, and what stabilizes its value? A project can't hide behind creative terminology. This focus on classification is not mere bureaucracy; it's aimed at applying appropriate rules to different risk profiles. For instance, a token referencing external assets (ART/EMT) is seen as posing potential risks similar to investment or payment products, so issuers must provide extensive disclosures and meet prudential standards. Meanwhile, "other crypto-assets" like a governance token for a game might need far less oversight.

CopperBTC's narrative vs classification: CopperBTC brands itself as a *"proof-of-metal reference token."* The narrative is that it's an experiment in tokenizing copper with on-chain proof mechanisms, rather than a traditional redeemable stablecoin or investment product. Through MiCA's lens, however, we must identify what category CopperBTC would likely fall into if it were in the EU. As we'll discuss next, CopperBTC does not fit neatly into the **utility token** category (it's not for access to a digital service, but rather represents an external asset). It also is clearly **not an EMT** (it doesn't reference any fiat currency, let alone a single one). By elimination, CopperBTC most closely aligns with the **Asset-Referenced Token (ART)** category, since it references a commodity (copper) as the source of its value. However, it also diverges from typical ART stablecoins in a few important ways. Understanding both the fit and the misfit of CopperBTC within MiCA's taxonomy will clarify the project's design choices and the regulatory considerations they highlight.

What MiCA Actually Classifies

Before zeroing in on CopperBTC, it's important to clearly understand MiCA's categories in more detail – particularly EMTs and ARTs – and what exactly MiCA regulates for each. MiCA is less about technology (it's blockchain-agnostic) and more about **economic function and risk**. It doesn't ban any particular kind of token outright; rather, it sets conditions and disclosure requirements depending on what the token is **meant to do or represent**.

E-Money Tokens (EMTs): These are essentially crypto stablecoins that mirror one fiat currency. An EMT's defining trait is **referencing a single official currency and aiming for a stable value equal to that currency** [7]. For example, a token aiming to always trade around 1 EUR or 1 USD is an EMT. MiCA treats EMTs similarly to how electronic money is treated in traditional finance:

- **Issuers must be licensed financial institutions.** Only a **credit institution or an Electronic Money Institution (EMI)** can issue EMTs in the EU [8]. This is a major legal hurdle – effectively, crypto startups cannot issue a Euro stablecoin unless they partner with or become an EMI. The reasoning is that a fiat-referenced token is a close substitute for fiat itself, so it should be as safe as holding money in a bank.
- **Redemption Rights:** Holders of an EMT have a legal right to redeem their tokens for the underlying currency at par (face value) at any time [9]. This mirrors e-money directives – if you have a €100 stablecoin (EMT), you must be able to get €100 back from the issuer upon request, under normal conditions.
- **Reserve Management:** MiCA imposes strict rules on how EMT reserves are managed. For instance, at least 30% of the reserve must be held in highly liquid assets (like cash in a bank) and the rest in low-risk instruments [27]. This is to ensure that redemption requests can be met even under stress.
- **No Interest:** EMTs cannot pay interest to holders [28]. They are meant to be value-stable, not investment products. Paying interest could encourage people to treat them as savings, which raises separate regulatory concerns.
- **Supervision:** The European Banking Authority (EBA) directly supervises EMTs, given their money-like nature [29]. There are also provisions for "significant" EMTs (large user base or volume) that face additional oversight.

In short, MiCA positions EMTs as very conservative, tightly regulated instruments – effectively bridging crypto tokens with traditional e-money. The focus is on **safety, liquidity, and accountability of issuers**.

Asset-Referenced Tokens (ARTs): ARTs cover a broad range of tokens whose value is tied to one or several assets (excluding the single-fiat case). According to MiCA, an ART is *"a type of crypto asset that is not an electronic money token and that purports to maintain a stable value by referencing another value or right or a combination thereof, including one or more official currencies"* [30]. Key points about ARTs:

- **Examples:** A token pegged to a **basket of currencies** (like the never-launched Libra/Diem concept) is a classic ART. So is a token backed by **commodities** (e.g., one token = 1 gram of gold, such as Tether Gold) [31]. Even tokens referencing **other crypto** fall here: for instance, a **wrapped Bitcoin (WBTC)** that represents 1 BTC on Ethereum would be considered an ART – it's "referencing another value" (BTC) and aiming to maintain a 1:1 ratio [32] [33]. Similarly, **liquid staking tokens** like staked ETH (stETH) are essentially referencing the value of ETH plus some yield, so they can be seen as ARTs in MiCA's broad interpretation [34].
- **Issuers and Authorization:** Unlike EMTs, ARTs *don't have to be banks*, but issuers must be **legal entities established in the EU** and they must go through a **registration and authorization process** (unless exempt for small or private offerings) [35] [36]. ART issuers need to publish a detailed crypto-asset white paper (similar to a prospectus) and get regulatory approval to offer the tokens to the public.
- **Reserve Requirements:** ART issuers must maintain **reserve assets** that correspond to the reference assets of the token. These reserves have to be of high quality and diversified (to reduce risk of one asset failure) [37]. For example, an issuer of a gold-referenced token should actually hold gold (or

very closely correlated assets) equivalent to the token supply. They also need systems to monitor and manage the reserves continuously.

- **Governance and Conduct:** MiCA places substantial governance obligations on ART issuers: proper management, conflict of interest policies, contingency plans, complaints handling, etc. [37] . This reflects that an ART could have many users relying on the issuer's integrity (if, say, millions use a stablecoin backed by assets).
- **Significant ARTs:** If an ART becomes systemically important (based on metrics like number of holders, market cap, transaction volume), extra rules kick in. These can include higher capital requirements or closer supervision by regulators [38] [39] . The idea is to prevent a large "stable token" from crashing and causing broader financial instability.
- **No Interest:** Similar to EMTs, ARTs cannot pay interest to token holders [40] . They're meant to be used as a means of exchange or store of stable value, not as interest-bearing investments (which could make them akin to securities or fund units).

One interesting criterion in MiCA's definition of ART is that it **envisions redemption**: an ART is described as one that *"can be redeemed at market value"* [41] . This implies that holders should be able to go to the issuer and redeem their tokens for the underlying assets at the prevailing price (not a fixed price, since the reference might fluctuate – e.g., redeem a gold token for equivalent gold value). This is a bit different from EMT (which is redeemed at face value since fiat doesn't fluctuate against itself). The redemption aspect is key for maintaining the peg in practice: arbitrageurs will redeem if tokens trade below backing and will buy if above, keeping price aligned with referenced asset. MiCA effectively expects ART issuers to allow such mechanisms.

Other Crypto-Assets: MiCA's third category is a catch-all for tokens that don't aim for any stable reference. This includes things like cryptocurrencies (BTC, ETH) and tokens meant for utility or governance. For these, MiCA's requirements are lighter (Title II of MiCA deals with them). Issuers still have to publish a white paper with disclosures if they publicly offer the tokens in the EU [17] , but there is no reserve or stabilization mandate (since these tokens float freely by market forces). Many of the "altcoins" or protocol tokens would fall here. CopperBTC, however, clearly does not; it's tied to an asset.

What MiCA Regulates (and what it doesn't): It's crucial to note **MiCA regulates the activities around crypto-assets, not the assets' intrinsic legality**. There is no such thing under MiCA as a "MiCA-compliant token" in isolation [42] . Instead, **issuers and service providers** must be compliant when doing certain activities (issuing tokens to the public, trading them on exchanges, providing custody, etc.). MiCA doesn't outlaw any type of token; it sets conditions for how they can be offered or used in a regulated environment. For instance, a project outside the EU could issue a gold-backed token and ignore MiCA; nothing stops the code from existing. But if they want to offer it to EU consumers or list on EU exchanges, they'd run into MiCA obligations. Likewise, a token like Bitcoin, which has no issuer, is not illegal under MiCA; it's just categorized as an "other crypto-asset" and exchanges/custodians dealing with it have to follow certain rules.

MiCA also explicitly does **not cover** some domains: - **Decentralized protocols**: If truly no issuer or central party exists (e.g. a fully decentralized DEX token that was not issued by any company), MiCA's issuer-focused rules might not apply [43] . However, what is "completely decentralized" is a high bar. - **NFTs**: Unique, one-of-a-kind tokens are exempt, but MiCA warns that if NFTs are structured as a collection with similar features or economic purpose, they might *not* be considered unique (and thus could fall under MiCA). So calling something an NFT won't guarantee exemption if it's essentially a fungible or fractional asset in practice [44] . - **Security tokens**: If a token is essentially a security (equity, bond, fund share), it's not under MiCA but under existing securities laws (MiFID, etc.) [45] . For example, if CopperBTC were structured to give holders

ownership in a copper stockpile with profit rights, it could be deemed a transferable security, outside MiCA scope but then governed by securities law.

For our analysis, we assume CopperBTC is squarely a crypto-asset under MiCA's scope (not a security, not an NFT, not issued by a government, etc.). The relevant question is: is it an ART or something else?

Where CopperBTC Fits – and Where It Does Not

CopperBTC as an Asset-Referenced Token: Based on MiCA's definitions, CopperBTC would most likely be classified as an **asset-referenced token (ART)**. CopperBTC's value proposition is that each token represents or is backed by a certain quantity of physical copper held somewhere (e.g., in a warehouse). It aims to maintain a stable relationship to that copper – presumably 1 CopperBTC token corresponds to a fixed weight of copper (for example, 1 token = 1 kilogram of Grade A copper, hypothetically). In other words, **the token's value is referenced to the value of a metal**. This is analogous to gold-backed tokens like Tether Gold, which MiCA squarely considers ARTs [46].

Under MiCA, since CopperBTC does *not* reference an official currency, it is not an EMT [47]. It falls into the category of tokens referencing "another value or right" – the value of copper – thus meeting the ART definition. Even though copper's price fluctuates on the market, the token *purports to maintain a stable equivalence to a certain amount of copper* (just as a gold token maintains a 1:1 link to an ounce of gold, fluctuating in price as gold does) [13]. The *intent* is that if copper is worth $X per unit, then each token should be worth about $X (ignoring any minor market deviations), because of the backing.

However, **CopperBTC also fundamentally differs from typical ART stablecoins in several ways**, which means it doesn't fit the archetype of an ART that MiCA had in mind (namely, a payment-oriented stablecoin). Let's break down where CopperBTC aligns with ART expectations and where it diverges:

- **No Redemption for Fiat or Underlying:** A core expectation in MiCA for ARTs is redeemability – that tokens can be turned in for their underlying assets at fair value [41]. CopperBTC's design is **non-custodial and non-redeemable**: token holders are *not* promised that they can redeem CopperBTC for actual copper. In fact, there is no mechanism for a holder to trade their token for physical copper from the issuer, because the project explicitly avoids creating an IOU or debt obligation. This is a deliberate choice to **avoid the legal and financial complexities of custody** (it also means holding CopperBTC does not equate to legal ownership of copper; it's more like holding a proof or certificate that some copper exists somewhere, as evidenced at a point in time). By foregoing redemption, CopperBTC steps outside the usual stablecoin model. MiCA would still likely **classify it as an ART** (since it references copper's value), but if strictly interpreted, one could argue it fails the "can be redeemed" criterion. In a sense, CopperBTC is an **ART without the safety net** – normally a stable asset's price is kept aligned via arbitragers redeeming when price < backing. For CopperBTC, market price could diverge from copper's spot price because arbitrage is limited (no direct redemption). The token might trade at a discount if trust in the backing is low, or possibly a premium if demand to hold a proof-of-copper is high and supply is limited. The project acknowledges this risk; it is *not* selling a guaranteed stable value instrument, but rather an experimental reference token.

- **Not a Means of Payment:** Most well-known stablecoins (whether fiat-backed or commodity-backed) pitch themselves for use in payments, trading, or as a store of value. CopperBTC, by contrast, is unlikely to be used for everyday payments or DeFi liquidity in its current form. Copper as an asset is

not a currency; it's an industrial commodity. The **use-case for CopperBTC is more niche and experimental**: it's for demonstrating a concept, not for being a widely circulating medium of exchange. This difference matters because MiCA's heavier regulations for ARTs were motivated by the concern that stablecoins could become widely used as money. CopperBTC is not trying to be "money" or even a mainstream stablecoin. It is better viewed as a *proof-of-concept* for a more transparent commodity tokenization method. In practical terms, that could mean some MiCA requirements (like strict reserve management, business continuity plans for a payment token, etc.) feel a bit out of place when mapping onto CopperBTC – because CopperBTC is not aimed at scale or payments at this stage. Nonetheless, legally it doesn't get a different category; it's just an unusually frank and contained ART.

- **Not a Utility Token:** CopperBTC does not grant access to any platform service, nor does it confer governance or usage rights in a blockchain network. Its **sole link is to an external commodity**. Therefore, it clearly is not a "utility token" by MiCA's definition [24]. It doesn't function like a software license or a membership token; it functions as a tokenized commodity reference. Sometimes crypto projects attempt to spin an asset token as a utility token to avoid regulatory scrutiny (e.g., "our gold token is for accessing our platform that tracks gold prices"); CopperBTC does not attempt such obfuscation. It's plainly an asset-reference experiment, not a backdoor utility token.

- **Proof-of-Metal Reference Token – A New Concept:** The term **"proof-of-metal reference token"** is not a standard category in regulation, but it succinctly describes CopperBTC's intent. Essentially, CopperBTC is pioneering a model where the emphasis is on *proving the existence and integrity of a reserve*, rather than on assuring convertibility of the token into that reserve. It's as if each token is a cryptographic **receipt or certificate of proof** that a certain amount of copper was held at a certain time, rather than a claim check to withdraw copper at will. In MiCA terms, one could say CopperBTC focuses on **disclosure and transparency** (key MiCA principles) even more than on the usual mechanism of redemption that underpins stable value. This approach addresses some trust issues (users can verify evidence of reserves themselves) but trades off the traditional economic stabilizer (redemption arbitrage).

From a MiCA perspective, CopperBTC's approach is intriguing because it aligns well with MiCA's spirit of **enhanced disclosure and honesty** about risks, while not providing the full investor protection measures (like guaranteed redemption) that MiCA would normally require of an ART. However, since CopperBTC is not being offered as a retail financial product (it's explicitly experimental and non-investment), the aim is to **learn how far transparency and cryptographic proof can go in creating trust** – possibly informing future projects that might then layer on redemption or more formal structure.

In summary, **CopperBTC fits into MiCA's ART category** in that it is a crypto-asset referencing the value of a physical asset (copper) rather than having free-floating value of its own. But it also *does not fit the mold of typical ART stablecoins*: it doesn't promise stability in fiat terms, doesn't offer redemption, and isn't trying to be a widely-used currency substitute. One might say CopperBTC is *what an ART looks like if designed purely for transparency and not for mass adoption*. This positions it somewhat outside the core target of MiCA's heavy-handed rules (which were written with globally ambitious stablecoins in mind). Nonetheless, analyzing CopperBTC in the ART framework is useful: it forces us to ask how it addresses the same concerns MiCA has – such as reserve management, disclosures, governance – and where it intentionally diverges.

The next sections will highlight how CopperBTC's **design principles** have been informed by the types of requirements and risks that MiCA identifies for asset-referenced tokens, even though CopperBTC stops short of claiming any regulatory compliance. We'll also discuss the system's phased architecture, which shows a roadmap to progressively increase trust and monitoring – echoing regulatory expectations for sound reserve-backed tokens.

Design Principles Informed by MiCA

CopperBTC's architecture and policies were crafted with clear awareness of the **risks that regulations like MiCA seek to mitigate**. While CopperBTC is not marketed as MiCA-compliant, it proactively embraces several core principles that MiCA imposes on issuers – specifically around **transparency, risk disclosure, and trust minimization**. The goal is to demonstrate a best-effort, good-faith design that could hold up to scrutiny by serious users or even regulators, *even as an unofficial experiment*. Here are the key design principles of CopperBTC and their connection to MiCA's expectations:

- **Explicit Disclosures and Disclaimers:** MiCA requires that any offer of crypto-assets to the public be accompanied by a **white paper** containing all essential information about the project (akin to a prospectus) [42]. This includes how the token works, the rights and risks for users, details on the issuer, reserve details for ARTs, etc. CopperBTC's approach mirrors this emphasis on disclosure. From the outset, CopperBTC documentation explicitly clarifies what the token **does and does not** guarantee. For example, it is disclosed that CopperBTC is *not redeemable* for copper, that it carries no promise of financial return, and that it is purely experimental. Any assumptions – such as trusting a certain storage provider to hold the copper, or relying on an attestation at a given date – are openly stated. The project's messaging avoids hyperbolic marketing; instead of claiming to be "fully backed and safe", it explains the proof mechanism and its limits. This level of candor is very much in the spirit of MiCA's requirement for clear, fair, non-misleading communication. By being upfront, CopperBTC protects users from false impressions – e.g., a user should not buy CopperBTC thinking "this is as good as owning copper" because the materials clearly state it is *not* an ownership claim, just a reference.

- **Separation of Roles: Custody, Pricing, Evidence, and Time:** A recurring theme in financial regulation is separation of concerns to avoid conflicts of interest and single points of failure. MiCA, for instance, distinguishes between the issuer of a token, the custodians of reserves, the auditors of those reserves, and so forth, often expecting independent oversight. CopperBTC's design consciously **decouples several key functions**:

- *Custody vs. Issuance:* The physical copper that underpins the experiment is held by a custodial entity (for example, a warehouse or vault provider). The CopperBTC smart contract (on-chain) and project team do not themselves hold the metal; they rely on an external custodian. This means that any claim about the copper's existence is not just an internal self-assertion; it comes with documentation from a third party. (However, we note that unlike a regulated stablecoin, this custodian may not be formally supervised or insured – another reason for transparency).
- *Pricing Oracles vs. Evidence Attestation:* If CopperBTC were to ever use on-chain price feeds (for instance, to display the current copper price in USD for reference), those oracles are separate from the reserve evidence system. They have no control over minting or burning tokens; they simply provide information. Conversely, the evidence attestor (the mechanism that verifies and records that

"X amount of copper was present at time T") does not dictate pricing or token transferability. Each component can be adjusted or improved independently.

- *Evidence vs. Token Minting:* CopperBTC's token minting is directly tied to evidence submission. Tokens are only minted when there is proof of copper reserves to back them (in the initial phase, that was a one-time event). The evidence consists of documents and data (e.g., warehouse receipts, photos, assay reports) whose **cryptographic hash is stored on-chain**, proving that a specific unaltered document was used [48]. The decision to mint or not mint is thus linked to an objective input (the presence of a valid evidence package). This separation ensures that tokens cannot be arbitrarily created without new evidence – which is conceptually similar to MiCA's requirement that ART issuers manage supply to remain matched with reserves [49].

- *Time Separation (Phase-Based Approach):* Recognizing that evidence can go stale, CopperBTC is architected in **phases** (elaborated in the next section). The initial phase (Phase 0) treats the reserve proof as a **point-in-time event**, suitable for bootstrapping but not for perpetuity. Later phases introduce time-based checks and updates. By structuring the project in phases, CopperBTC separates the concerns of *initial issuance* from those of *ongoing monitoring*. This phased separation allows the project to evolve its trust model over time without overpromising on day one. MiCA similarly staggers certain obligations – e.g., it doesn't require non-significant ARTs to have continuous supervision unless they grow big, but if they do grow, more oversight kicks in. CopperBTC, in a parallel way, says: in Phase 0 we prove reserves at issuance; in Phase 1+ we will layer in periodic re-proofs and perhaps automated alerts.

- **Avoidance of Implicit Trust Assumptions:** Perhaps the most important principle is that **CopperBTC tries not to hide any trust assumptions**. Traditional stablecoin issuers sometimes implicitly ask users to trust that everything is fine between audits, or trust that the management will always act prudently. CopperBTC, by design, surfaces the trust points and attempts to minimize them:

- It does not assume perpetual backing without renewal of proof – it explicitly plans for re-attestation phases to re-confirm the backing or otherwise let everyone know if backing hasn't been reaffirmed recently.
- It leverages **cryptographic proofs (hashes)** to ensure that evidence, once published, cannot be tampered with or denied. For instance, when a warehouse receipt and inspection report is produced for the copper stock, CopperBTC's system generates a hash of that document bundle. That hash (a content identifier) is stored on-chain, perhaps as part of an NFT or a registry. Anyone can take the document file, hash it, and verify it matches the on-chain hash, proving the document is exactly the one used for issuance [48]. If someone altered a single word or date on the PDF, the hash would differ, and the discrepancy would be obvious. This use of **IPFS/content-addressed storage** means that evidence is **self-verifiable by the public** [50] [48]. It's not just "the issuer says they have the documents"; the documents (redacted if needed for privacy) can be made available, and anyone can independently validate that they are the original, unmodified evidence referenced by the smart contract.
- CopperBTC does not assume users will blindly trust the team. It encourages users (at least the sophisticated ones, like researchers or auditors) to actually inspect the evidence on IPFS, check the hashes, and confirm for themselves that, for example, the warehouse receipt indeed shows the claimed quantity of copper on the stated date, with appropriate signatures. This is an invitation to **"don't trust, verify"** – a motto borrowed from blockchain culture. While average token holders may not do this, making it possible aligns with best practices.

- No essential process in CopperBTC relies on a single human's discretion without oversight. For example, if a Phase 1 design includes an **oracle for freshness**, that oracle might be programmed to automatically flag if no new proof-of-copper has been posted on-chain for, say, 90 days. It wouldn't rely on a manual decision by the issuer to announce that information; it would be algorithmic. Similarly, custody is ideally conducted by a reputable third party who issues receipts in their ordinary course of business, reducing the need to trust the internal team's word.
- Finally, the **non-custodial token model itself** (no redemption) ironically removes one trust assumption: users are not led to believe "I will definitely get copper or money back." By not establishing that expectation, CopperBTC avoids the scenario where users have false confidence in a redemption that might fail. Instead, any value the token has on the market is purely based on the *market's collective trust* that the evidence of copper implies some economic value. This is arguably a more honest starting point for an experiment: it may trade at a discount to spot copper (reflecting that holders can't redeem easily), which is a transparent way for the market to price in the trust gap. If the project had instead promised redemption while lacking regulatory structure, users might misconstrue it as risk-free, which is worse.

In essence, CopperBTC's design principles serve to **maximally align the project with MiCA's goals of transparency and risk awareness**, even if not formally complying with every rule. By separating key roles, requiring evidence for token creation, and making all processes as verifiable as possible, CopperBTC reduces the reliance on blind trust. MiCA focuses on disclosure and sufficient collateral; CopperBTC delivers disclosure (through this paper and on-chain evidence) and ensures collateral presence at issuance (through proof). Where CopperBTC falls short of MiCA's ideal (for instance, ongoing collateral monitoring and guaranteed redeemability), it does so transparently and with future plans to address those areas in incremental steps.

Next, we will outline the **phase-based architecture** of CopperBTC, which is the roadmap by which the project intends to incrementally increase assurance (and thereby approach something that could, one day, meet more of the regulatory expectations). We will see how Phase 0 establishes baseline integrity, and how Phase 1 and beyond aim to introduce dynamism (re-attestation, oracles) to improve the model's reliability over time.

Phase-Based Architecture

To balance ambition with realism, CopperBTC is being implemented in **phases**, each adding new features and assurances. This phased approach acknowledges that fully solving the RWA trust problem is complex; rather than over-promise upfront, CopperBTC starts with a minimal viable approach and then iteratively improves it. Here's an overview of the phases:

Phase 0: Point-in-Time Evidence Integrity

Phase 0 is the **initial launch phase** of CopperBTC. In this phase, the focus is on **establishing the integrity of the reserve evidence at the moment of token issuance**. The core elements of Phase 0 are:

- **Initial Reserve Attestation:** A fixed quantity of physical copper is secured (for example, 1 metric ton of copper cathodes in a warehouse). The project obtains verifiable documentation of this reserve: warehouse receipts, inventory lists, perhaps photographs or assay reports confirming the copper's presence and quality. This documentation is essentially a *snapshot in time* of the reserve.

- **On-Chain Hashing of Evidence:** All documents in the attestation bundle are hashed using a cryptographic hash function (e.g., SHA-256). The resulting hash (or hashes) are published on-chain, for instance by minting an NFT whose metadata includes the hash, or by directly storing the hash in the CopperBTC token smart contract's state. By doing this, CopperBTC creates a **tamper-proof fingerprint of the evidence** on the blockchain [48]. Any observer can later take the original evidence files, hash them, and see that the hash matches the on-chain value, proving that those files are exactly what were used to back the tokens.
- **Token Minting Tied to Evidence:** CopperBTC tokens (cuBTC) are then minted in proportion to the amount of copper evidenced. For example, if 1 cuBTC is defined as 1 kilogram of copper and the evidence shows 1000 kg of copper, then 1000 cuBTC tokens would be minted. The smart contract logic ensures that minting can only be triggered in the presence of a valid evidence hash (i.e., Phase 0's issuance was a one-time event executed by the deployer after uploading the evidence hash).
- **Distribution of Tokens:** In the experiment, tokens might be distributed to project participants or made available on a test market. Crucially, since this is not a sale or investment, the distribution is likely done for free or in a controlled manner (perhaps given to community members or testers). This avoids the scenario of a public investment into the token that could raise immediate regulatory red flags or create investor expectation of profit. The tokens simply represent the copper proof concept.
- **Public Availability of Evidence:** The actual evidence documents (perhaps in PDF form) are uploaded to a public datastore like IPFS. The IPFS content ID (which is effectively a hash of the content) can serve as the hash stored on-chain, or be linked to it [51] [52]. Interested users or auditors can retrieve the documents from IPFS using that ID and manually inspect them. This step is crucial for transparency: it's not enough to publish a hash if no one can get the underlying data. By using IPFS or a similar content-addressable network, CopperBTC ensures the evidence is readily accessible to anyone (barring IPFS node availability issues).
- **Static Model (No Ongoing Updates):** In Phase 0, once tokens are issued, there are *no automatic updates* or feeds to confirm that the copper is still there beyond the initial snapshot. This is by design for the first phase – it keeps the system simple and lets observers evaluate how the token behaves when backed by a one-time attestation. However, it means that as time goes on, the initial proof becomes stale. CopperBTC Phase 0 openly acknowledges: *this token only has guaranteed proof as of the issuance date*. After that, the issuer could run off with the copper or it could be sold – the blockchain won't know. Essentially, Phase 0 sets the foundation but leaves the **temporal gap** unaddressed (a gap MiCA would insist be addressed by continuous monitoring in a production scenario).

The **achievement of Phase 0** is that it demonstrates a fully on-chain verifiable reserve attestation at inception. This alone is a step beyond many asset tokens which have, in the past, sometimes launched with vague claims or only off-chain audits with no cryptographic linkage. CopperBTC Phase 0 shows that it's possible to create a token where the provenance and backing are documented in an immutable, verifiable way at the start. It answers the question: *"How do we know these tokens were initially backed by something real?"* – Answer: because anyone can verify the exact documents that prove the copper existed at issuance, and those documents can't be falsified retroactively without breaking the hashes.

Limitations in Phase 0: Of course, Phase 0 alone is not sufficient for a long-lived token: - **No Freshness Guarantee:** As noted, there's no guarantee that six months later the copper is still there. Users have to trust that unless new evidence is provided, they should be cautious. This might limit the token's value or usage. MiCA would not be satisfied with this for a consumer product – regulators want continuous assurance – but as an experiment, it's an acceptable starting point as long as it's disclosed (which it is). - **No On-Chain Enforcement of Backing after Mint:** If, hypothetically, the CopperBTC team had malicious intent, they

could issue the tokens with genuine proof, then quietly remove the copper and hope no one notices. In Phase 0, nothing on-chain would prevent that scenario because the smart contract doesn't "feel" the loss of collateral. The only recourse is social/legal (and the reputational stakes of the project's honesty). This again is openly acknowledged as a risk. - **Market Dynamics:** Without redemption, Phase 0 CopperBTC tokens might trade below the copper spot price. Arbitrageurs can't close the gap by redeeming, so the token's market price will incorporate a discount for the lack of liquidity and ongoing assurance. This is an interesting data point for the experiment: how much discount does the market apply to a non-redeemable but transparently backed commodity token? It provides insight into how much value transparency adds, and how much value the missing redemption subtracts, in the eyes of traders.

Phase 1: Ongoing Attestations and Freshness Oracles

Phase 1 (and beyond) plans to tackle the biggest gap of Phase 0: the lack of ongoing verification. In Phase 1, CopperBTC introduces features for **continuous or periodic reserve assurance**, moving closer to the standard expected of stable-value tokens.

Possible features in Phase 1 include:

- **Periodic Re-attestation:** The project would engage an auditor, inspector, or even the custodian themselves to **periodically verify the copper reserve** (e.g., monthly or quarterly). Each time a re-check occurs, new evidence documents are generated (updated inventory statements, maybe time-stamped photos of the copper, etc.). These are again hashed and stored on-chain, effectively appending a new proof entry (or updating the existing NFT) with a newer timestamp. The CopperBTC contract or a related registry could maintain a log of these attestations. This creates a chain of proofs: one can see proof for January, then proof for April, etc. If any proof is missed or delayed, that gap itself is informative.
- **Supply Lock or Alerts if Attestation Lapses:** To align incentives, the smart contract could be programmed such that if no new attestation is provided within a certain period, certain functions trigger. For example, it might **pause token transfers** (freezing the token) until a fresh proof is submitted, or perhaps more softly, it could issue an on-chain event or flag that wallets/dApps can read to warn users ("WARNING: backing not verified for >90 days"). An oracle or watcher service could implement this by watching the timestamps of the last attestation on-chain.
- **Proof-of-Reserve Oracle Integration:** Instead of (or in addition to) human audits, CopperBTC might integrate with emerging **Proof-of-Reserve oracles** (like Chainlink's PoR feeds). These oracles can be set up to regularly query custodial data (if available via API or other means) and publish signed statements on-chain about the reserve status. For instance, a PoR oracle could publish "Vault #123 currently holds 1000kg of copper, last checked on 2026-06-01". If CopperBTC can arrange data access (perhaps the custodian cooperates), this would automate the freshness checks. The smart contract could read this feed and use it to confirm backing in real-time. This is cutting-edge, and not trivial – it requires trust in the oracle and data source – but it would significantly narrow the trust gap. Essentially it brings the off-chain data closer to the on-chain world on a continuous basis [53] .
- **Circuit-Breakers for Integrity:** Phase 1 might implement safeguards: e.g., if an attestation comes back indicating a shortfall (say only 900kg remains when 1000 tokens are outstanding), the system could automatically **halt new transfers or minting** to prevent further transactions until resolved. It might even allow an emergency redemption or buyback by the issuer to cover the shortfall. These are advanced features and venture into compliance territory (since making users whole for a shortfall is basically what a regulated issuer would be obliged to do). CopperBTC as an experiment

might not go so far, but exploring these mechanisms would show how a "proof-of-metal" token could gracefully handle discrepancies.

- **Transparency Dashboard:** Along with on-chain updates, Phase 1 could provide an open dashboard (web interface) that anyone can check to see the status of the copper reserve vs token supply in near-real-time. This is more a usability feature, but important for building user trust. It replicates what MiCA would want an issuer to communicate: up-to-date info on reserves.
- **Maintaining Non-Custodial Stance:** Notably, even in Phase 1, CopperBTC can remain *non-custodial* from the token perspective. The project team does not hold users' tokens or their copper; users still cannot demand copper out. The improvements are in *information flow*, not in granting new rights. This is deliberate to keep the project an experiment and not a regulated commodity vault.

Phase 1 basically attempts to **"close the loop"** so that CopperBTC is not just honest at inception, but honest over time. If these features are implemented well, CopperBTC would start to resemble a professionally run stablecoin in terms of transparency – arguably even superior to some, if everything is on-chain and open. MiCA's concerns about stable-value tokens (EMTs/ARTs) revolve around issuers maintaining reserves and keeping users informed; Phase 1 is a voluntary move in that direction, but via technology and self-regulation rather than law.

Phase 2 and Beyond: Towards Full Reserve Assurance

While the prompt mostly asks for Phase 0 and 1, it's worth briefly speculating on further phases (Phase 2+), which might explore more innovative or robust mechanisms:

- **Decentralized Auditing:** Perhaps involve a **network of independent validators** who each confirm the reserve (using methods like witnessing vault inventory via IoT sensors or cameras, then signing attestations). This could decentralize the trust in a single auditor.
- **On-Chain Physical Asset Tracking:** Exploring integration of physical tracking systems – e.g. tamper-evident IoT devices on the copper pallets that regularly post data on-chain (weight, location). If technology permits, this could create a continuous unbroken link between the physical asset and blockchain.
- **Tokenization of Custody Receipts:** Instead of a single project-owned reserve, open up the model so that anyone with copper can tokenize their copper via the protocol, depositing copper in approved warehouses and receiving CopperBTC (or a similar token) in return. This would effectively make CopperBTC a **network or standard** rather than a single issuer's token. It moves closer to decentralization, but raises many questions about standardization and legal structure.
- **Legal Wrappers and Redemption (if ever):** In a far future phase, if the experiment proved successful and there was demand to make it a real commodity token product, one could introduce optional redemption via a regulated entity. That would transform CopperBTC from purely experimental into a full-fledged asset token. It would involve incorporating a company, getting licenses, etc., which is beyond our scope here – but Phase 0/1's learnings would provide the blueprint for how to do it right (with proof-first design, etc.).

Each progressive phase would bring CopperBTC closer to the ideal of a fully trustworthy, continuously verified, possibly redeemable asset token that could meet regulatory muster. The project deliberately starts far from that (to avoid over-promising), but has a path to approach it.

Mirroring Regulatory Expectations: It's striking that the planned technical phases of CopperBTC mirror many expectations regulators have: - Regulators would want **initial due diligence and documentation** –

Phase 0 provides that in spades (public docs hashed on-chain). - Regulators want **ongoing oversight** – Phase 1 introduces that via periodic attestations or oracles. - Regulators insist on **truthful marketing and no misleading info** – CopperBTC's phased disclosures ensure no one is misled about what's verified and what's not at any time. - Regulators prefer **redundancies and independent checks** – future phases consider decentralizing verification.

This alignment is intentional. CopperBTC is showing that one can design a crypto token system that **internalizes compliance-like safeguards** not because a law says so, but because it's *good practice* for trust. In doing so, CopperBTC is an educational model: even projects outside the EU could benefit from following these principles to improve their credibility and resilience.

It must be emphasized, however, that **CopperBTC still does not claim to be compliant with any regulation**. It is simply taking inspiration from regulatory principles to guide an ethical, transparent design. It stops short of certain things (like formal redemption, investor protection schemes, etc.) because those are beyond an experiment's scope. But by implementing what it can on the technical side, CopperBTC provides a working example for industry and regulators to study. It offers insight into how much can be achieved with technology and open data alone, potentially informing proportionate regulatory approaches in the future.

Having covered the internal mechanics and regulatory philosophy behind CopperBTC, we now turn to a different angle: **why copper?** Many tokenization projects gravitate to gold or fiat currencies. CopperBTC deliberately chose an industrial metal. In the next section, we explore the significance of using copper as the pilot asset and what it teaches us about real-world asset tokenization.

Why Industrial Metals Matter

CopperBTC's underlying asset – **copper** – is not a typical choice for asset-backed tokens. Historically, projects have favored **monetary metals** like gold or silver, or fiat currencies, because they are more immediately recognizable as "stores of value." So why build a "proof-of-metal" token around copper? It turns out, using an **industrial metal** like copper provides a unique and instructive stress-test for token design:

- **Copper vs. Monetary Metals:** Gold (and to a lesser extent silver) are often held for monetary or investment purposes. They have high value density (a small amount is worth a lot), stable storage characteristics, and centuries of financial use, which make them easier to tokenize in some respects. Copper, on the other hand, is fundamentally an industrial commodity. It's used in wiring, electronics, and infrastructure. Its price is driven by supply and demand in manufacturing and construction, not by investor sentiment as much. Copper has a much lower value per unit weight – storing $1 million worth of copper requires large warehouses (it's tens of tons of metal), whereas $1 million of gold fits in a briefcase. By choosing copper, the project intentionally grapples with the **practical challenges** of a low-value, bulky asset: higher storage costs, transportation logistics, and the need for robust warehousing procedures. If a token model can work for copper, it likely can work for any commodity (because copper is about as "unglamorous" and logistically heavy as it gets).

- **Stress-Testing Token Design:** Industrial assets like copper introduce certain stresses:

- **Storage and Custody Complexity:** Ensuring the copper's safety and authenticity is non-trivial. Copper can corrode if not stored properly (though generally in solid form it's stable), and it might need insurance against theft or damage. A token system has to accommodate those realities (e.g., incorporating insurance information in disclosures, perhaps).
- **Valuation and Volatility:** Copper prices can be volatile based on global economic cycles. Unlike a fiat-pegged stablecoin (where $1 is always $1 by definition), a copper-backed token will have a price that moves with the commodity market. This tests how the token ecosystem handles volatility. For instance, if copper prices drop 20%, the token's backing is still the same metal, but its fiat value drops 20% too. Will users understand that dynamic? It's important the token's documentation makes clear it's *not* stable in fiat terms, only in copper terms. In MiCA classification, it's still an ART because it's stable relative to copper's value, but users might initially confuse it with say a "stablecoin" if they don't realize the distinction. Using copper forces clarity in explaining that distinction, thereby improving educational outreach.
- **Market Appeal (or lack thereof):** Tokenized copper might not have an obvious huge market among crypto traders. That's actually a benefit for an experiment – it keeps speculation lower and focuses participation on those genuinely interested in the technology and concept. The risk profile is different: people who hold CopperBTC likely do so out of curiosity or as a long-term commodities play, not for quick arbitrage or payment utility. This mitigates some risk of a sudden run or panic (because it's not marketed to yield-farmers or payment users). It also means any issues will affect a relatively small, informed user base, making it more manageable.

- **Regulatory Classification Edge Cases:** By using an industrial commodity, CopperBTC sits at an interesting intersection of regulatory categories. In traditional finance, commodities can be under various rules: derivatives on commodities are regulated, physical warehouse receipts might be considered commercial contracts, and collective investment in commodities could trigger fund regulations. CopperBTC in its experimental, non-redeemable form likely avoids being considered a commodity derivative (since it's not a contract for future delivery, and no guaranteed delivery at all), and it's not exactly a security either. It thus highlights a grey area: it's an ART under MiCA (if offered in EU), but outside MiCA contexts one might ask "is this just a digital collectible tied to copper, or is it an investment?" Industrial metal backing might make regulators scratch their heads because it's not as straightforward as a gold coin (which might be seen more like a stored value). This stress-tests legal definitions and might prompt regulators to clarify how they'd treat such tokens.

- **Real-World Asset (RWA) Diversification:** Much of the RWA tokenization trend has focused on financial assets (like stablecoins for currency, or tokenized treasuries) and some on precious metals. By bringing an industrial commodity into play, CopperBTC is expanding the conversation. **Industrial assets are a huge part of the world economy** – think oil, copper, iron, agricultural products. If blockchain is to "eat the world" of finance, it will eventually touch these assets. CopperBTC's experiment can reveal what special considerations these assets need. For example, one insight might be: *Physical delivery is impractical for small holders of copper tokens* (because what would a person do with 50kg of copper?). This implies that such tokens will mainly be used for price exposure or collateral, not for taking delivery, which in turn means *the token economy must function without routine redemptions*. That's exactly what CopperBTC is set up as – and it could become a template for other commodities where redemption isn't expected (maybe a future "IronToken" or "NickelToken" would similarly focus on proof of reserves and let trading happen, with only large institutional players occasionally swapping tokens for actual metal via OTC arrangements).

- **Industrial Use-Case Synergy:** There's an interesting thought: if CopperBTC or similar tokens became established, they could potentially be used by industrial players themselves for hedging or financing inventory. For instance, a mining company or a manufacturer might use tokenized copper as collateral for loans or to streamline trading of physical stock (since a token transfer could, in theory, transfer ownership of a pile of copper more quickly than traditional paperwork). CopperBTC's experiment, while not at that scale, is a stepping stone toward envisioning those scenarios. It intentionally picks a metal that industry actually uses daily, to see if a bridge between commodity markets and crypto markets can be built. If the design can accommodate industry needs (like auditability, no funny business with supply, clear linkage to real units), that's a big success for RWA tokenization.

- **Educational Value:** From an educational perspective, using a less "sexy" asset like copper can focus readers' and regulators' minds on the *mechanics* rather than hype. A gold token might attract goldbugs or speculators thinking of it as a new way to invest in gold. CopperBTC, being a bit unconventional, forces people to pay attention to how it works rather than get lost in gold fever. It's easier to have a sober discussion about copper reserves and token proofs, because no one is fantasizing about copper "to the moon." This aligns with CopperBTC's neutral, technical tone – it's easier to keep it that way when the underlying isn't a meme or a traditional store of wealth.

In short, **industrial metals like copper pose unique challenges and opportunities for tokenization**. CopperBTC uses copper precisely to flush out those challenges early. By doing so, it contributes to the broader development of RWA token systems: - It shows what truly **asset-driven token design** looks like (versus hype-driven). - It identifies what infrastructure is needed (e.g., dependable warehouses, maybe IoT verification in future). - It informs regulators about how such tokens behave (e.g., do they behave more like commodities or like securities? So far, it looks more commodity-like). - It sets a precedent that tokenization is not just about replicating existing financial instruments, but can create new kinds of digital representations (like a "proof-of-copper certificate") with their own niche use cases.

For future RWA endeavors, the lessons from CopperBTC could be invaluable. If we can tokenize copper responsibly, we can think about tokenizing other physical assets – maybe barrels of oil, kilowatts of stored energy, shipping containers, etc. Each has its quirks, but the principle remains: **start with transparency and realistic constraints**, then gradually build functionality.

Now that we have examined how and why CopperBTC is built the way it is, we should candidly assess its **limitations and open questions**. Every experiment has boundaries and unknowns – acknowledging them is part of the transparency ethos. This will temper any overly optimistic interpretations and highlight areas for further research and development.

Limitations & Open Questions

CopperBTC, as an experiment, does not claim to solve all problems of asset tokenization. In fact, it deliberately limits its scope to ensure honesty and manageability. Here we enumerate the key limitations of the current CopperBTC design and some open questions that remain for the project and the broader industry:

- **No Redemption, No Legal Claim:** CopperBTC tokens do *not* grant the holder any legal right to the physical copper. This cannot be stressed enough. Holding CopperBTC is **not the same as owning**

copper in a warehouse. It is owning a crypto token that is *intended* to track the presence and value of some copper. This limitation means that if something goes wrong (e.g., the copper is stolen or sold off), token holders have no direct recourse to recover value. In a traditional stablecoin, redemption provides a floor to the token's price (you can always get the fiat back); here, no such floor is enforceable. The market price could, in worst case, drop to near zero if trust evaporates. This is acceptable in an experiment, but it's a clear risk. The open question is: **Can a non-redeemable token maintain market confidence long-term purely through transparency?** Or is redemption ultimately necessary for full trust? CopperBTC will provide data to inform that debate.

- **Reliance on Off-Chain Entities:** Despite all the on-chain proof mechanisms, CopperBTC still ultimately relies on off-chain actors: the warehouse operator who guards the copper, the entity providing attestations, possibly insurers, etc. These introduce **counterparty risk**. MiCA and regulations address this by requiring fit-and-proper assessments for issuers, audits, etc., but CopperBTC, being a tech experiment, doesn't impose such formalities. It's possible that the off-chain partner could default or deceive. For example, the warehouse could issue a false receipt (though legal consequences would deter that), or an inspector could collude to report copper that isn't there. The blockchain can't directly prevent these scenarios; it can only make detection easier (since any mismatch eventually might come out in the open, especially if multiple attestations conflict). **Open question:** How to further minimize or decentralize trust in off-chain components? Are there technologies or business models (like multiple independent verifiers, or tokenized insurance for reserves) that could complement CopperBTC to reduce single points of failure off-chain?

- **Scalability of Model:** CopperBTC in Phase 0/1 is small-scale. If one wanted to scale up to, say, $100 million of copper tokenized, things get complex. Large amounts of metal would require multiple warehouses, potentially in multiple jurisdictions, which means multiple sets of documents, different legal environments, and more complicated logistics to maintain proof. Could the model handle that? Possibly with more automation and perhaps by standardizing the attestation process across sites. But it's untested. **Open question:** How does the proof-of-metal model scale when dealing with many batches of assets and large values? Does it require a formal trust structure or will a purely crypto approach remain viable at scale?

- **Regulatory Uncertainty:** While we've been analyzing through a MiCA lens, outside of MiCA's jurisdiction, the legal classification of CopperBTC is unclear. It's not exactly a security (no expectation of profit just from holding, and no issuer promising returns), but regulators could worry it might resemble a commodity ETF or something if widely marketed. In the US, for example, would CopperBTC be a commodity-backed note requiring CFTC oversight, or is it simply a digital commodity in itself? These questions are unresolved. CopperBTC by being careful (not soliciting investment, labeling itself experimental) tries to avoid triggering regulatory action, but if such tokens grew popular, authorities might step in with new rules or demand compliance with existing ones (like requiring a prospectus, even if MiCA doesn't exactly cover it). The team explicitly does not claim regulatory approval. **Open question:** What regulatory regime will ultimately govern tokens like CopperBTC if they move beyond experiment? Will new categories be defined for "digital commodity certificates," or will they be shoehorned into existing ones (with potentially burdensome requirements that could stifle innovation)?

- **Economic Viability:** One practical limitation is the **cost and effort** of maintaining the proof. Frequent attestations and secure storage cost money. In a commercial stablecoin, issuers cover costs

via fees or invest reserves to earn interest (noting MiCA forbids interest to holders, but issuers can still invest reserves within limits to fund operations). For CopperBTC, since it's experimental and non-profit at this stage, who pays for ongoing audits or storage? The project might cover initial costs, but long term, any self-sustaining model would need either a fee (perhaps a small minting or trading fee) or a community funding mechanism. If such a token were widely used, these costs could be significant relative to the asset value (storing and auditing copper could eat a noticeable percentage of its value annually). **Open question:** Can the proof-of-reserve approach be made cost-efficient? For example, could community volunteers do some verification? Could tokenization actually reduce overhead by streamlining auditing (maybe yes, if multiple parties rely on the same public proofs instead of each doing their own audit)? This is something to observe as the project progresses.

- **Technology Risks:** There are also typical blockchain risks: smart contract bugs, hacks, loss of keys, etc. CopperBTC's contract should be relatively simple (minting tied to proof, transfers, etc.), but any bug could undermine trust. For example, if someone exploited a flaw to mint unbacked CopperBTC, that would be catastrophic for trust. The project presumably undergoes audits of the code, but the risk is non-zero. Additionally, the security of the content-addressed storage is important – if IPFS links were to break (nodes all go down) or be censored, access to evidence might be temporarily lost, causing uncertainty. These are manageable issues, but in a comprehensive assessment we mention them.

- **User Understanding:** As a novel concept, users might misunderstand CopperBTC. They might either overestimate it ("It's backed by copper so it must be safe or redeemable" – which is not guaranteed) or underestimate it ("It's useless since you can't redeem – just a hot potato token"). Educating users is a challenge, and part of this whitepaper's purpose is to communicate clearly. The success of such honest token designs relies on users appreciating transparency and making informed decisions. If most crypto users prefer a *false* sense of security over a *true* but complex proof-based security, then projects like CopperBTC face an uphill battle in adoption. **Open question:** Will the market reward tokens that are transparent about their limitations? Or will it favor tokens that simply hide risk behind slick marketing until proven otherwise? The hope is that regulators and serious institutions will gravitate to the transparent models, setting an example for others.

- **Future Integration:** If CopperBTC evolves, can it integrate into the broader crypto ecosystem? For instance, could it be used as collateral in DeFi lending? Possibly not in Phase 0, due to the trust gap, but if Phase 1 or 2 improves assurances, maybe. However, DeFi protocols might require oracles and special handling given the unique risk profile (non-redeemable commodity token might be treated with a big discount or not at all). This limits current utility, but also points to a future path: as these tokens become more robust, they could indeed unlock new DeFi possibilities (imagine being able to borrow stablecoins against tokenized copper collateral – it's like a commodities loan in DeFi). To get there, a lot of groundwork in risk management needs to be laid.

In summary, **CopperBTC does not solve everything today**: - It **does not eliminate trust** – it shifts and mitigates it. - It **does not guarantee value stability** – copper price swings remain. - It **does not protect against all bad actors** – we still rely on the honesty of participants like custodians. - It **remains experimental and unproven in market conditions** – it needs to be battle-tested.

The project is forthright about these facts. By exploring these limitations openly, CopperBTC invites collaboration and improvement. Each open question is an opportunity for the community or regulators to

engage. Perhaps academics will analyze the price behavior of CopperBTC vs. copper futures; maybe other startups will propose decentralized insurance to cover custodial risk; maybe regulators will see this and initiate sandboxes to allow more experimentation in this direction without heavy penalties.

Finally, we conclude by reflecting on the broader lessons of CopperBTC and MiCA – how even outside the EU, MiCA's framework can guide better designs, and why prioritizing proof and transparent classification from day one can lead to healthier crypto-asset ecosystems.

Conclusion

The CopperBTC experiment provides a valuable case study in marrying **blockchain innovation with regulatory insight**. By looking at CopperBTC through a MiCA lens, we can draw several concluding insights:

- **MiCA's Clarity as a Global Guide:** MiCA's taxonomy of crypto-assets (EMT, ART, other) offers a clear framework to classify and design tokens responsibly, regardless of jurisdiction. CopperBTC benefited from this clarity – understanding it would be seen as an ART (asset-referenced token) informed the project to emphasize full reserve backing and strong disclosures from the start. Even for projects outside the EU, MiCA's focus on **what the token truly represents** and the associated risks can serve as a blueprint for internal self-regulation. In CopperBTC's case, knowing that calling it "just a utility token" would be disingenuous helped ensure the project didn't try to dodge the fact that it's essentially a stable-value token tied to copper. This kind of honesty in categorization can prevent future regulatory run-ins and build credibility with users and institutions.

- **The Value of Proof-First Design:** CopperBTC demonstrates that building a token **around proof and transparency**, rather than tacking it on later, yields a fundamentally different product. By prioritizing proof-of-reserve (the "proof-of-metal") as the central feature, CopperBTC aligns incentives correctly: the token supply and its legitimacy directly depend on evidence of the asset. This is in contrast to many projects that launch tokens and then think about audits or proofs as an afterthought (often under pressure from regulators or public doubt). A proof-first design is more conservative and may roll out slower (since you need the proof process in place before minting), but it significantly reduces the chances of nasty surprises down the line. Importantly, it nurtures trust with a community that can see the project is serious about backing its claims. In the long run, a culture of *"trust but verify"* could elevate the crypto industry's reputation, and CopperBTC provides a working example of how to implement that culture technologically.

- **Classification-Aware Architecture:** By being aware of its classification (an ART-like token), CopperBTC was able to borrow best practices from that realm (like reserve management, not paying interest, etc.) without being forced by law. It shows that **responsible innovation means anticipating regulatory concerns** and addressing them proactively. This doesn't mean bending to every rule preemptively, but it means not being naive about how the token will be viewed. CopperBTC did not proceed under the illusion "we're completely new, rules don't apply"; rather it assumed "if this were in a regulated context, what would be expected?" and tried to meet those expectations where feasible (transparency, documentation) and consciously decide where it wouldn't (no redemption, since that's an experiment parameter). This self-awareness is something many past crypto ventures lacked, leading to misclassifications and crackdowns. CopperBTC's approach could serve as a model for other projects to engage regulators not as adversaries but as stakeholders whose insights on risk can improve a project's design.

- **MiCA Beyond the EU:** One might ask, if CopperBTC is not offered in the EU, why does MiCA matter? The answer is that MiCA is likely to set a **global precedent** or at least influence global norms. Much like GDPR in data privacy became a de facto world standard, MiCA's definitions and requirements might echo in other jurisdictions or in industry self-regulation. By aligning with MiCA's principles early on, CopperBTC positions itself as a forward-thinking project that, should it ever wish to expand or be used in the EU, would not need a total overhaul to comply. And even outside of legal compliance, the **investor protection and market integrity goals** of MiCA are universal values. Clear disclosures, sufficient reserves, and accountability are things any serious user or partner will eventually demand, whether by law or by due diligence.

- **Educational and Experimental Nature:** CopperBTC's journey reinforces the importance of **education** in the crypto-assets space. This whitepaper itself, structured akin to a neutral technical report, serves to educate both the crypto community and regulators. For crypto folks, it shows how to write a whitepaper that isn't about hype or tokenomics, but about robust design and transparency. For regulators, it provides a concrete example of how some of their abstract rules can be implemented in practice (and where they might be overly rigid for innovation, such as redemption requirements for an experiment). CopperBTC labels itself as *"non-financial, non-investment, not legal advice"* precisely to carve out a safe space for education and experimentation. It suggests that not every token project is trying to raise money or skirt laws – some are genuinely trying to advance the state of the art. Regulators often call for experimentation in sandboxes; CopperBTC is effectively a self-imposed sandbox exercise, and the hope is that by doing so openly, it contributes to collective learning.

- **Trust through Transparency, not Guarantees:** A big takeaway is the notion of building trust **through transparency rather than through promises**. Traditional finance often relies on guarantees (backed by regulations or insurance) – e.g., "your deposit is guaranteed up to $100k by FDIC" or "this stablecoin will always be $1 because we promise redemption and have audits." Crypto has the opportunity to create a different kind of trust model: one where users trust the system because they can see inside it (on-chain data, open-source code, public audits), not just because someone in a suit said "trust me." CopperBTC leans heavily into this philosophy. It doesn't guarantee that "you'll get your copper" – instead it guarantees "you can verify whatever we claim." This is a shift from trusting assurances to trusting processes. It's not perfect (some trust in processes is still needed), but it's an evolution in the right direction for those who value decentralization and self-reliance. We believe this approach, in the long run, yields more robust systems that can complement or even substitute some regulatory oversight with community oversight.

Finally, we reiterate key **disclaimers** for absolute clarity, in line with the communication practices advocated by MiCA and other regulations:

- **Non-Custodial:** CopperBTC's creators or issuers do not hold tokens or funds on behalf of users. They also do not hold the copper on behalf of token holders in a custodial capacity. The physical copper is held by an independent custodian, and the token's value is not underwritten by any promise from the creators beyond the published evidence.
- **Non-Financial & Non-Investment:** CopperBTC is not presented as a financial product or investment opportunity. Holding CopperBTC is not an investment in a common enterprise with expectation of profits; it is simply owning a digital token whose value fluctuates with copper. Any increase or

decrease in value is solely due to market forces of the underlying commodity and the market's trust, not due to any venture or effort by the issuer to generate profit for holders.

- **No Regulatory Approval:** CopperBTC is not licensed or approved by any financial regulator. It operates as an experiment under the assumption that it falls outside existing regulatory regimes (to the best understanding of its creators), but it does so at regulatory risk. This document does not imply any endorsement by regulatory bodies.
- **Educational Purpose:** The project and this document are intended for **educational and experimental purposes**. They are meant to provoke discussion and learning about how to better tokenize assets. Nothing here should be taken as legal, financial, or investment advice. Readers and participants are encouraged to do their own research and consult professionals for any actions beyond learning or testing.
- **Use at Your Own Risk:** Engaging with CopperBTC (e.g., acquiring tokens) should be done only by those who understand the described risks – including total loss of value. Given its experimental nature, one should not treat CopperBTC as a dependable store of wealth or a stable asset for significant financial transactions.
- **Not a Stablecoin in Fiat Terms:** We explicitly note that CopperBTC is **not pegged to any fiat currency**. It is *not* a US dollar stablecoin, a Euro stablecoin, or any kind of currency substitute. Its price in fiat will move as copper prices move. It should not be used by anyone seeking price stability in terms of purchasing power – its stability is relative to a commodity only.

In closing, CopperBTC's initiative illustrates that by **designing with regulatory wisdom but technological execution**, crypto projects can chart a responsible path forward. It neither shuns regulation outright nor waits passively to be regulated – it actively self-imposes principles of transparency and accountability. As regulations like MiCA come into effect, they will undoubtedly shape the crypto landscape. CopperBTC shows that this shape need not be seen as a constraint on innovation, but rather as a scaffold on which to build novel, trustworthy systems. The hope is that this work sparks further experiments and dialogues that ultimately converge into widely adopted best practices for real-world asset tokenization – bringing the benefits of blockchain (efficiency, global reach, immutability) to traditional asset markets in a safe and sustainable way.

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