

Relevance of on-chain asset tokenization in 'crypto winter'

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Asia's largest private market exchange ADDX is on a mission to democratise private market investing. Using blockchain and smart contract technology, ADDX tokenises and fractionalises multi-asset securities such as private equity, hedge funds, bonds and pre-IPO companies, overcoming manual processes that have previously locked out smaller investors. The minimum investment ticket size for private market investments can be reduced from USD 1 million to USD 10,000, extending access to a much larger segment of accredited individual and corporate investors. Today, the ADDX platform serves investors from 39 countries, spanning Asia Pacific, Europe, and the Americas (excluding the US).

ADDX is regulated by the Monetary Authority of Singapore (MAS) as a digital securities exchange, and has raised around USD 120 million in total since its inception in 2017. Its shareholders include Singapore Exchange, the Stock Exchange of Thailand, Temasek subsidiary Heliconia Capital, the Development Bank of Japan, UOB, Hamilton Lane and Korea's Hanwha Asset Management.

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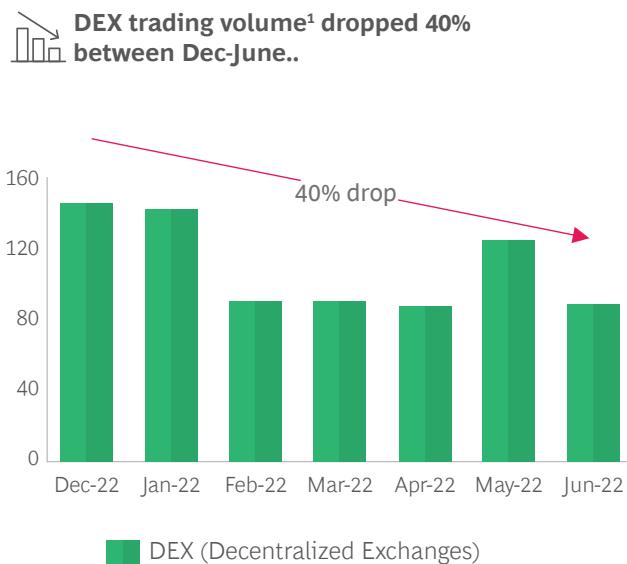
Since scaling meteoric highs in market cap in November 2021, cryptocurrencies have been weathering a period of price volatility. In the 8 months since, the price of Bitcoin has fallen by ~70%¹, and Ethereum by ~75%¹. The collective erosion of market capitalization amounts to over \$1 trillion (Exhibit 1) – a slide reminiscent of the crypto winter in 2018.

Response to this erosion has varied across stakeholders. Retail investor confidence on cryptocurrencies and decentralized projects has taken a hit, as evidenced by the liquidity pull from DeFi projects. Total Decentralized Exchange (DEX) volume transactions² plunged 40%+ since Nov'21. The Total Value Locked (TVL) in DeFi protocols has plummeted³ from \$257 billion on 9th Nov, 2021 to \$86 billion on 19th June, 2022, on account of the Terra Luna crash (Exhibit 2), Celsius debacle, FTX rescuing BlockFi and the collapse of 3AC. Crypto-native firms (including Coinbase, Gemini) have effected layoffs and hiring freezes (Gemini

announced 10% global headcount cut⁴, Coinbase has extended its hiring freeze indefinitely⁴, Bitpanda reduced its staff by 25%⁵), while other fintechs like Robinhood have tempered their crypto aspirations. Investors have responded by tightening their purse strings for blockchain-based projects (Crypto funds and DeFi projects recorded outflows totaling \$110 million⁶ by institutional investors in March'22 alone).

Stakeholder response to the crypto winter has been further exacerbated by regulatory uncertainty across geographies, geopolitical turmoil, and unrealistic expectations of supernormal return on investments on DeFi projects⁷. In the United States alone, regulatory uncertainty around crypto has increased crypto-related litigation⁸ and enforcement, as evidenced by increasing frequency of lawsuits brought on by the SEC, class action lawsuits and private litigation, in recent years (Exhibit 3).

The recent erosion in crypto market cap is reminiscent of the 'crypto winter' of 2018



Source: CoinGecko, Coinmarketcap, BCG analysis
¹ Monthly combined trading volume on DEX exchanges
² Market capitalization data for April 2013 to June 2022

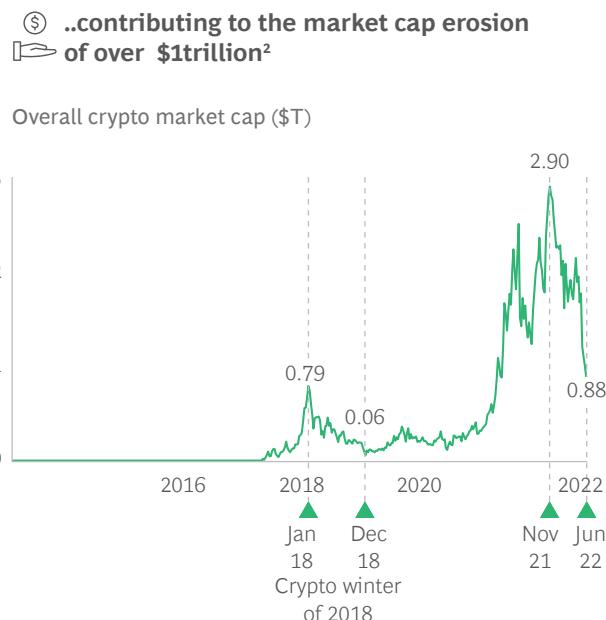


Exhibit 1: Recent erosion in crypto market cap

1. 'Bitcoin Plummets Below \$20,000 for First Time Since Late 2020', The New York Times, June 2022.
2. 'DEX Volume Plunges 50% Since November', The Defiant, April 2022.
3. 'Total Value Locked (TVL) in DeFi protocols', Stelareum.
4. 'Crypto winter freezes hiring at Gemini and Coinbase after Terra crash and Bitcoin slump', Euronews, June 2022.
5. 'Bitcoin trading platform Bitpanda lays off 250 employees', The Economic Times, June 2022.
6. 'Institutional investors pull money out of crypto funds after seven-week run of inflows', The Financial Express, March 2022.
7. 'Regulatory uncertainty creates rash of 'novel' lawsuits: Legal experts', CryptoNews, June 2022.
8. 'Where US Regulators Stand on Cryptocurrency', Bitcoin, July 2022.

The Terra-Luna crash was one of the key triggers for the drop in TVL in DeFi protocols

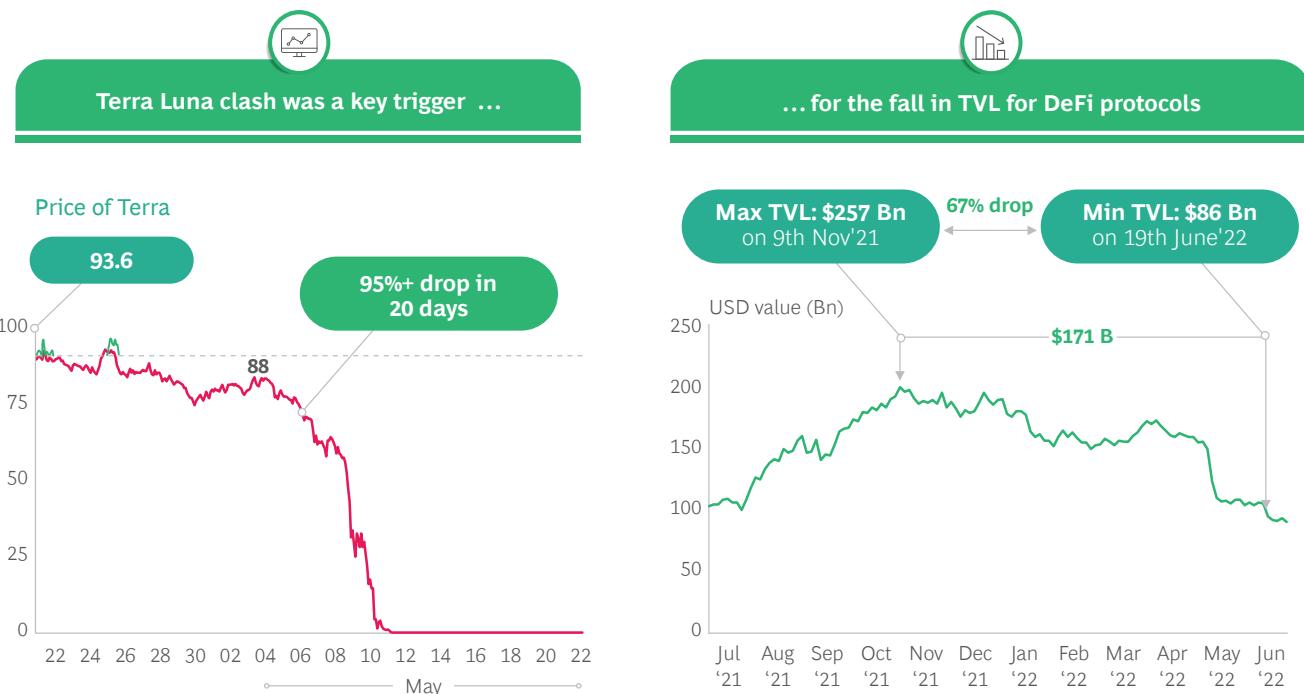


Exhibit 2: Terra-Luna crash a key trigger for drop in TVL in DeFi protocols

Number of crypto enforcement actions have risen over the years...

Trend of number of enforcement actions (2013-21)



Note: Dates represent the filing date of the complaint or order by the SEC. For delinquent filings, the filing date is the date of the order instituting admin proceedings pursuant to Section 12 (j) of the Exchange Act. Subpoenas and follow-on administrative orders are excluded from the figure. Source: SEC.gov

...as regulators' response remains uncertain

“ Several questions need to be answered, such as ‘How does the regulator know that they can custody and have a hold of crypto assets? And how can regulators be sure that prices of crypto assets aren’t subject to significant manipulation, given these trade on largely unregulated exchanges?’ ”

– Chairman, US Securities and Exchange Commission (SEC)

“ The Federal Reserve is very carefully following the whole question of digital currencies. It raises substantial, significant issues that need to be carefully resolved ”

– Chairman, US Federal Reserve

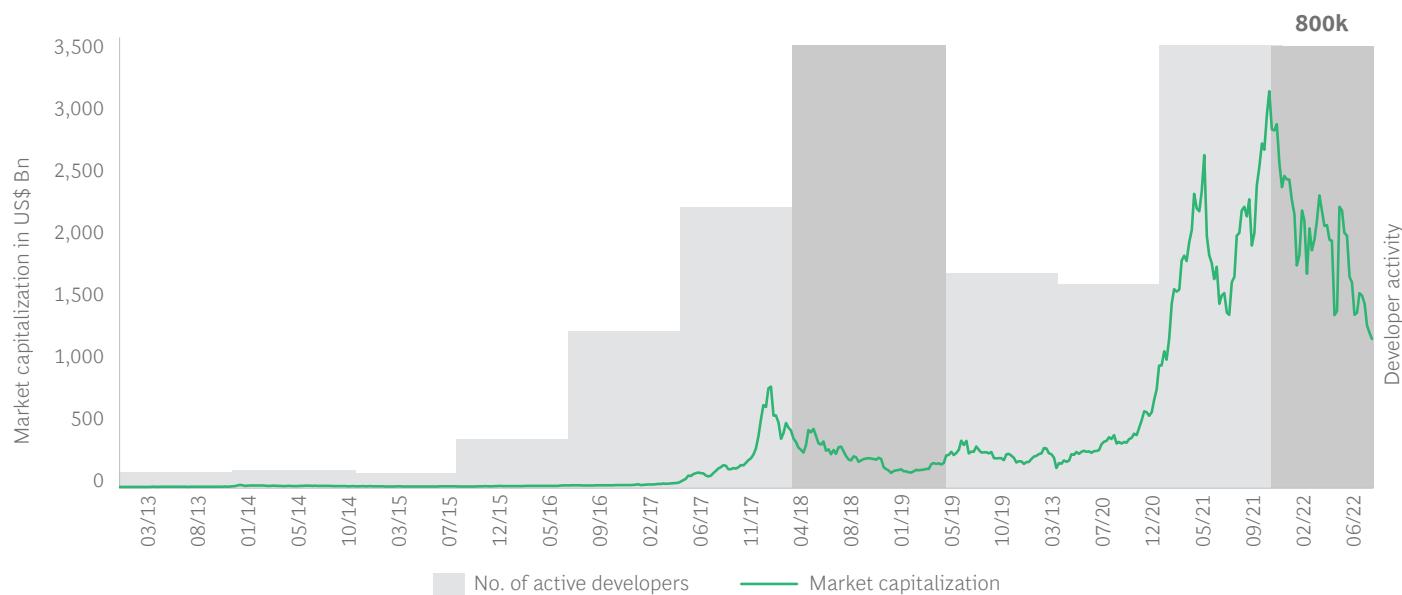
Exhibit 3: Increasing crypto enforcement actions amid regulatory uncertainty

Looking ahead, the funding outlook for DeFi/blockchain-based projects is expected to remain tight. As per Morgan Stanley in June'22, “Activity across eight of the most important VC bellwether markets over the past 12 months has reset 50% from peak⁹; worsening performance of some of the largest tech/crypto investors who are prioritizing existing holdings over deploying further dry powder, and the exit of ‘tourist capital’ as both token and equity investments become more challenging during a crypto bear market – a similar pattern seen during 2018/19”. However, despite the crash and the funding outlook, developer activity has continued to hold strong, indicating a resilient talent pool (Exhibit 4 shows the amount of development and deployment of new projects and coding on the protocols).

Consequently, the capital-constrained environment would act as a forcing function to eventually channel capital and talent pool to viable blockchain applications and DeFi projects. These projects should be able to demonstrate inherent value, built atop a robust, scalable infrastructure, and designed to enhance the traditional ecosystem versus try to replace it.

On-chain asset tokenization is one such blockchain-based application, with the potential to dramatically unlock liquidity, access and choice for multiple investment instruments at scale, especially for those assets that are traditionally illiquid (e.g., real estate, high-value art, public infrastructure, private equity). Regulators and corporate incumbents are increasingly recognizing and piloting the opportunity of asset tokenization. For example, the Monetary Authority of Singapore (MAS) recently launched a blockchain-based asset tokenization pilot, collaborating with financial players like JP Morgan, DBS Bank and Marketnode (SGX joint venture for bonds). Also, Deutsche Bank predicts¹⁰ that a larger number of autonomous automated platforms will allow cost-effective B2C issuances and interlink traditional financial assets with new digital assets services. The intent is to learn from this project and create a set of strong regulatory guardrails required to use DeFi while also limiting its risks.

Despite the recent crash, developer activity has continued to sustain



Source: Data as of 12th June'22; Statista, a16z State of Crypto, BCG analysis

Exhibit 4: Number of active developers has continued to remain strong

9. ‘Morgan Stanley Forecasts A Slowdown In Crypto Venture Capital Funding’, Market Watch, May 2022.

10. ‘The Triple revolution in securities post-trade’, Deutsche Bank white paper, June 2022.

Understanding asset tokenization and its underlying need

A large chunk of the world's wealth today is locked in illiquid assets. In a survey conducted in the U.S. in 1997, 56%+ of assets held by taxpayers with a net-worth of between \$600,000 and \$1 million were illiquid¹¹. All else being equal, illiquid assets typically trade at a discount vs. liquid assets, and are characterized by a high stock-to-flow ratio, lower trading volumes and imperfect price discovery vs liquid assets. For example, illiquid physical art assets¹² have a stock-to-flow ratio of 28.3 as opposed to 1.11 for liquid Real Estate Investment Trusts¹³ (REITs)¹⁴. Primary examples of illiquid assets include real estate (incl. home equity), natural resources, land, commodities, public infrastructure like mines/ports, fine art, computing infrastructure, private equity etc. On top of that, there are multiple other asset classes which are only accessible to limited wealthy investors/institutions due to constraints on ticket size, e.g., pre-IPO stocks, hedge funds, infrastructure projects, commodities and alternate investment instruments, private credit. The total size of illiquid asset tokenization globally would be \$16 trillion by 2030 (Exhibit 5).

Key reasons for asset illiquidity include **a**) limited affordability of mass investors given high ticket size ranging between \$250,000 and \$5 million, depending on the asset type (e.g., real estate, bonds, hedge funds), **b**) inability to fractionalize inherent utility (e.g., sharing living space in a house by 100 investors), **c**) lack of information to retail/high net-worth individual investors given the lack of wealth manager expertise (e.g., assets like livestock, plantation, alternate investments), **d**) limited access, restricted to elite cliques (e.g., fine art, vintage cars, vineyard etc.), **e**) regulatory hurdles (e.g., limitations on investments in certain asset classes to only accredited investors, complicated process of tokenization & custody transfer of assets, strict guardrails on allowing foreign investors in capital markets of certain geographies e.g. Indonesia, and also asset classes that require ownership proof in governmental registers such as real estate where the ownership is recorded in the land register), **f**) complex user journeys for obtaining access (e.g., KYC and payment set up across multiple platforms with no single interface for the customers) and **g**) lack of existing, scaled technological solutions to unlock liquidity in such assets.

The concept of traditional asset fractionalization, however, has already existed for several years. Some examples are Real Estate Investment Trusts (REITs), Exchange Traded Funds (ETFs) (with over \$5 trillion in asset under management), Mutual Funds, US stock tokenization etc. Traditional asset fractionalization is more focused on vehicles like equity and real estate asset classes.

Real Estate Investment Trusts (REIT): Typically, a REIT is a fund or company that owns, operates, and manages real estate assets (buildings for residential, commercial, or industrial use), and shares of that company are often listed on a public exchange, bought by a mix of institutional and retail investors. Ownership of a REIT allows participation in the income generated from the pool of properties as REITs are required to distribute at least 90% of taxable income to shareholders annually in the form of dividends. Investors may also benefit from the potential upside from the buy-sell of portfolio assets.

Exchange Traded Funds (ETFs): ETFs are funds which own some underlying assets. The shares of the fund are listed on a public exchange, and multiple parties can own fractions of that fund. ETFs have been very successful and today manage over USD 5 trillion in assets offering investors exposure to mainstream indices and a whole range of assets across equities, bonds, commodities, and currencies.

Mutual funds: Like other traditional financial assets, investors in mutual funds pool money into a fund, and the money is used to buy assets. Investors own a fraction of the fund.

The Terra-Luna clash¹⁵, a key driver of this fall was triggered by the liquidation of \$285 million worth of UST, leading to the stablecoin getting de-pegged from its value of \$1. This led to a spike in minting of Terra tokens with token supply growing from ~350 million to 6.9 trillion in May'22. In response, Terraform labs tried to liquidate their entire holdings of 40,000 bitcoins, but that didn't help arrest the slide.

11. 'More than 50% of wealthy's money is in illiquid assets', InvestmentNews, April 2001 'Crypto theses for 2022', Messari, Jan 2022.
12. 'Crypto theses for 2022', Messari, Jan 2022.
13. '19 REIT Industry Statistics and Trends', BrandonGaille, May 2018
14. REITs are a \$2 trillion asset class globally, and they were created

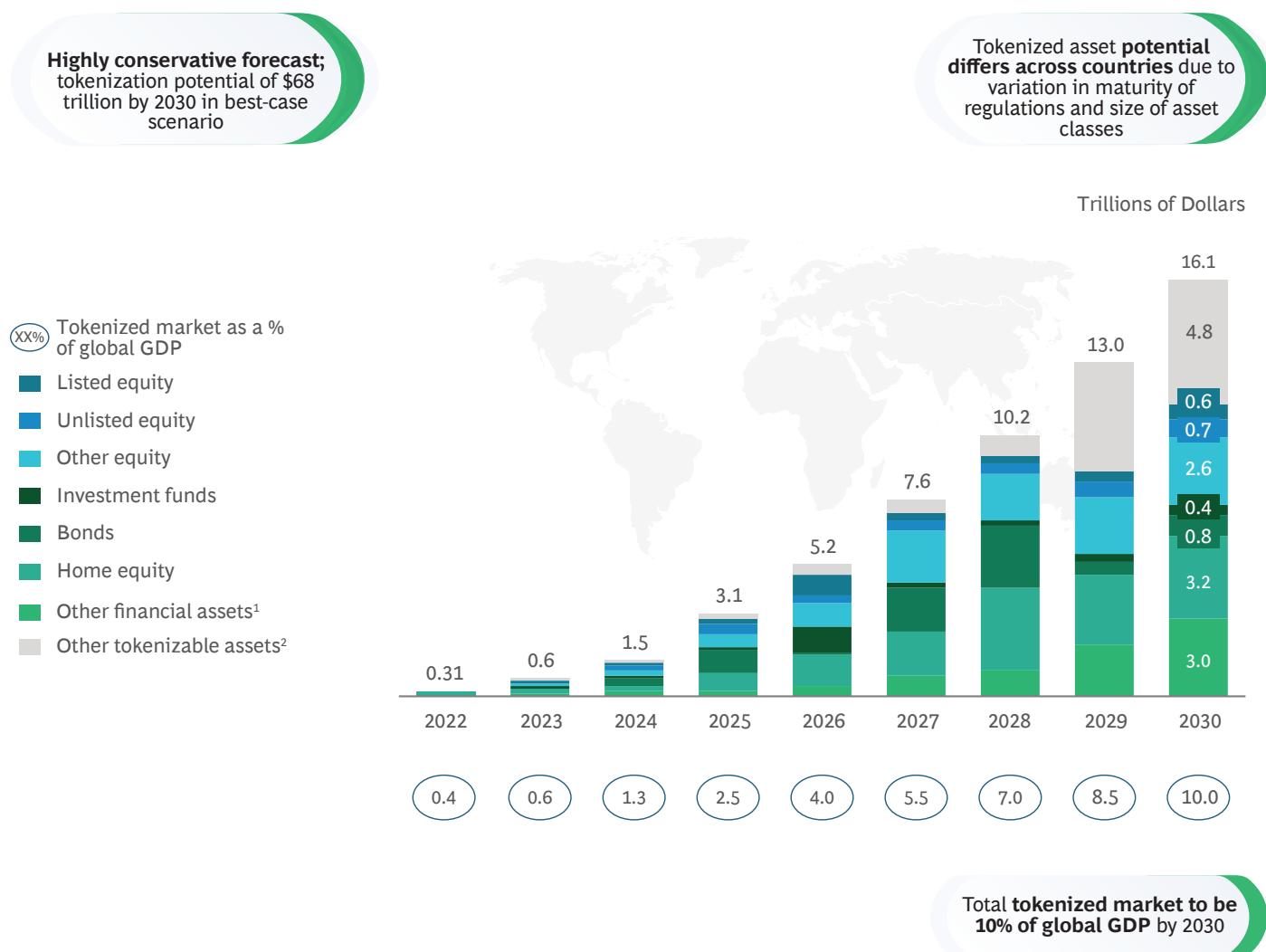
specifically so that investors could invest in commercial real estate in fractional lot sizes and in a regulated and tax-efficient structure', Pioneer Global Finance Management Consulting.

15. 'What is Terra LUNA - Explaining the LUNA Crash', Inside Bitcoins, May 2022.

However, the key limitation of traditional fractionalization is that the impact can only be seen in public markets which are already fairly efficient and high-tech, but not in private markets that are manual, slow, opaque and with high overheads. Additionally, the process of matching capital to investment opportunities in the private markets also involves

several steps from finding and qualifying investors and investment opportunities, through the initial capital allocation to the opportunities, to secondary trading of the assets, and the management of the assets, leading to suboptimal customer experience and cost structures.

Tokenization of global illiquid assets estimated to be a \$16 Trillion business opportunity by 2030



Source: World Economic Forum – Global Agenda Council, BCG Analysis

¹ For example, Insurance policies, Pensions, Alternative Investments; ² e.g., Infrastructure Projects, Car Fleets, Patents

Note: The analysis does not include crypto assets

Exhibit 5: Tokenization of illiquid assets to be a \$16 trillion worth opportunity globally

Understanding the tokenization landscape

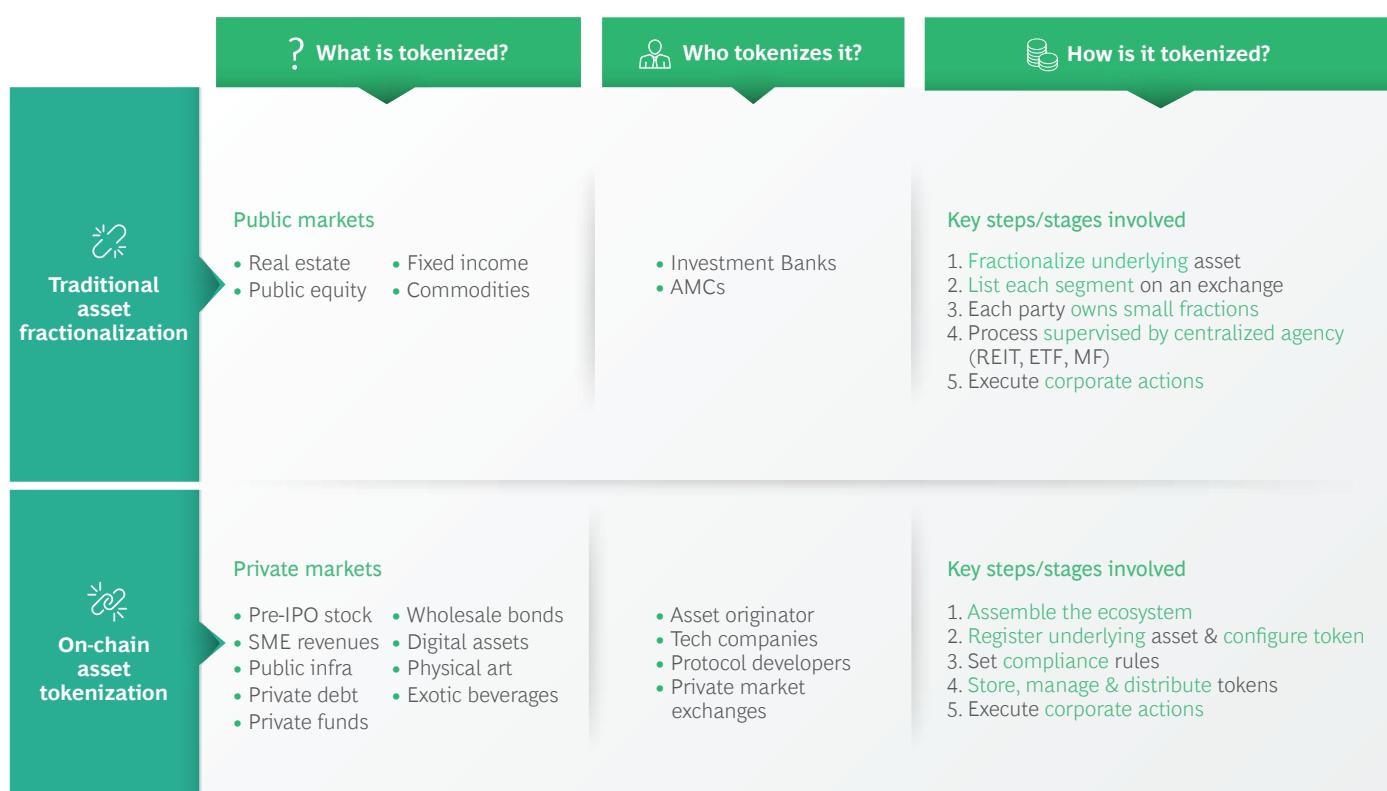
On-chain asset tokenization presents an opportunity to obviate many of these barriers of asset illiquidity as well as the current modality of traditional fractionalization. On-chain asset tokenization helps reimagine the end-to-end process of finding and matching investors with investment opportunities, and the subsequent secondary market opportunities once an investment has been made.

It is the process by which an issuer mints digital tokens (each representing a fraction of an underlying digital/physical asset) on a distributed ledger (i.e., blockchain), and guaranteeing transparent and immutable ownership as a result. There are broadly two types of tokenized assets – a) fungible tokenized assets are interchangeable and divisible i.e., each unit of the tokenized asset has the same market value, validity and can be divided into as many divisions as configured during its issuance (E.g., fiat, tokenized securities, crypto currency, gold), and b) non-fungible tokenized assets

are unique and non-interchangeable i.e., tokens can't be replaced with other tokens of the same type as each represents a unique value and attribute (E.g., vintage paintings or vinyl records, housing property, collectors' cards). Exhibit 6 paints the existing and emerging tokenization landscape.

However, there is an impending shift from traditional fractionalization to on-chain tokenization, which expands the scope of asset classes, stakeholder groups and regulatory scope for tokenization. Therefore, it is crucial to understand and appreciate the incremental benefit from fractionalizing assets on blockchain-based platforms. Exhibit 7a illustrates the emerging players offering on-chain tokenization and Exhibit 7b summarizes highlights of key players like FTX, ADDX, Agrotoken. The following section illustrates the more detailed mechanics of on-chain tokenization.

Distinct differences exist today between the landscapes of traditional fractionalization and on-chain tokenization



Source: BCG analysis

Exhibit 6: Landscape different for blockchain-based asset tokenization

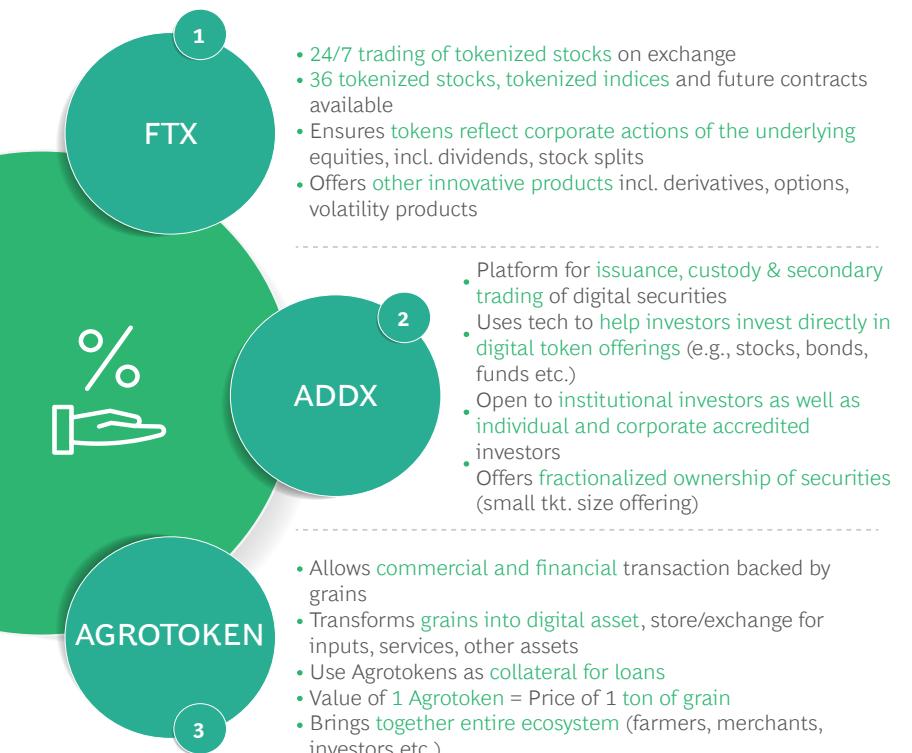
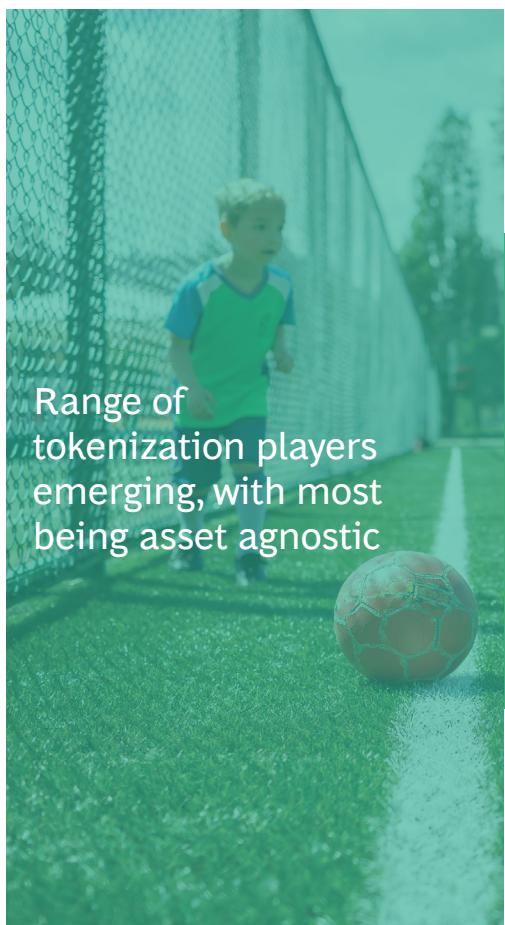
Range of tokenization players emerging, with most being asset agnostic

Tokenization players across asset categories, including financial assets like equity share, private fund												Niche asset classes like real estate	
Some players providing comprehensive solution e.g., Signum, also work on tokenization	Name	Tzero	ConsenSys Codefi	Securitize	ADDX	Polymath	Securrency	BitBond	Tokeny Solutions	Tokensoft	Liquefy	Digishare	
	HQ	US, New York	US, New York	US, San Francisco	Singapore, Singapore	Canada, Toronto	US, Washington	Germany, Berlin	Luxembourg, Luxembourg	US, San Francisco	Hong Kong, China	Nordjylland, Denmark	
	Years of Establishment	2014	2017	2017	2017	2017	2015	2013	2017	2017	2018	2018	
	Funding	\$330.3 Mn	\$82.5 Mn	\$73.0 Mn	\$120.0 Mn	\$58.7 Mn	\$49.4 Mn	\$7.6 Mn	\$5.6 Mn	\$4.0 Mn	\$3.0 Mn	\$1.1 Mn	
	Team Size	~84	~5	~90	>100	~44	~71	~91	~27	~20	~8	48	
	Category of Play	● ●	● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ●	● ●	● ●	● ● ●	● ●	● ●	● ●	
	# Tokenized Assets	4	-	115	40	225	-	5	45	50	-	-	
	Used Blockchain	Ethereum, Tezos, Algorand	Ethereum, Quorum	Ethereum, Algorand, Avalanche	Ethereum (Private)	Polymesh, Ethereum	Ethereum, Stellar, Ripple, Gochain, EOS	Stellar	Ethereum, Polygon	Ethereum, Stellar, Corda, Hyperledger	-	Ethereum	
	Token	TZROP	-	-	-	POLYX	-	BB1	-	TSFT	-	DIGI	
	Token Standard	ERC 20	Universal Token	DS Token Protocol	ERC 20	Polymesh, ERC 1400	CAT-20, CAT-721	Stellar Assets	ERC 3643	ERC 1404	-	Polymesh, ERC 1400	
	KYC/AML Compliant	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Operates a (Secondary Marketplace)	✓	✓	✓	✓	-	-	-	-	✓	-	-	
	Notable partners	Overstock	Societe Generale	Morgan Stanley, ARCA	SGX, SET, UOB	Marketlend, Redswan	US Bank, State Street	Standard, Chartered Vonovia	Principality of Monaco, Euronext	SEBA, CELO	-	tZERO	

Source: Blockdata (Oct. 2021); pitchbook, BCG analysis

● Blockchain Infrastructure ● Tokenization Platform ● Primary Market ● Secondary Market ● Custody

Exhibit 7a: Range of emerging on-chain tokenization players



Source: Company websites, Internet search, BCG Analysis

Exhibit 7b: Highlights of key tokenization players

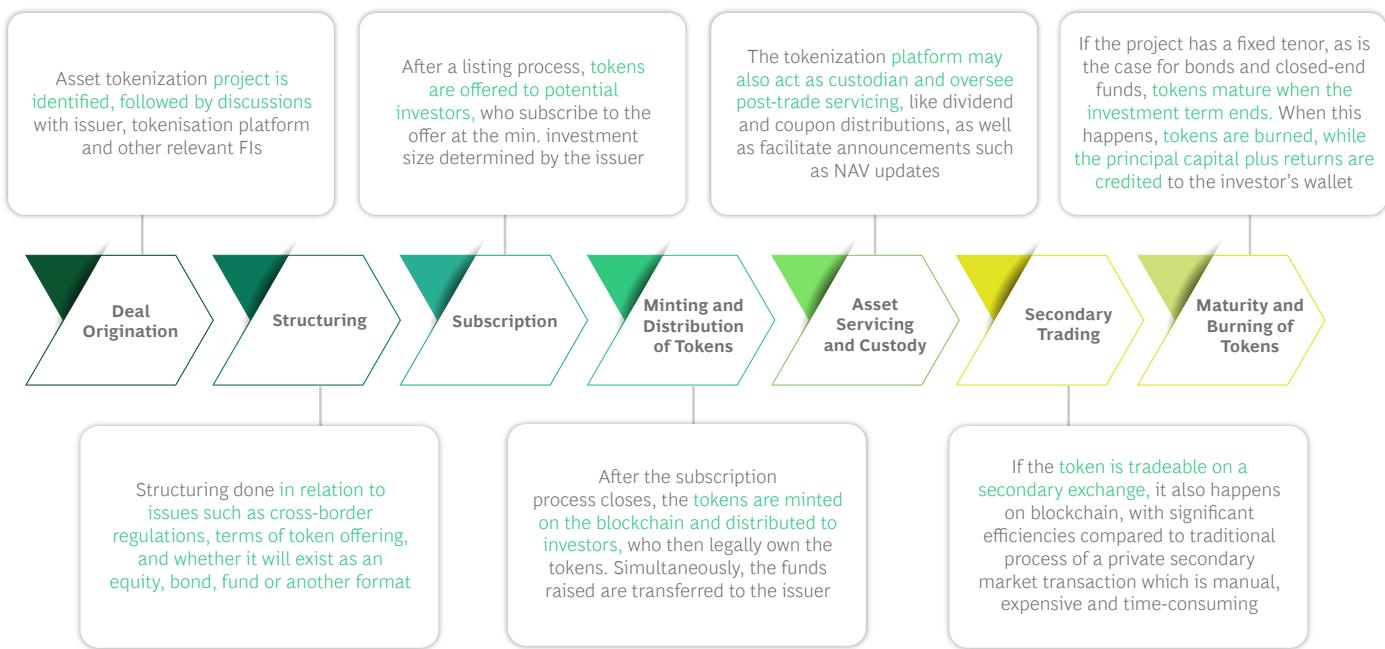
Mechanics of on-chain asset tokenization and its benefits vs. traditional fractionalization

The end-to-end process of on-chain asset tokenization covers five key steps¹⁶:

- **Assemble the ecosystem:** Service providers ensure that the integration of the technology is smoothly done with a large ecosystem of providers so that issuers can create a bespoke end-to-end solution (e.g., custody, KYC/AML provider, legal, marketing, advisory, tax etc.)
- **Register underlying asset & configure token:** The asset is registered and made available for tokenization on the blockchain network. Once the raise is structured and the ecosystem is mapped out, service providers let issuers configure their tokens in a simple and intuitive manner, no matter the asset type. The number of assets to be registered on the platform is a decision made in alignment between the issuer and platform provider. The assets are normally publicly visible, but some are also traded in an invite-only auction or through a select group of permissioned broker dealers.
- **Set compliance rules:** These compliance rules are encoded into the smart contract, enabling faster processing and lower protocol fees that can scale as demand and complexity of regulation grows. It gives flexibility to issuers to set rules around who can hold the token, how many investors can hold the token, and how it can be transferred.
- **Store, manage & distribute the token:** The tokens are stored in a software vault and supported by a custody service to manage digital twins (i.e., to maintain the link between an existing asset and its digital representative token). Tokenization service providers give issuers an automated and reportable way to manage the initial token distribution as well as future distribution events. Issuers assign broker dealer for all the customers on the platform. Customers can trade among themselves. If the issuer wishes to open it to as many investors as possible, then it requires a big marketing push followed by an auction.
- **Execute corporate actions:** Allows the issuer to input a few details and create a corporate action, for which the engine determines entitlements, schedules the communications, distributes capital (if required), and updates records. Tokenization reduces the costs of these corporate actions significantly.

ADDX, for example, is a platform that offers a complete suite of on-chain asset tokenization, distribution, custody and trading for the user. Exhibit 8 below illustrates the mechanics of on-chain asset tokenization.

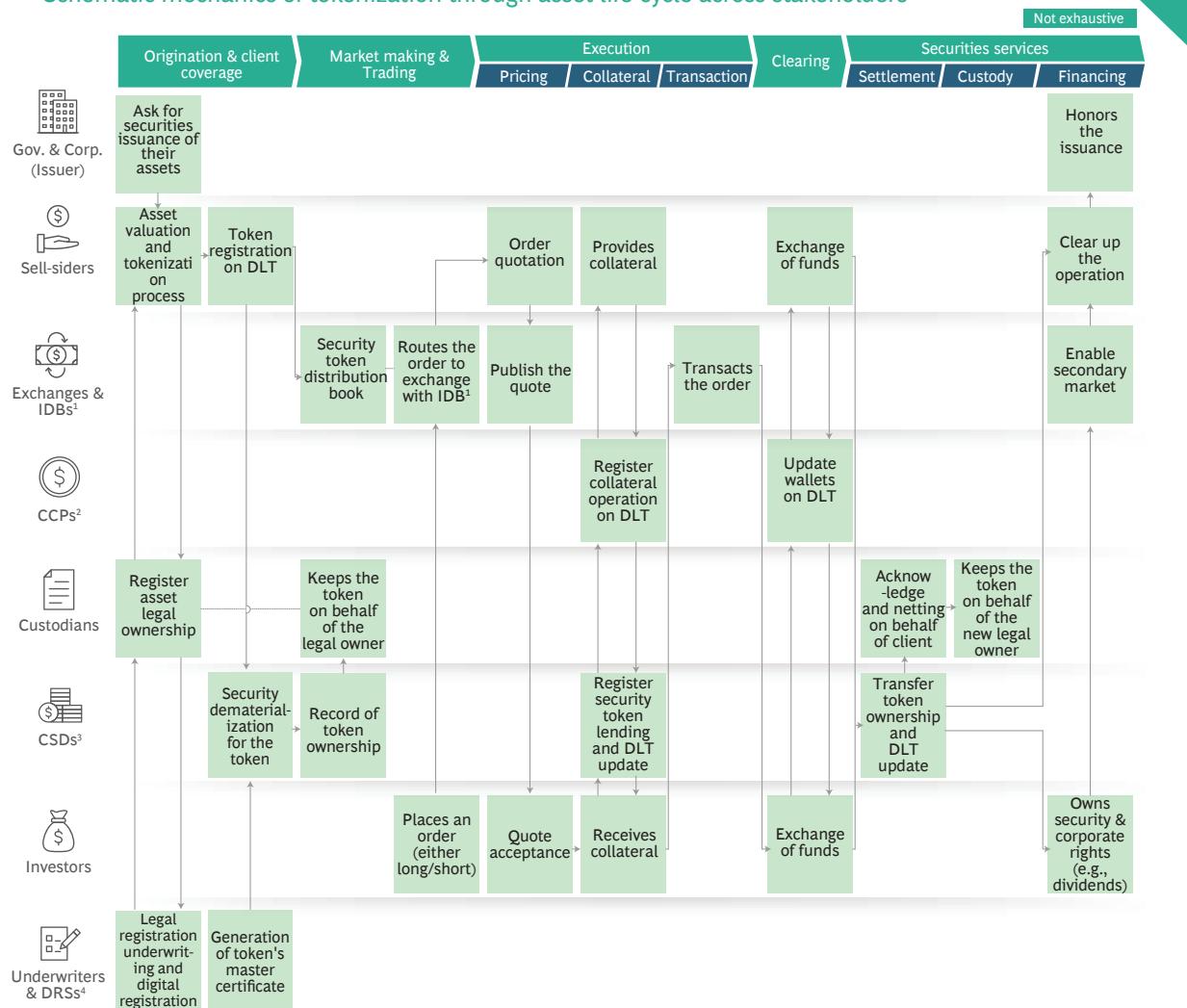
Mechanics of on-chain asset tokenization



Source: BCG analysis

16. 'Tokenization Guide', Polymath website.

Schematic mechanics of tokenization through asset life-cycle across stakeholders



Source: Global Legal Insights, Clifford Chance report, Charlton Quantum report, BCG analysis

¹ IDB = Inter-dealer broker; ² CCP = Central clearing counterparty; ³ CSD = Central securities depository; ⁴ DRS = Direct registration system

Note: An end-to-end digital securities exchange like ADDX can perform multiple functions listed here.

Exhibit 8: Schematic mechanics of tokenization through asset life-cycle, across stakeholders

On-chain asset tokenization offers six distinct advantages over traditional fractionalization:

- **Improves affordability** by enabling investments in divisible, fractional asset values of high-ticket instruments (e.g., hedge funds, alternatives)
- **Enables borderless accessibility** by enabling listing of hitherto illiquid assets (e.g., natural resources, land, vintage paintings) subject to local regulations in each jurisdiction, and enabling seamless trading in the secondary market
- **Unlocks liquidity and enhances flexibility** by enabling trading of assets before maturity (e.g., future earnings from agricultural land)
- **Enforces immutable transparency and accountability** by offering a clear historical and current transaction record and immutable assignment/recording of ownership rights governed by smart contracts, in a shared ledger on distributed P2P

network nodes (e.g., tokenization of government's infra projects as public ownership rights, improved tax recovery)

○ **Streamlines transaction efficiency** by **a**) enabling higher transaction speeds at lower price due to enhanced cost efficiency in asset transfer with smart contract to allow for automation of exchange, **b**) reducing friction by ensuring a single KYC suffices across all investments / platforms by linking users' wallets to the blockchain, **c**) gaining from asset servicing, i.e. the ability to distribute to tokenholders without having to go via transfer agents/3rd party custodians and depositories over the life of the asset, and **d**) reducing the settlement times with blockchain overcoming DvP inefficiencies.

○ **Ensures better price discovery** of illiquid assets as blockchain enabled platform disintermediates the process by helping reduce/lower 'rent-seeking' by intermediaries (e.g., auction houses, asset management companies)

Evidence of proliferation of on-chain asset tokenization

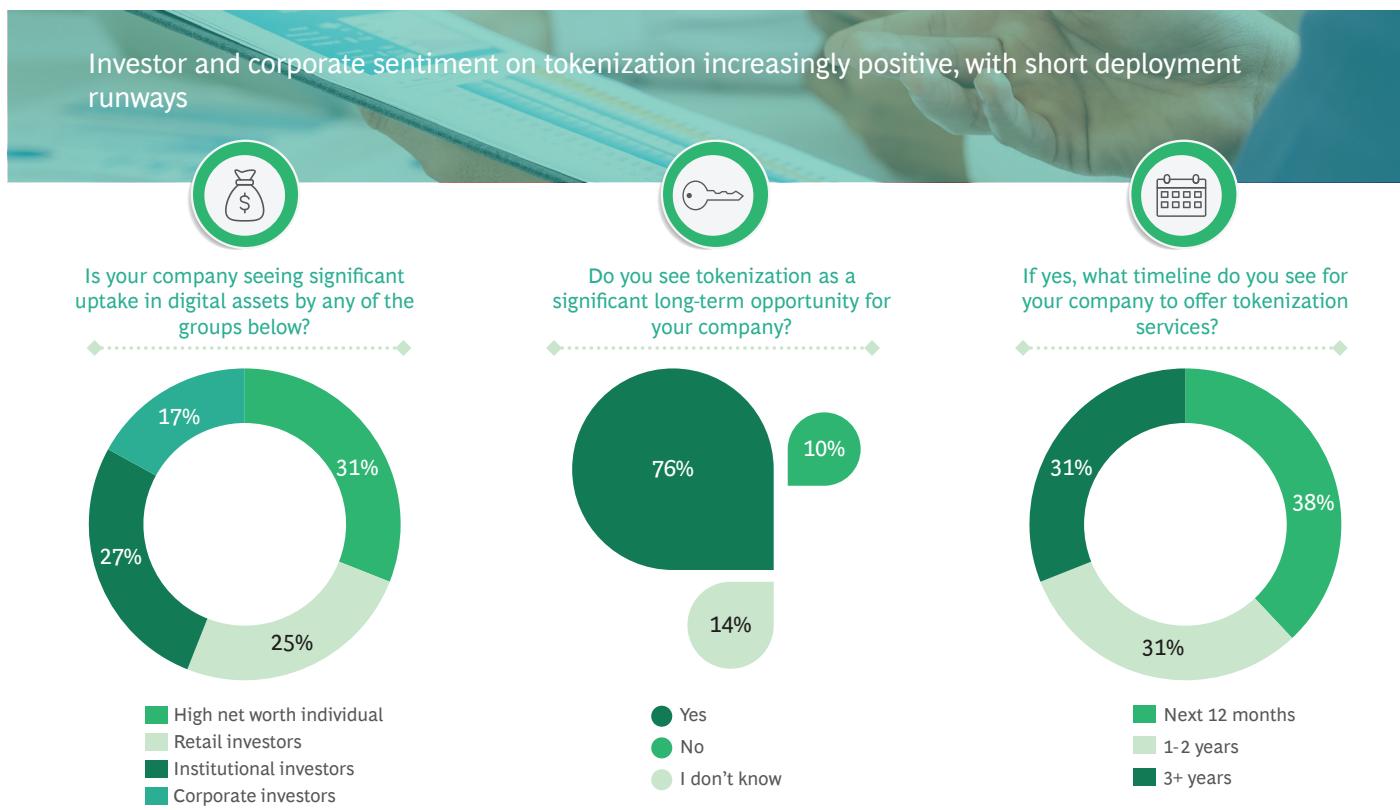
There are strong indicators pertaining to the rising prominence of on-chain asset tokenization, including:

◎ **Sharp growth outlook in digital asset trading volume:**

The on-chain asset tokenization market¹⁷ globally surpassed USD 2.3 billion in 2021 and is expected to reach USD 5.6 billion by 2026 (19% CAGR). The daily trading volume in digital assets globally has grown fivefold from EUR 30 billion in 2020 to EUR 150 billion in 2022¹⁸. (Average daily trading volume of REITs¹⁹ in 2018 in the USA was EUR 6.9 billion) However, this is still minuscule in comparison to the total potential of illiquid tokenizable assets in the world. Based on expert projections, the potential of on-chain asset tokenization in Asia alone is close to USD 3 trillion (i.e., total market cap of private unlisted assets).

◎ **Stronger stakeholder sentiment and successful pilots across countries:** The stakeholder sentiment on tokenization is increasingly positive, as evidenced in a 2021 survey²⁰ conducted on tokenization

(Exhibit 9). This reflects in the growing retail adoption of tokenized platforms in countries like Singapore, Indonesia etc. In Indonesia, Nanovest launched the NanoByte Token (NBT)²¹ in March 2022 for trading US stocks and cryptocurrencies based in Indonesia and gained 2 million+ users just during its beta launch. Nanovest plans to add asset classes including mutual funds, fractionalized bonds, and stocks, as the platform continues to grow. In India, Chingari has successfully created a crypto powered creator economy. It issued proprietary tokens GARI in October 2021 as in-app currency and governance tokens, and since then has surpassed a total of 150M users. It received a funding of over \$88 million and has reached a valuation of \$1 billion from \$70 million pre-launch. It has seen a very strong tokenized user engagement with 24-hr trading volume crossing \$100 million and a 65%+ active user base.



Source: "Taking the pulse of digital assets in financial services", BCG Analysis
Responses from a Global Blockchain survey conducted by Deloitte in 2021

Exhibit 9: Positive investor and corporate sentiment towards tokenization

17. 'The Complete Guide for Asset Tokenization on Blockchain', Blockchain Council, 2022.

18. NanoByte Whitepaper, NanoByte, February 2022.

19. '19 REIT Industry Statistics and Trends', BrandonGaille, May 2018.

20. 'Taking the pulse of digital assets in financial services across EMEA', Deloitte survey, 2022.

21. NanoByte Whitepaper, NanoByte, February 2022.

④ Recognition of on-chain tokenization by monetary authorities

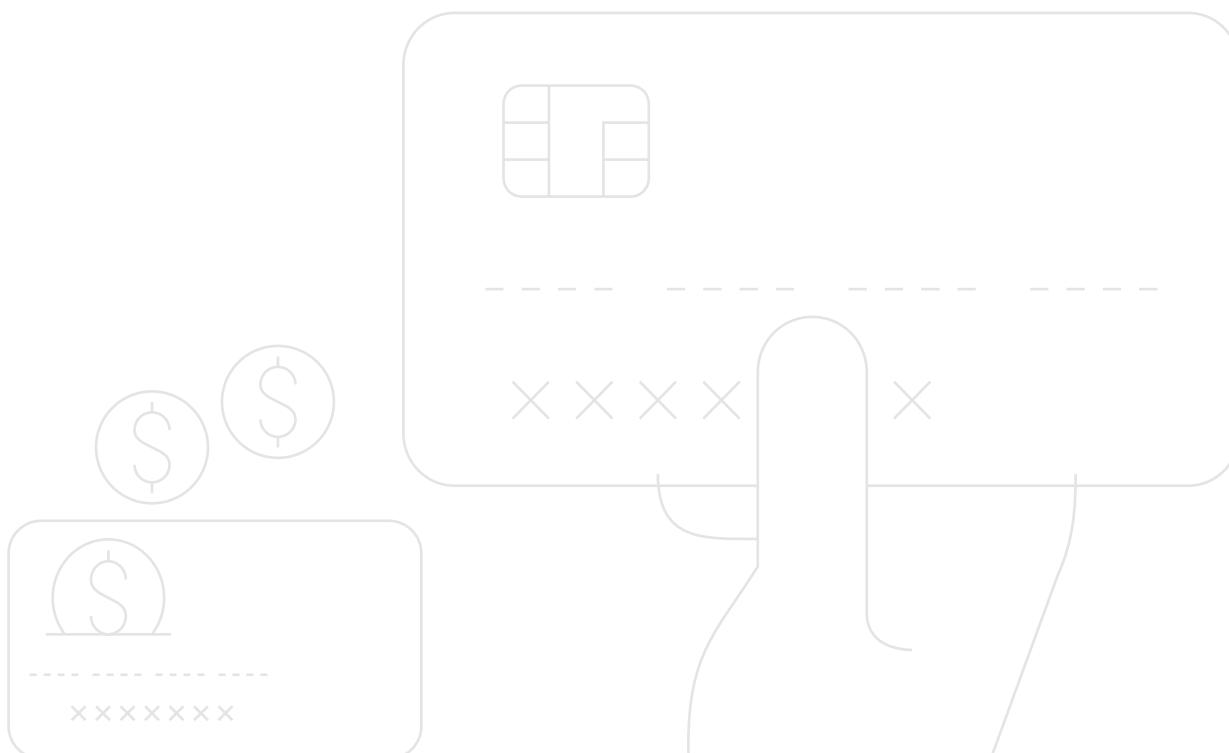
monetary authorities: The Monetary Authority of Singapore (MAS)²² recently launched Project Guardian, a blockchain-based asset tokenization pilot, in collaboration with financial institutions like JP Morgan Chase, DBS Bank and Marketnode (SGX joint venture for bonds). The project will involve MAS investigating DeFi applications in wholesale funding markets by creating a liquidity pool of tokenized bonds and deposits to execute borrowing and lending on a public blockchain-based network. In wholesale banking activities, DBS and JP Morgan have both developed digital assets and blockchain technology. Lessons from this project would serve as foundation for informing policy markets on the regulatory guardrails required to use DeFi while also limiting its risks. ADDX is the first digital securities issuance, custody and trading platform licensed by the MAS.

⑤ More asset classes are being tokenized

More asset classes are being tokenized: More non-conventional illiquid assets (e.g., crops, strawberry farms, exotic wine, whiskey etc.) are being tokenized by platforms like Agrotoken in Argentina etc. Agrotoken²³ introduced new financial options to the multi-trillion-dollar agribusiness sector by letting farmers convert tons of soybean crops into a commodity-backed stablecoin that could be spent with merchants and investors. Since its launch, Agrotoken²⁴ has scaled from 1,000 to 30,000 tons of soy in just a few months. It now focuses

on a new unit dedicated to tokenization-as-a-service (TAAS) to expand beyond grains into other illiquid agricultural commodities and countries. Agrotoken is also working with a major bank on the development of a token-collateralized loan system that would allow farmers easy, fluid access to a new system of credit at competitive rates. Another example is Budja.io²⁵ which is connecting the digital and physical art worlds through the development of Metaverse galleries, chain of custody NFTs and NFT art (e.g., fractionalized ownership of Andy Warhol arts, or NASA photographs). Another tokenization service provider, ADDX, is able to issue digital securities representing multiple asset classes (equities, bonds, funds and structured products). Each of the asset classes can have an underlying asset like a company, a loan, a real estate portfolio, wine, art etc.

⑥ Growing and resilient talent pool: Monthly active developers in Web3 hit an all-time high in late 2021. In the year 2020 alone, monthly active developers in just the DeFi space grew by 67%²⁶, and frequent contributors (those who commit more than 10 days a month) grew by 45%. The Ethereum network received over 300 new developers per month. Other high-growth ecosystems include Polkadot for example, that has doubled its number of developers over 2020.



22. 'Singapore Will Investigate Digital Asset Tokenization On Public Chains', CoinCu, May 2022.

23. 'Agrotoken - A new dimension of agribusiness', Agrotoken website.

24. 'Agrotoken Stablecoin Case Study', Accenture website.

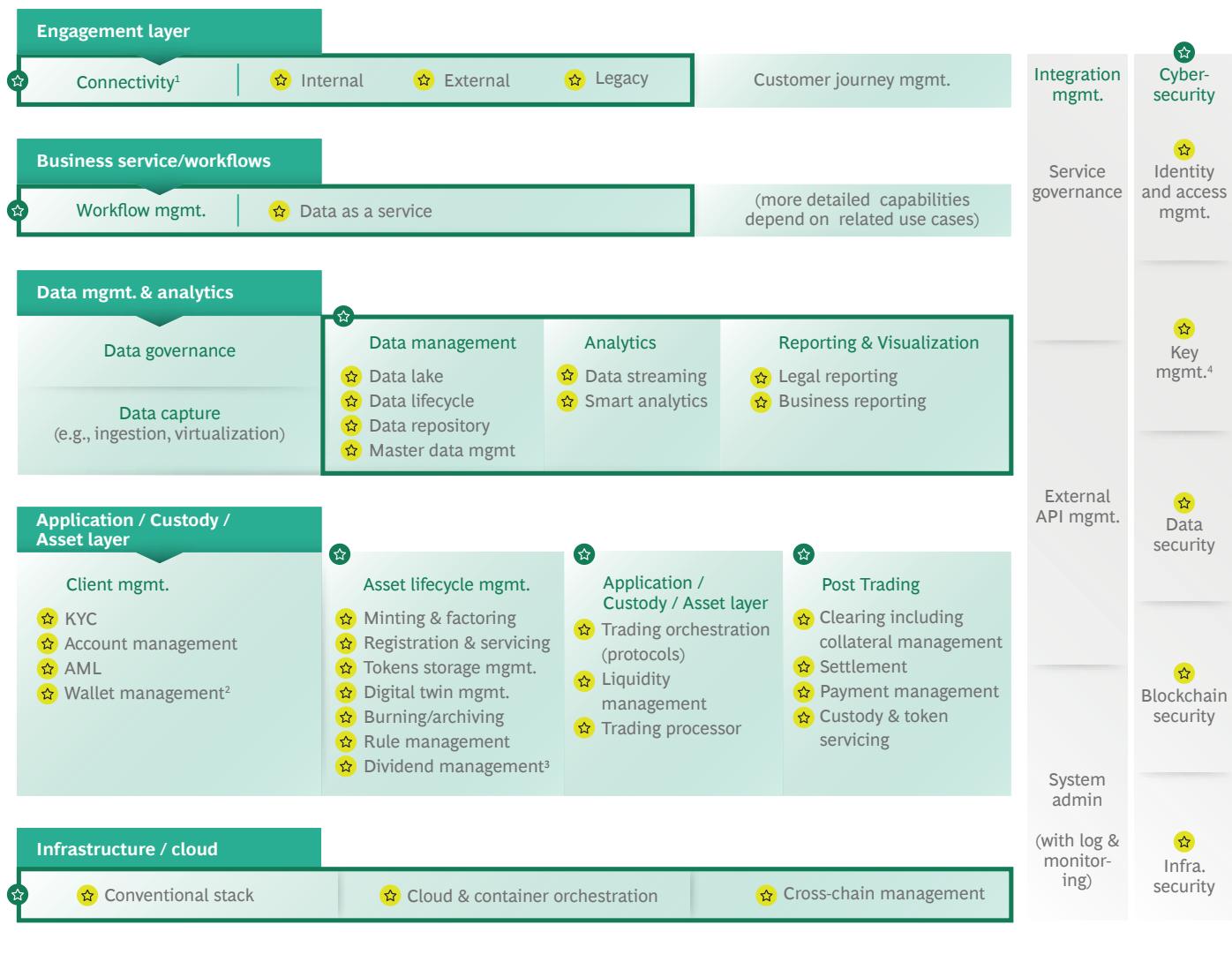
25. Budja.io website

26. 'DeFi developers growing faster than the rest', AMBCrypto, December 2020

Technology stack requirement for asset tokenization

Key tokenization capabilities that need to be unlocked across the digital stack are as illustrated below:

Key capabilities needed across the digital asset stack to fulfill use cases



¹ Provide functional connectivity to clients through omni user channels (e.g., web, mobile), electronic trading channels and other commercial interfaces/services; ² Wallet management is part of Custody capability and is highlighted for its significance in the architecture; ³ Dividend mgmt. is part of token servicing capability and is highlighted for its significance in the architecture; ⁴ Part of secrets management

Exhibit 10: Key capabilities required across the stack to fulfil asset tokenization use-cases

Key challenges / impediments to growth

Some risks exist which need to be mitigated to scale up blockchain-based asset tokenization.

Increasing regulatory scrutiny, geographical variance and associated uncertainty in governance could lengthen runway for scaling tokenization across borders

• **Variance in regulations across key markets (Exhibit 11)**, (e.g., money laundering, terrorism financing, illegal trades, cyber attacks etc.) could require several revisions or adjustments to operating models, thereby lengthening path to scale

• **Unclear protocols on managing the tussle between TradFis and the market disintermediation caused by on-chain tokenization providers because of disruption to the market-making model**

Lack of concerted programs to improve the nascent investor awareness and adoption

• **Awareness:** Lack of demonstrable proof of concept in key markets like India, regulator-led awareness campaigns to instill awareness and confidence in investors post market shock

• **Adoption:** Potentially slower adoption given stickiness of users to existing incumbents, nascent distribution capabilities (via digital/TV marketing, referral bonus in B2C; brokers, asset managers in B2B2C)

Tokenization regulation landscape 1/2

Singapore	Hong Kong	Japan	South Korea	India	China	Russia
Token issuance is regulated	Token issuance is regulated	Token issuance is regulated	All forms of ICOs are banned by FSC	No specific law enacted	Token issuance is comprehensively banned by PBoC	Restrictions on ICOs with exceptions
<ul style="list-style-type: none">Security tokens are regulated as traditional securitiesUtility tokens and payment tokens don't fall under SFA legislation	<ul style="list-style-type: none">Virtual assets are not regulated by defaultBut those that fall under securities are subject to SFC legislation	<ul style="list-style-type: none">Security tokens are classified as ERTRs¹ and thus not regulated by Payment Services ActUtility tokens are regulated whereby the issuer need to register as crypto asset exchange	<ul style="list-style-type: none">Once classified as virtual assets, security tokens are legitimate and require special license to sell	<ul style="list-style-type: none">Security tokens cannot be traded under SEBI's aegis;Utility tokens subject to Payment and Settlement Systems Act	<ul style="list-style-type: none">Regulators use terms of ICOs and STOs synonymously, both regarded as illegal securities offering	<ul style="list-style-type: none">Only registered business can conduct ICOMaximum investing amount limit is imposed by BoR on unqualified investors

Source: Global Legal Insights, Clifford Chance report, Charlton Quantum report, BCG analysis

¹ Electronically recorded transferrable rights

Room for technology associated with tokenization stack layers to mature

• **DLT risks, platform risks, coding errors in the smart contracts, key management risks, network security risks, digital twin (connection) risks** need to be mitigated by platform providers but also financial institutions that want to be active in this space to prevent any losses on account of technical shortfalls. Especially after the turmoil in Q2 2022, various financial institutions are becoming aware of all the inherent and significant new risks of crypto services and are incorporating crypto risk into their risk management procedures and policies.

Only gradual acceptance of tokenized assets from investors

• While demand is growing for tokenized assets is growing, it is still not strong enough yet among some investors (esp. corporate investors), which stems often from their own internal policies where digital assets are often not mentioned.

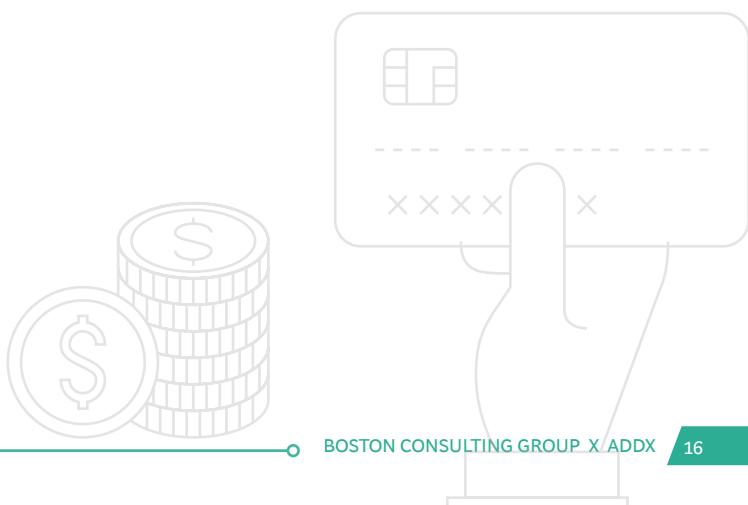
Tokenization regulation landscape 2/2

EU	UK	USA	UAE	Germany	Austria	Switzerland
Token issuance is regulated	Token issuance is regulated	Token issuance is regulated	Token issuance is regulated	Token issuance is regulated	Token issuance is regulated	Token issuance is regulated
<ul style="list-style-type: none"> Security tokens are subject to EU financial services regulation MiCA in drafting process regulate utility tokens 	<ul style="list-style-type: none"> Security tokens which provide rights similar to Specified Investments under RAO¹ are regulated 	<ul style="list-style-type: none"> Security tokens, judged by the Howey test are regulated but can transform into non-securities once the network do not need managerial efforts from issuers 	<ul style="list-style-type: none"> FSRA determines whether a proposed token is security or commodity on a case-by-case basis Security tokens are subject to securities law 	<ul style="list-style-type: none"> BaFin generally decides whether a token is security token on a case-by-case basis Security tokens are subject to securities law 	<ul style="list-style-type: none"> Security tokens are typically subject to prospectus requirements with a few exceptions (only issue to qualified investors, etc.) 	<ul style="list-style-type: none"> Utility tokens that do not represent any claims against an issuer can be validly created Security tokens are regulated

Source: Global Legal Insights, Clifford Chance report, Charlton Quantum report, BCG analysis

¹ Regulated Activities Order

Exhibit 11: Variance in regulations on tokenization across key markets



Call to action for key stakeholders

Some clear imperatives exist for all stakeholders including tokenizers, issuers, developers and policy leaders, in order for on-chain asset tokenization to achieve transformative growth.

Traditional asset fractionalizers (FIIs, auction houses, AMCs, REITs)

- **Identify path to pilot, deploy, scale on-chain tokenization** as an upgrade of existing business model, not as a replacement
- **Leverage incumbent advantage** of large capital & customer bases, deep institutional knowledge of customer preferences and financial markets, while deploying these projects
- **Partner with emerging fintech companies and DeFi projects/firms** and contract developer talent to accelerate go-to-market instead of trying to build projects in-house with full-time employees.
- **Example:** JP Morgan, for example, intends to bring trillions of dollars' worth assets²⁷ (e.g., US Treasury's, money market fund shares etc.) into DeFi, so that it can be used for trading, borrowing, and lending at a scale of institutional assets. JP's blockchain-based collateral settlement system today sees \$350 billion in trading volume.

On-chain tokenization service providers

- Build world-class companies with competent, high-conviction leaders among senior management, board and shareholders and raise ample funding to ensure long runway, sufficient regulatory capital and trust among customers
- **Improve financial literacy of customers** to dispel myths and build conceptual understanding regarding on-chain projects
- **Significantly invest in know-your-customer (KYC) and AML capabilities**, especially since institutional DeFi means imposing KYC structures on crypto's permissionless lending pools (e.g., examples of innovation include Aave Arc, Siam Commercial Bank, Compound Treasury)
- **Convince principal investors** (e.g., PE/VCs, pension funds) and other issuers of the economic & social value of fractionalizing assets, to enable them to unlock the required capital

Developers:

- **Design standard architectures** that can ensure underlying blockchain is built for scale, performance (block size, transaction speed) and functionality (e.g., smart-contract support, design of appealing UI/UX for users to effectively navigate)
- **Develop standard protocols** for creating a user-friendly on-ramp to the tokenization world to improve adoption
- **Build talent incubation mechanisms** for growth, skill building, community building
- **Ensure quality of coding** by validating smart contracts via external, certified service providers

Principal investors / issuers:

- **Establish guardrails on investment returns** on the basis of type of asset classes and projects invested in; assuming a narrow range of ROI across all investments might risk crowding out lower-return, longer-term, sustainable assets

Policy leaders and regulators:

- **Establish a ringfenced regulatory apex body** governed by a board of technocrats for DLT and digital assets to streamline licensing, governance, dispute resolution, risk mitigation and shape policy on investor education, systemic adoption, cross-border flows, energy efficiency
- **Establish guardrails to ensure monetary policy integrity** (e.g., capital controls) given the dollarization of key cryptocurrencies & tokens, and get rid of white spots in regulation to set clear rules and provide clarity to all stakeholders. Deepen regulatory thinking around other risks as well, such as: anti-money laundering and terrorism financing, investor and consumer protection, financial system stability and market integrity (i.e. combating market manipulation).
- **Drive rapid innovation in controlled risk environments** via sandbox frameworks for incumbents to collaborate and pilot innovations. A successful analog would be the three cohorts of sandboxes deployed by the Reserve Bank of India. Also of note is the Fintech Regulatory Sandbox by the Monetary Authority of Singapore. ADDX, an asset tokenisation platform, became the first company to graduate from the sandbox in February 2020.

27. 'JPMorgan Wants to Bring Trillions of Dollars of Tokenized Assets to DeFi', CoinDesk, June 2022.



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