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Structure of Tokenized Commodities and Commodities Regulation

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Recent years have seen the emergence of blockchain projects seeking to tokenize an ever-expanding range of assets that are not blockchain-native – the so-called tokenized real world assets ("***RWAs***") phenomenon. Tokenized commodities have emerged as one of the most important categories of tokenized RWAs.[1] This paper will briefly examine the structure and use of tokenized commodities, and their interface with commodities regulation.

a. Structure of Tokenized Commodities

The term "tokenized commodity," however, is imprecise and can cover a range of different structures. The variations in technical structure of tokens, and the variations in such structures' relationships to underlying physical commodities, mean that different tokenized commodities may represent legally divergent rights under the UCC and property law, and may result in divergent regulatory consequences under commodities laws.

A threshold question for any tokenized asset, including a tokenized commodity, is how the legal value and rights of an underlying RWA are transmitted to the digital token representing it.[2] How the tokenized asset is structured – *e.g.,* by means of the smart contract that generates the token, the contractual structures, or statutory regimes that surround the tokenization transaction, and the nature of the underlying assets as property.

Frequently, what is described as a tokenized commodity is "indirectly" tokenized, meaning that the legal rights that a token holder acquires in the commodities via the token are not direct links to the underlying commodities themselves, but actually intermediated through matrices of various holding entities, off-chain contractual and regulatory structures, and non-blockchain-enabled Internet features.[3]

For example, one leading tokenized gold project uses a fungible token compliant with the Ethereum ERC-20 standard[4] to represent ownership of allocated gold held at a vault. The ERC-20 token does not, in itself, create a token holder's legal ownership of the gold. Rather, such ownership is established via the bankruptcy-remote custody of the gold by a limited-purpose New York trust company on behalf of the token holder.[5] Redemption of the token for physical gold requires the token holder to transact through the issuer's website or partner outlets.[6] Other tokenized gold projects employ similar arrangements.[7]

Other types of commodities might similarly use "indirect" tokenization strategies. For example, projects tokenizing oil and gas royalty interests may use a special purpose entity (such as a limited liability company, statutory trust or offshore company) to hold title to such royalty interests in a manner similar to other types of tokenized real estate, with digital tokens issued by a special purpose entity ("***SPE***") to evidence equity interests in the SPE.[8] In such a structure, the token holder's tokenized oil and gas royalty interest legally constitutes an equity interest in a corporate "wrapper" rather than the royalty interests themselves. The token holder's rights would thus be subject to the SPE's other contractual arrangements (such as the terms of subscription and operating agreements) and subordinate to any debts or liabilities that SPE might accrue.

While indirect tokenization might be presumed to be dictated by the off-chain nature of RWAs like physical commodities, in certain circumstances a tokenized commodity project might seek a more "directly" tokenized structure. For example, if a digital token were designed to constitute in itself an electronic negotiable document of title under the Uniform Commercial Code ("***UCC***")[9] for commodities held with a bailee (such as a negotiable bill of lading or a

negotiable warehouse receipt), a token holder with "control" of the digital token could obtain the rights of a holder by due negotiation, which rights would include direct title to the underlying commodity.[10] The token and protocol would, of course, need to be structured to comport with the UCC requirements for "due negotiation" – such as the token holder's purchase in good faith, without notice of defense or claim, and for value[11] – and "control" of an electronic document of title.[12] Nonetheless, if properly structured such a tokenized commodity would be much more "directly" tokenized than those having intermediated structures.

Further, the nature and standard of the crypto token employed may have significant impact on the structure of the asset. Tokens might be fungible (such as an ERC-20 token), or non-fungible tokens ("**NFTs**"), which commonly utilize the ERC-721 standard.[13] Different commodity interests might most naturally utilize one token type or another – a class of widely traded futures might seek tokenization as ERC-20 tokens, whereas a specific cargo of goods might be better suited to be represented by a non-fungible ERC-721. Related token standards such as ERC-1400 and ERC-3643 may be employed to natively encode permissions and whitelisting.

b. Commodities Regulation Impacts of Token Structure

Such variations in technical and legal structures can potentially have significant impacts on the regulatory treatment of tokenized commodities. Under the Commodity Exchange Act ("**CEA**"),[14] there are important differences between how a "commodity"[15] is treated compared to how a "commodity interest"[16] is treated. A "commodity" for CEA purposes is defined to encompass a litany of enumerated commodities, which are mostly agricultural, as well as exempt commodities,[17] which are metals, energy, and other physically deliverable commodities as well as excluded commodities,[18] which are currencies, interest rates, indices, events, and a broad catch-all provision that pulls in "all other goods and articles" (with some notable exceptions, like onions, movie box office receivables and – most recently – payment stablecoins issued under the Genius Act[19]).[20]

"Commodity interests" are derivatives on commodities such as swaps, futures and options, as well as certain leveraged retail contracts.[21] Further, other contractual arrangements relating to commodities such as forwards on non-financial commodities, spot contracts, and securities, securities options, security index options and security-based swaps are excluded from the definition of "swap" and therefore fall out of the definition of "commodity interest."[22] The jurisdiction of the Commodity Futures Trading Commission ("**CFTC**") differs as to commodities themselves and commodity interests:[23] while the CFTC has exclusive jurisdiction over commodity interests to promulgate regulation, the CFTC's jurisdiction over commodities themselves is limited to enforcement.[24]

Accordingly, different digital tokens styled "tokenized commodities" – even if the technological attributes of the token look similar to a casual observer – may nonetheless partake of very different regulatory status depending on the underlying structure of the tokenized asset. If the underlying structure of the tokenized commodity is an "indirect" tokenization, it is important to examine whether the matrix of technological, corporate and contractual arrangements create an asset that would fall within the definition of "commodity interest" (*i.e.*, a derivative), or perhaps one of the asset types excluded from that definition such as spots, forwards, or some other forms of commercial arrangements. If the underlying structure is a "direct" tokenization, then the examination might focus on whether the token itself should be treated as a "commodity" for CFTC purposes (as might be the case with a tokenized document of title that conveys actual title to the commodity to the token holder).

By analogy, carbon credits, such as California carbon allowances ("**CCAs**") and renewable energy certificates ("**RECs**") do not exist in nature, essentially are a figment of humans' imagination and one cannot touch them; however, they can be delivered (*e.g.*, into a purchaser's account or for cancellation or redemption) and used (*e.g.*, for carbon offset purposes). Both CCAs and RECs are considered exempt commodities because they can be delivered and therefore one can have a forward contract on them, as well as commodity trade option (that exercises into a deliverable commodity transaction).[25] Also, one can also have derivatives on CCAs and RECs, such as swaps, or futures and options traded on an exchange (*i.e.*, a designated contract market or **DCM**). Likewise, a token, depending on how it is issued and what purposes it is intended to be used for, may be qualified as a "commodity," or a "commodity interest" (*i.e.*, a derivative) or even a security[26] if such token, *e.g.*, meets the Howey test for an investment contract.[27]

Further, a commodity token may be neither a commodity nor a commodity interest – *e.g.*, similar to a warehouse certificate or receipt that is only evidentiary of commodity ownership, but is not itself a commodity. Thus, a commodity token may be qualified as a financial instrument similar to a warehouse certificate.[28]

The impact of these varying legal treatments might have significant impacts on how users may transact with tokenized commodities. In particular, if a tokenized commodity is structured in such a way that it would be treated as a "commodity interest," using such tokenized commodity in an enterprise operated to trade the tokens could render that

enterprise a "commodity pool"[29] (unless an exemption or exclusion from commodity pool designation is available). The operator and adviser of the enterprise, further, would need to determine whether they would need to register as a commodity pool operator and commodity trading adviser, respectively.[30] Further, if such token qualifies as a "swap," transactions in such tokens would need to be reported to a swap data repository, among many other requirements, and if a token is a futures contract, such token can only trade on a DCM, and the intermediates transacting in such token will be required to register in various applicable categories. Conversely, if a token is only a "commodity" itself, then no such regulatory requirements will apply. While these considerations raise important regulatory issues to be addressed in any transactions with tokenized commodities, in no context are the issues more pointedly drawn than in the deployment of such tokens in the novel strategies of decentralized finance ("*DeFi*").

c. Regulatory Considerations of Tokenized Commodities in DeFi

DeFi projects have long had the disadvantage of primarily involving natively on-chain cryptocurrencies, which have famously volatile prices and yields. Tokenized RWAs are being eagerly incorporated into DeFi precisely because their real world based asset prices and yield streams derive from more stable, established traditional markets. To date, the most common species of tokenized RWAs have been fiat-backed stablecoins, tokenized treasury securities and tokenized money market funds. In addition to the advantages of speed, efficiency, 24/7/365 trading and asset-for-value atomic settlement, such assets have also been widely used in decentralized, smart contract-powered investment structures such as lending protocols, liquidity pools, and multi-collateral stablecoin issuance.[31]

Introducing tokenized commodities into such DeFi protocols is a natural progression, as the integration of tokenized RWAs moves up the risk curve. However, in doing so, market participants must take care that, in the deployment of such commodity-based tokens into such DeFi protocols, they carefully consider the regulatory structure appurtenant to the commodities markets.

Many DeFi protocols rely on decentralized pool structures, often utilizing an automated market maker ("*AMM*") protocol. AMMs are a kind of smart contract that operates the pool logic without any central person or entity. Such pool structures are directed at various strategies, such as lending, liquidity provision, staking, yield farming and arbitrage. DeFi pools typically function by users depositing ("locking") tokens into the pool smart contract and receiving in exchange pool tokens that reflect yield accruing from the pool, or borrowed tokens (such as stablecoins) that reflect a borrowing from the pool collateralized by the supplied tokens. Pools will frequently comprise vaults that can accommodate multiple types of supplied tokens, using structures such as collateralized debt position ("*CDP*") vaults, or the newer ERC-4626 (single asset) and ERC-7575 (multiple asset) vault structures which are more interoperable than older CDP vaults.[32]

For example, two of the most venerable DeFi protocols are Uniswap and MakerDAO (now Sky). Uniswap is an automated smart contract-powered liquidity protocol that manages liquidity pools of each consisting of two ERC-20 tokens. The smart contract acts as an AMM for the token pair, maintaining the pool on a constant product formula. Traders seeking one or the other of the tokens can swap into the pool to obtain them, in the process paying a fee that generates yield to the token suppliers. Importantly, the Uniswap smart contracts are open source and non-upgradeable —no person can control or change the smart contract once it has been launched—but also involve a front-end web interface through which users can access the pools.[33] MakerDAO/Sky operates by accepting deposits of digital assets of various types that have been authorized by its decentralized governance system, and locking them as collateral into smart contracts called Maker Vaults to back its decentralized, multi-collateral stablecoin, DAI. [34]

In addition to blockchain-native cryptocurrencies and tokens, both Uniswap and Sky permit users to deploy tokenized RWAs to its protocols as collateral.[35] Our earlier review of the variations in tokenized commodity structure and the potential effects on treatment of those tokens under the commodities regulations pose important compliance issues with the deployment of tokenized commodities in decentralized DeFi platforms, such as being one of a token pair in a liquidity pool or being as collateral in a vault.

If a token were to be deemed to be a "commodity interest" under the CEA because it used an "indirect" structure that effectively functioned as a swap, future or option on a future, for example, would deployment of that token into a DeFi liquidity pool or a yield vault transform it into a "commodity pool"? If a "commodity pool" is defined to require an "investment trust, syndicate or similar form of enterprise,"[36] would a fully decentralized and non-upgradeable smart contract fit the bill? If such a DeFi structure were deemed a "commodity pool," where would one look for its "commodity pool operator" and "commodity pool adviser"? Since the protocol is not a person, and in this example is not controlled by any person, where would the regulatory analysis take us?

Uniswap faced a similar conundrum in its 2024 settlement with the CFTC[37] where leveraged tokens for ether and bitcoin did not contain any restrictions that would result in the actual delivery of the underlying cryptocurrency within 28 days, and did not restrict access to non-eligible contract participants ("*ECPs*",[38] *i.e.*, allowed retail participation). Accordingly, the CFTC contended that such leveraged tokens were commodity futures contracts that needed to be traded on a board of trade designated or registered with the CFTC. [39] The CFTC, crucially, concluded that because Uniswap actively operated and maintained a *front-end* user interface through which users accessed the protocol Uniswap had acted as an offeror of the commodity interests, even though the *back-end* smart contracts that executed the transactions were immutable, and therefore not controllable by Uniswap.[40] Such reasoning begs the question whether the interaction with the DeFi pool would have been permissible if the user accessed the smart contract without going through an interface provided and maintained by another person.

Given the permissionless nature of DeFi pools, the potential ramifications of committing tokens that constitute regulated commodity interests to them seem extensive. Might any investors participating in a DeFi vault or pool containing tokenized commodities be deemed to constitute an enterprise? If so, and if that DeFi vault or liquidity pool were deemed a "commodity pool," would that render all users of the protocol potential CPOs? Or would a DeFi platform qualify as a DCM or a swap execution facility depending on the qualification and characterization of the instrument traded (*i.e.*, whether the token is just a "commodity" itself or whether the token is a "commodity interest" (*i.e.*, a derivative)?[41]

Thus, the key question for tokenized commodity structures becomes whether the commodity token itself is a "commodity" (similarly to the CCA or a REC) or a commodity interest.

d. <u>Movement Toward Regulatory Clarity</u>.

As discussed above, there are four distinct possibilities of what legally a commodity token can be: (i) a "commodity" itself; (ii) a "commodity interest"; (iii) a "security"; or (iv) none of these and merely an evidence of commodity ownership. Depending on the classification, significantly different compliance regimes will apply.

Unfortunately, at this time it is difficult with certainty to opine on what legal form a commodity token may take. Even thought the CFTC and the SEC no longer engage in regulation by enforcement, there remains a regulatory gap while financial engineering and tokenization of various types of assets advance. The Clarity Act (and the eventual market structure legislation) is intended to provide greater certainty. For example, the Clarity Act specifically excludes commodity tokens from the definition of "digital commodities," which means that commodity tokens would still need to be categorized in one of the above categories if the current version of the Clarity Act eventually is enacted into law.

[1] *See* Team RWA.io, "Understanding Tokenized Commodities: Revolutionizing the Future of Trade," RWA.io (Feb. 11, 2025) **https://www.rwa.io/post/understanding-tokenized-commodities-revolutionizing-the-future-of-trade** . *See also* the Tokenized Commodities page of the rwa.xyz website (listing tokenized precious metals and agricultural commodities) **https://app.rwa.xyz/commodities** .

[2] *See* C. McDermott, "The 'Hard Problem' of Tokenization" (May 29, 2025) **https://www.linkedin.com/pulse/hard-problem-tokenization-christopher-mcdermott-ty61e**

[3] *See* Xavier Lavayssière, "Legal Structures of Tokenised Assets," European Journal of Risk Regulation (2025), 1–13 **https://www.cambridge.org/core/journals/european-journal-of-risk-regulation/article/legal-structures-of-tokenised-assets/5D3537D89F9AD858339424E1D60D7C43**

[4] The ERC-20 standard is the most common fungible token standard on Ethereum. Because it permitted fungible tokens to interoperate across the platform, it radically simplified development of tokens and drove the development of decentralized finance. *See* F. Vogelsteller, V. Buterin, "ERC-20: Token Standard," Ethereum Improvement Proposals (Nov. 19, 2015) **https://eips.ethereum.org/EIPS/eip-20** ; Cyptopedia Staff, "ERC-20: The Definitive Ethereum Token Standard" (updated May 17, 2021) **https://www.gemini.com/cryptopedia/erc20-token-standard-ethereum**.

[5] *See* Charles Cascarilla, Pax Gold Whitepaper, V1.0 (Sep. 5, 2019) ("Pax Whitepaper"), p. 7 **https://www.paxos.com/pax-gold** ; Leighton Dellinger, "How Paxos Protects Customer Assets from Bankruptcy," (Oct. 20, 2023) **https://www.paxos.com/blog/how-paxos-protects-customer-assets-from-bankruptcy**

[6] Pax Whitepaper, p. 7.

[7] *See, e.g.* Tether Gold, Gold Token Terms of Sale and Service (Jan. 27, 2025), section 4.3 **https://gold.tether.to/legal/termsofservice** ; Matrixdock Docs (XAUm), Token Features, Minting and Redeeming

https://matrixdock.gitbook.io/matrixdock-docs/english/gold-token-xaum/token-features , Whitepaper
https://2505056629-files.gitbook.io/~/files/v0/b/gitbook-x-
prod.appspot.com/o/spaces%2FZx9GNWaNV9JB3JZlW74D%2Fuploads%2FeD1E9k2VeThD4bhfDyke%2FMatrixdo
alt=media&token=c6d38acc-7530-4d91-a5df-ea19f9e49525

[8] *See* Mineral Vault, FAQs https://mineralvault.io/faq/what-is-mineral-vault/. Another project, Elmts.io, was announced in 2024 to similarly wrap oil well royalty interests in separate series of a limited liability company (note that at this date it is not clear whether the project is ongoing). *See* Aleks Gilbert, "A Solana project wants to tokenise oil rights — will investors bite?" DLNews (Jul. 8, 2024) https://www.dlnews.com/articles/defi/solana-project-elmnts-wants-to-tokenize-oil-rights/#:~:text=A%20new%20Solana%20project%20has,xyz. ; https://www.elmnts.io/

[9] References to the "UCC" in this memo are, unless otherwise indicated, references to the Uniform Commercial Code as amended by the amendments (the "2022 Amendments") promulgated by the Uniform Law Commission and American Law Institute in July 2022. Uniform Law Commission, American Law Institute, Uniform Commercial Code Amendments (2022) (available https://www.uniformlaws.org/viewdocument/final-act-164?CommunityKey=1457c422-ddb7-40b0-8c76-39a1991651ac&tab=librarydocuments).

[10] *See* UCC §7-502(a)(2).

[11] *See* UCC §7-501(b)(3).

[12] *See* UCC §7-106.

[13] W. Entriken, D. Shirley, J. Evans, N. Sachs, "ERC-721: Non-Fungible Token Standard," Ethereum Improvement Proposals (Jan. 24, 2018) https://eips.ethereum.org/EIPS/eip-721.

[14] 7 USC § 1a *et seq*.

[15] *See* § 1a(9) of the CEA.

[16] *See* § 1.3 of CFTC regulations (the "**CFTC Regulations**"), 17 CFR § 1.3 Definitions.

[17] *See* § 1a(20) of the CEA.

[18] *See* § 1a(19) of the CEA.

[19] Guiding and Establishing National Innovation for U.S. Stablecoins Act (GENIUS Act), Pub. L. 119–27 (2025). https://www.govinfo.gov/content/pkg/PLAW-119publ27/pdf/PLAW-119publ27.pdf

[20] *See* § 1a(9) of the CEA.

[21] *See* § 1.3 of CFTC Regulations.

[22] *See* § 1a(47) of the CEA.

[23] *See* https://www.congress.gov/crs-product/R48451#:~:text=Futures%20contracts%20and%20most%20types,SEC%20oversees%20security%2Dbased

[24] *See* § 180.1 of the CFTC Regulations.

[25] *See* § 32.4 of CFTC Regulations.

[26] Securities and Exchange Commission v. Ripple Labs, Inc., Bradley Garlinghouse, and Christian A. Larsen, Case No. 1:20-cv-10832 (S.D.N.Y. filed Dec. 22, 2020)

[27] Securities and Exchange Commission v. W. J. Howey Co., 328 U.S. 293 (1946).

[28] https://www.cmegroup.com/education/articles-and-reports/warehouse-receipts-vs-shipping-certificates-frequently-asked-questions.html. Also see, NORTZ v. UNITED STATES, 294 U.S. 317 (1935).

[29] §1a(10) of the CEA.

[30] § 1a(11) and (12) of the CEA.

[31] *See e.g.,* Aave, Uniswap, Centrifuge.

[32] *See* ERC-4626 https://eips.ethereum.org/EIPS/eip-4626 and ERC-7575 https://eips.ethereum.org/EIPS/eip-7575.

[33] *See* Uniswap Docs, How Uniswap Works **https://docs.uniswap.org/contracts/v2/concepts/protocol-overview/how-uniswap-works**

[34] *See* The Sky Protocol: Sky's Multi-Collateral Dai (MCD) System **https://makerdao.com/en/whitepaper#introduction** (accessed 9/1/2025).

[35] **https://makerdao.com/en/whitepaper#rwa-vaults** . A recent check of the Uniswap interface disclosed several liquidity pools tokenized gold and other precious metals as a paired token (*e.g.*, PAXG/USDC 0x5ae13baaef0620fdae1d355495dc51a17adb4082 (gold), USDC.e/TXPT 0xa451ac008eb750e2d5e7d464f70a9838ff292b28 (platinum)).

[36] *See* §1(a)(10) of the CEA.

[37] In the Matter of Universal Navigation Inc. d/b/a Uniswap Labs, CFTC Docket No. 24-25 (Sep. 4, 2024) ("Uniswap"). **https://www.cftc.gov/media/11201/enfuniswaplabsorder090424/download**

[38] § 1a(18) of the CEA.

[39] *See* § 2(c)(2)(D) of the CEA that allows a narrow exception for leveraged commodity contracts with non-ECPs provided that actual delivery of commodity is made within 28 days.

[40] *See* Uniswap, fn. 7 at p. 5.

[41] **https://blockchain.bakermckenzie.com/2023/06/13/court-holds-dao-may-be-sued-as-person-and-orders-the-shutdown-of-ooki-dao-website/**